THE

ENGLISH ENCYCLOPÆDIA.

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THE

ENGLISH ENCYCLOPÆDIA:

BEING

A COLLECTION OF TREATISES,

AND

A DICTIONARY OF TERMS,

ILLUSTRATIVE OF THE

ARTS AND SCIENCES.

COMPILED FROM MODERN AUTHORS OF THE FIRST EMINENCE IN THE DIFFERENT BRANCHES OF SCIENCE.

IN TEN VOLUMES.

THE WHOLE ILLUSTRATED WITH UPWARDS OF FOUR HUNDRED COPPER-PLATES.

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1802.

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DIAMOND, a genus of earths of the ſiliceous kind, called *Adamas Gemma* by the Latins, *Demant* by the Germans and Swedes, and *Diamant* by the French, is the hardeſt of all ſtones hitherto diſcovered; commonly clear or tranſparent; though this property may perhaps belong only to the cryſtals, and not to the rock from which they originate. When brought to Europe in its rough ſtate, it is either in the form of roundiſh pebbles, with ſhining ſurfaces, or of octoedral cryſtals; but though they generally appear in octoedral forms, yet their cryſtals are frequently irregular, eſpecially when the ſurface inclines to cryſtallize during the ſhooting of the whole cryſtal, and alſo when ſeveral of them unite in one group; in which caſe the one hinders the other from aſſuming a regular ſhape. Mr. Magellan, however, informs us, that diamonds ſometimes aſſume other forms. Though the diamond is commonly clear and pellucid, yet ſome are met with of a roſe colour, or inclining to green, blue, or black, and ſome have black ſpecks. Tavernier ſaw one in the treaſury of the Mogul, with black ſpecks in it, weighing about 56 carats; and he informs us, that yellow and black diamonds are produced in the mines at Carnatica. Mr. Dutens alſo ſaw a black diamond at Vienna in the collection of the prince de Lichtenſtein. Some diamonds have a greeniſh cruſt; and of theſe M. Tavernier relates, that they burſt into pieces while working into a proper ſhape. The fineſt diamonds are thoſe of a complexion like a drop of pure water, of a regular form, and free from ſtains, ſpots, flaws, &c. Diamonds tinctured yellow, blue, green, or red, in a high degree, are next in eſteem; but if they are tinctured with theſe colours only in a low degree, the value of them is greatly diminiſhed. There are alſo diamonds of other complexions; ſuch as brown, and thoſe of a dark hue: the firſt reſembling the browneſt ſugar-candy, and the latter duſky iron. In the *Philoſophical Commerce of Arts*, Dr. Lewis tells us of a *black* diamond that he himſelf had ſeen. At a diſtance, it looked uniformly black; but on cloſer examination appeared in ſome parts tranſparent, and in others charged with foulneſs, on which the black hue depended. Theſe gems are lamellated, conſiſting of very thin plates like thoſe of talc, but very cloſely united; the direction of which muſt be found out by lapidaries before they can work them properly: ſuch as have their foliated ſubſtance not in a flat poſition, are called by the workmen *diamonds of nature*.

The names of *oriental* and *occidental*, given by jewellers to this and all other precious ſtones, have a different meaning from the obvious ſenſe; the fineſt and hardeſt being always called *oriental*, whether they be produced in the eaſt or not. Thoſe called *occidental* are of inferior value; but according to Mr. Jefferies, who has written a treatiſe on the ſubject, the diamonds of Braſil equal the fineſt oriental ones. The art of cutting theſe gems was invented in 1476 by Louis de Berquen a native of Bruges in the Auſtrian Netherlands. This ſtone becomes luminous in the dark, by expoſure during a certain time to the rays of the ſun; by heating it in a crucible; by plunging it in boiling water; or by rubbing it with a piece of glaſs. By friction it acquires an electrical property, by which it attracts the ſubſtance uſed for foils called *black maſtic*, and other light matters. Some chemiſts have ſaid, that diamonds are refractory in the fire, and even apyrous. Nevertheleſs, experiments have been made, which prove that diamonds are capable of being diſſipated, not only by the collected heat of the ſun, but alſo by the heat of a furnace. A diamond, by expoſure to a concave ſpeculum, the diameter of which was 40 inches, was reduced to an eighth part of its weight: Phil. Tranſ. N° 386. Some experiments made on precious ſtones, by order of the grand duke of Tuſcany, with a burning lens, ſhow that diamonds are more capable of alteration from ſolar heat than moſt other precious ſtones, although not the leaſt appearance of a commencing fuſion could be obſerved. A diamond weighing 30 grains, thus expoſed during 30 ſeconds, loſt its colour, luſtre, and tranſparency, and became of an opaque white. In five minutes, bubbles appeared on its ſurface; ſoon afterwards it burſt into pieces, which were diſſipated; and the ſmall fragment which remained was capable of being cruſhed into fine powder by the preſſure of the blade of a knife. Neither the addition of glaſs, flints, ſulphur, metals, or ſalt of tartar, prevented this diſſipation of diamonds, or occaſioned any degree of fuſion. The action of fire on diamonds, however, has, notwithſtanding theſe relations, been greatly doubted in France, where numerous experiments have been made. M. D'Arcet found, not only that diamonds included in procelain crucibles, cloſe, or covered with perforated lids, and expoſed to the long and intenſe heat of a porcelain furnace, were perfectly diſſipated; but alſo, that theſe ſtones could in a few hours be totally volatiliſed with a much inferior degree of heat, by expoſing them in a coppel, under the muffle of an eſſay-furnace. In this latter experiment, he obſerved that the diſſipation was gradual, and that it was effected by a kind of exfoliation. The diſſipation of diamonds expoſed in coppels was confirmed by Macquer; who further obſerved, that the diamonds were, before the diſſipation began, rendered, by the fire, brilliant and ſhining, as it were, with a phoſphoric light. In order to determine whether the diſſipation of diamonds was actually effected by their reduction into vapour, or by a combuſtion or other effect of air upon them, Meſſrs. Lavoiſier, Macquer, and Cadet, expoſed diamonds to intenſe heat in an earthen retort, during ſeveral hours, but without any other effect than that their poliſh was deſtroyed, and about $\frac{1}{5}$th of their weight diminiſhed. M. Mitouard put diamonds in a tobacco-pipe filled with pounded charcoal and accurately cloſed with lute. He further ſecured the diamonds

from acceſs of air or flame, by placing the tobacco-pipe in a crucible, to which another crucible was inſerted and carefully luted. The diamonds, thus ſecluded from external air, having been expoſed to the moſt intenſe heat which could be excited in a well conſtructed furnace, were not thereby altered or diminiſhed. M. Mitouard was induced to believe, that the charcoal conduced to the preſervation of diamonds not merely by excluding the air, but by ſome peculiar property, which he ſuppoſes may be the ſame as that by which this ſubſtance defends metals from deſtruction by fire. M. Darcet, however, having renewed and multiplied his experiments, became confirmed in his opinion of the volatilization of diamonds even in veſſels perfectly cloſed.

Diamond mines are found only in the Eaſt Indies, and in Braſil in South America; in the kingdoms of Golconda, Viſapour, Bengal, and the iſland of Borneo. There are four mines, or rather two mines and two rivers, whence diamonds are drawn. 1. The mine of Raolconda, in the province of Carnatica, five days' journey from Golconda, and eight from Viſapour, which has been diſcovered about 200 years. 2. That of Gani, or Coolour, ſeven days' journey from Golconda eaſtwardly. It was diſcovered 140 years ago by a peaſant, who digging in the ground found a natural fragment of 25 carats. 3. That of Soumelpour, a large town in the kingdom of Bengal, near the Diamond-mine. This is the moſt ancient of all; and ſhould rather be called that of *Goual*, which is the name of the river, in the ſand whereof theſe ſtones are found. Laſtly, the fourth mine, or rather the ſecond river, is that of Succudan, in the iſland of Borneo.

Diamond-*Mine* of Raolconda.—In the neighbourhood of this mine the earth is ſandy, and full of rocks and copſe. In theſe rocks are found ſeveral little veins of half and ſometimes a whole inch broad, out of which the miners, with a kind of hooked irons, draw the ſand or earth wherein the diamonds are; breaking the rocks when the vein terminates, that the track may be found again, and continued. When a ſufficient quantity of earth or ſand is drawn forth, they waſh it two or three times, to ſeparate the ſtones. The miners work quite naked, except for a thin linen cloth before them; and beſides this precaution, have likewiſe inſpectors, to prevent their concealing of ſtones, which, however, maugre all this care, they frequently find means to do, by ſwallowing them.

Diamond-*Mine* of Gani or Coolour.—In this mine are found a great number of ſtones from 10 to 40 carats, and even more; and it was here that famous diamond of Aureng-Zebe the Great Mogul, which before it was cut weighed 793 carats, was found. The ſtones of this mine are not very clear; their water is uſually tinged with the quality of the ſoil; being black where that is marſhy, red where it partakes of red, ſometimes green and yellow, if the ground happen to be of thoſe colours. Another defect of ſome conſequence is a kind of greaſineſs appearing on the diamond, when cut, which takes off part of its luſtre. There are uſually no leſs than 60,000 perſons, men, women, and children, at work in this mine. When the miners have found a place where they intend to dig, they level another ſomewhat bigger in the neighbourhood, and incloſe it with walls about two feet high, only leaving apertures from ſpace to ſpace, to give paſſage to the water. After a few ſuperſtitious ceremonies, and a kind of feaſt which the maſter of the mine makes for the workmen, to encourage them, every one goes to his buſineſs, the men digging the earth in the place firſt diſcovered, and the women and children carrying it off into the other walled round. They dig 12 or 14 feet deep, and till ſuch time as they find water. Then they ceaſe digging; and the water thus found ſerves to waſh the earth two or three times, after which it is let out at an aperture reſerved for that end. This earth being well waſhed, and well dried, they ſift it in a kind of open ſieve, or riddle, much as we do corn in Europe; then thraſh it, and ſift it afreſh; and laſtly, ſearch it well with the hands to find the diamonds. They work naked as in the mine of Raolconda, and are watched after the like manner by inſpectors.

Diamond-*Mine* of Soumelpour, or river Goual.—Soumelpour is a large town built all of earth, and covered with branches of cacao-trees: the river Goual runs by the foot of it, in its paſſing from the high mountains towards the ſouth to the Ganges, where it loſes its name. It is from this river that all our fine diamond points or ſparks, called *natural ſparks*, are brought. They never begin to ſeek for diamonds in this river till after the great rains are over, that is, after the month of December; and they uſually even wait till the water is grown clear, which is not before January. The ſeaſon at hand, eight or ten thouſand perſons, of all ages and ſexes, come out of Soumelpour and the neighbouring villages. The moſt experienced among them ſearch and examine the ſand of the river, going up it from Soumelpour to the very mountain whence it ſprings. A great ſign that there are diamonds in it, is the finding of thoſe ſtones which the Europeans call *thunder ſtones*. When all the ſand of the river, which at that time is very low, has been well examined, they proceed to take up that wherein they judge diamonds likely to be found; which is done after the following manner: They dam the place round with ſtones, earth, and faſcines, and lading out the water, dig about two feet deep: the ſand thus got is carried into a place walled round on the bank of the river. The reſt is performed after the ſame manner as at Coulour, and the workmen are watched with equal ſtrictneſs.

Diamond-*Mine* in the iſland of Borneo, or river of Succudan.—We are but little acquainted with this mine; the queen who reigns in that part of the iſland not allowing ſtrangers to have any commerce in theſe ſtones: though there are very fine ones to be bought at Batavia, brought thither by ſtealth. They were anciently imagined to be ſofter than thoſe of the other mines; but experience ſhows they are in no reſpect inferior to them.

Beſide theſe four diamond-mines, there have been two others diſcovered; one of them between Coulour and Raolconda, and the other in the province of Carnatica; but they were both cloſed up almoſt as ſoon as diſcovered: that of Carnatica, becauſe the water of the diamonds was always either black or yellow; and the other, on account of their cracking, and flying in pieces when cut and ground.

The diamond, we have already obſerved, is the hardeſt of all precious ſtones. It can only be cut and ground by itſelf and its own ſubſtance. To bring it to that perfection which augments its price ſo conſiderably, they begin by rubbing ſeveral againſt each other, while rough; after having firſt glued them to the ends of two wooden blocks, thick enough to be held in the hand. It is this powder thus rubbed off the ſtones, and received in a little box for the purpoſe, that ſerves to grind and poliſh the ſtones.—Diamonds are cut and poliſhed by means of a mill, which turns a wheel of ſoft iron ſprinkled over with diamond-duſt mixed with oil of olives. The ſame duſt well ground, and diluted with water and vinegar, is uſed in the ſawing of diamonds; which is performed with an iron or braſs wire, as fine as a hair. Sometimes, in lieu of ſawing the diamonds they cleave them, eſpecially if there be any large ſhivers therein. But the Europeans are not uſually daring or expert enough to run the riſk of cleaving, for fear of breaking.

The *firſt water* in diamonds means the greateſt purity and perfection of their complexion, which ought to be that of the pureſt water. When diamonds fall ſhort of this perfection, they are ſaid to be of the *ſecond* or *third* water, &c. till the

ſtone may be properly called a *coloured one*: for it would be an impropriety to ſpeak of an imperfectly coloured diamond, or one that has other defects, as a ſtone of a bad water only.

Mr. Boyle has obſerved, from a perſon much converſant in diamonds, that ſome of theſe gems, in their rough ſtate, were much heavier than others of the ſame bigneſs, eſpecially if they were cloudy or foul. With regard to their ſpecific gravities, Mr. Ellicot, who made many experiments, has drawn out a table of their ſeveral differences with great care and accuracy. This taking in all the common varieties in diamonds, may indeed ſerve as a general rule for their mean gravity and differences. From this the mean ſpecific gravity of the Braſil diamonds appears to be 3513: Of Eaſt India diamonds 3519: The mean of both 3517. Therefore, if any thing is to be concluded as to the ſpecific gravity of the diamond, it is, that it is to water as 3517 to 1000.

For the valuation of diamonds of all weights, Mr. Jefferies lays down the following rule. He firſt ſuppoſes the value of a rough diamond to be ſettled at 2l. per carat, at a medium; then to find the value of diamonds of greater weights, multiply the ſquare of their weight by 2, and the product is the value required. *e. g.* To find the value of a rough diamond of two carats; $2\times 2=4$, the ſquare of the weight; which, multiplied by two, gives 8l. the true value of a rough diamond of two carats. For finding the value of manufactured diamonds, he ſuppoſes half their weight to be loſt in manufacturing them; and therefore, to find their value, we muſt multiply the ſquare of double their weight by 2, which will give their true value in pounds. Thus, to find the value of a wrought diamond weighing two carats; we firſt find the ſquare of double the weight, *viz.* $4\times 4=16$; then $16\times 2=32$. So that the true value of a wrought diamond of two carats is 32l. On theſe principles Mr. Jefferies has conſtructed tables of the price of diamonds from 1 to 100 carats.

The greateſt diamond ever known in the world is one belonging to the king of Portugal, which was found in Braſil. It is ſtill uncut: and Mr. Magellan informs us, that it was of a larger ſize; but a piece was cleaved or broken off by the ignorant countryman, who chanced to find this great gem, and tried its hardneſs by the ſtroke of a large hammer upon the anvil. This prodigious diamond weighs 1680 carats: and though uncut, Mr. Romé de l'Iſle ſays, that it is valued at 224 millions ſterling; which gives the eſtimation of 79,36 or about 80 pounds ſterling for each carat: *viz.* for the multiplicand of the ſquare of its whole weight. The famous diamond in the ſceptre of the empreſs of Ruſſia, weighs 779 carats, and is worth at leaſt 4,854,728 pounds ſterling, although it hardly coſt 135,417 guineas. This diamond originally was one of the eyes of a Malabarian idol, named *Scheringham*; and a French grenadier, who had deſerted from the Indian ſervice, contrived to become one of the prieſts of that idol, and by that means to ſteal it: after paſſing through ſeveral hands, the late prince Orloff purchaſed it at Amſterdam in 1766, for his ſovereign the empreſs of Ruſſia. The diamond of the great Mogul is cut in Roſe; weighs $279\frac{9}{16}$ carats, and it is worth 380,000 guineas, though it has a ſmall flaw near the bottom: and Tavernier, who fully examined it, valued the carat at 150 French livres. Another diamond belonging to the king of Portugal, weighs 215 carats, is extremely fine, and is worth at leaſt 369,800 guineas. The diamond of the emperor of Germany weighs $139\frac{1}{2}$ carats, and is worth at leaſt 109,520 guineas. It is ſaid this diamond has a little hue of a citron colour. The diamond once the property of the late unfortunate king of France, called the *Pitt* or *Regent*, weighs $136\frac{3}{4}$ carats: this gem is worth at leaſt 208,333 guineas, although it did not coſt above half that ſum. Another diamond of the ſame monarch, called the *Sancy*, weighs 55 carats, coſt 25,000 guineas; and is ſaid to be worth much more.

Brilliant DIAMOND, is that which is cut in faces both at top and bottom; and whoſe table, or principal face at top, is flat. To make a complete ſquare brilliant, if the rough diamond be not found of a ſquare figure, it muſt be made ſo; and if the work is perfectly executed, the length of the axis will be equal to the ſide of the ſquare baſe of the pyramid.—Jewellers then form the table and collet by dividing the block, or length of the axis, into 18 parts. To render a brilliant perfect, each corner of the table-diamond muſt be ſhortened by $\frac{1}{20}$ of its original. The corner ribs of the upper ſides muſt be flattened, or run towards the centre of the table $\frac{1}{8}$ leſs than the ſides; the lower part, which terminates in the girdle, muſt be $\frac{1}{6}$ of one ſide of the girdle; and each corner rib of the under ſides muſt be flattened at the top, to anſwer the above flattening at the girdle, and at bottom muſt be $\frac{1}{4}$ of each ſide of the collet. The parts of the ſmall work which completes the brilliant, or the ſtar and ſkill facets, are of a triangular figure. Both of theſe partake equally of the depth of the upper ſides from the table to the girdle; and meet in the middle of each ſide of the table and girdle, as alſo at the corners. Thus they produce regular lozenges on the four upper ſides and corners of the ſtone. The triangular facets, on the under ſides, joining to the girdle, muſt be half as deep again as the above facets, to anſwer to the collet part.—The ſtone here deſcribed is ſaid to be a *full-ſubſtanced brilliant.*—If the ſtone is thicker than in the proportion here mentioned, it is ſaid to be an *over-weighted brilliant.*—If the thickneſs is leſs than in this proportion, it is called a *ſpread brilliant.*—The beauty of brilliants is diminiſhed from their being either over-weighted or ſpread. The true proportion of the axis, or depth of the ſtone to its ſide, is as 2 to 3.—Brilliants are diſtinguiſhed into ſquare, round, oval, and drops, from the figure of their reſpective girdles.

Corniſh DIAMOND, a name given by many people to the cryſtals found in digging the mines of tin in Cornwall. Theſe cryſtals are of the nature of the Kerry-ſtone of Ireland, but ſomewhat inferior to it: they are uſually bright and clear, except towards the root, where they are coarſe and foul, or whitiſh. They are uſually found in the common form of an hexangular column, terminated at each end by an hexangular pyramid.

Roſe-DIAMOND is one that is quite flat underneath, with its upper part cut in many little faces, uſually triangles, the uppermoſt of which terminate in a point.—In roſe diamonds, the depth of the ſtone from the baſe to the point muſt be half the breadth of the diameter of the baſe of the ſtone. The diameter of the crown muſt be $\frac{3}{5}$ of the diameter of the baſe. The perpendicular, from the baſe to the crown, muſt be $\frac{3}{5}$ of the diameter of the ſtone. The lozenges which appear in all circular roſe-diamonds, will be equally divided by the ribs that form the crown; and the upper angles or facets will terminate in the extreme point of the ſtone, and the lower in the baſe or girdle.

Rough-DIAMOND, is the ſtone as nature produces it from the mine. It ſhould be choſen uniform, of a good ſhape, tranſparent, not quite white, and free from flaws and ſhivers. Black, rugged, dirty, flawey, veiny ſtones, and all ſuch as are not fit for cutting, they uſe to pound in a ſteel mortar made for that purpoſe; and when pulverized, they ſerve to ſaw, cut, and poliſh the reſt. Shivers are occaſioned by the miners attempting to get them more eaſily out of the vein, which winds between two rocks, by breaking the rocks with huge iron levers, which ſhake, and thus fill the ſtone with cracks and ſhivers. The ancients had two miſtaken notions with regard to the diamond: the firſt, that it became ſoft, by ſteeping it

in hot goat's blood; and the fecond, that it is malleable, and bears the hammer.

Factitious DIAMONDS. Attempts have been made to produce artificial diamonds, but with no great fuccefs. Thofe made in France, called *Temple diamonds*, on account of the Temple at Paris, where the beft of them are made, fall vaftly fhort of the genuine ones; accordingly they are but little valued, except to ornament the habits of the actors on the ftage, &c. See PASTES.

DIAMOND, in the glafs-trade, an inftrument ufed for fquaring the large plates or pieces; and, among glaziers, for cutting their glafs. Thefe forts of diamonds are differently managed. That ufed for large pieces, as looking-glaffes, &c. is fet in an iron ferril, about two inches long, and a quarter of an inch in diameter; the cavity of the ferril being filled up with lead, to keep the diamond firm: there is alfo a handle of box or ebony fitted to the ferril, and by which it is held.

DIAMOND, in heraldry, a term ufed for expreffing the black colour in the achievements of peerage. Guillim does not approve of blazoning the coats of peers by precious ftones inftead of metals and colours; but the Englifh practice allows it. Morgan fays the diamond is an emblem of fortitude.

DIANA, the goddefs of hunting. According to Cicero, there were three of this name: a daughter of Jupiter and Proferpine, who became mother of Cupid; a daughter of Jupiter and Latona; and a daughter of Upis and Glauce. But the fecond is the moft celebrated, and to her all the ancients allude. She was born at the fame birth as Apollo; and the pains which fhe faw her mother fuffer during her labour gave her fuch an averfion to marriage, that fhe obtained of her father to live in perpetual celibacy, and to prefide over the travails of women. To fhun the fociety of men, fhe devoted herfelf to hunting; and was always accompanied by a number of chofen virgins, who like herfelf abjured marriage. She is reprefented with a quiver and attended with dogs, and fometimes drawn in a chariot by two white ftags. Sometimes fhe appears with wings, holding a lion in one hand and a panther in the other, with a chariot drawn by two heifers, or two horfes of different colours. She was called *Lucina*, *Ilythia*, or *Juno Pronuba*, when invoked by women in childbed; and *Trivia* when worfhipped in the crofs-ways, where her ftatues were generally erected. She was alfo called *Agrotera*, *Orithia*, *Taurica*, *Delia*, *Cynthia*, *Aricia*, &c. She was fuppofed to be the fame as the Ifis of the Egyptians, whofe worfhip was introduced into Greece with that of Ofiris under the name of Apollo.

DIANÆ ARBOR, or ARBOR LUNÆ, in chemiftry, the beautiful cryftallizations of filver diffolved in aquafortis, to which fome quickfilver is added; and fo called from their refembling the trunk, branches, leaves, &c. of a tree. See CHEMISTRY.

DIANÆ *Portus*, a port of Corfica, fituated between Aleria and Mariana, on the eaft fide.

DIANDRIA, from δις *twice*, and ανηρ *a man*, the name of the fecond clafs in Linnæus's fexual fyftem, confifting of hermaphrodite plants, which, as the name imports, have flowers, with two ftamina or male organs. The orders in this clafs are three, derived from the number of ftyles or female parts. Moft plants with two ftamina have one ftyle; as jeffamine, lilac, privet, veronica, and baftard-alaternus; vernal grafs has two ftyles; pepper, three.

DIANTHERA, in botany; a genus of the monogynia order, belonging to the diandria clafs of plants; and in the natural method ranking under the 40th order, *Perfonatæ*. The corolla is ringent; the capfule bilocular, parting with a fpring at the heel; the ftamina each furnifhed with two antheræ placed alternately.—There is only one fpecies, a native of Virginia and other parts of North America. It is a low herbaceous plant, with a perennial root, fending out upright ftalks a foot high, garnifhed with long narrow leaves of an aromatic odour, ftanding clofe to the ftalks. From the fide of the ftalks the footftalks of the flowers are produced, fuftaining fmall fpikes of flowers.—This plant is very difficult to be preferved in Britain; for though it is hardy enough to live in the open air, it is very fubject to rot in winter. It may be propagated by feeds fown on a gentle hot-bed; and in the winter the plants muft be kept in a dry ftove.

DIANTHUS, CLOVE-GILLIFLOWER, CARNATION, PINK, SWEET-WILLIAM, &c. A genus of the digynia order, belonging to the decandria clafs of plants; and in the natural method ranking under the 22d order, *Caryophyllei*. The calyx is cylindrical and monophyllous, with four fcales at the bafe. There are five petals, with narrow heels; the capfule is cylindrical and unilocular.—There are a great number of fpecies; but not more than four that have any confiderable beauty as garden flowers, each of which furnifhes fome beautiful varieties. 1. The *caryophyllus*, or clove-gilliflower, including all the varieties of carnation. It rifes with many fhort trailing fhoots from the root, garnifhed with long, very narrow, evergreen leaves; and amidft them upright flender flower-ftalks, from one to three feet high, emitting many fide-fhoots; all of which, as well as the main ftalk, are terminated by large folitary flowers, having fhort oval fcales to the calyx, and crenated petals. The varieties of this are very numerous, and unlimited in the diverfity of flowers. 2. The *deltoides*, or common pink, rifes with numerous fhort leafy fhoots crowning the root, in a tufted head clofe to the ground, clofely garnifhed with fmall narrow leaves; and from the ends of the fhoots many erect flower-ftalks, from about fix to 15 inches high, terminated by folitary flowers of different colours, fingle and double, and fometimes finely variegated. This fpecies is perennial, as all the varieties of it commonly cultivated alfo are. 3. The *Chinenfis*, Chinefe, or Indian pink, is an annual plant with upright firm flower ftalks, branching erect on every fide, a foot or 15 inches high, having all the branches terminated by folitary flowers of different colours and variegations, appearing from July to November. 4. The *barbatus*, or bearded dianthus, commonly called *fweet-william*. This rifes with many thick leafy fhoots, crowning the root in a clufter clofe to the ground; garnifhed with fpear-fhaped ever-green leaves, from half an inch to two inches broad. The ftems are upright and firm, branching erect two or three feet high, having all the branches and main ftem crowned by numerous flowers in aggregate clufters of different colours and variegations. The culture of thefe is very generally known.

DIAPASON, in mufic, a mufical interval, by which moft authors who have wrote on the theory of mufic ufe to exprefs the OCTAVE of the Greeks. Among the mufical inftrument-makers, it denotes a kind of rule or fcale whereby they adjuft the pipes of their organs, and cut the holes of their hautboys, flutes, &c. in due proportion for performing the tones, femitones, and concords, juft.

DIAPASON-*Diaex*, in mufic, is a kind of compound concord, whereof there are two forts; the greater, which is in the proportion of 10-3; and the leffer, in that of 16-5. DIAPASON *Diapente*, a compound confonance in a triple ratio, as 3-9. This interval, fays Martianus Capella, confifts of 9 tones and a femitone; 19 femitones, and 38 diefes. It is a fymphony made when the voice proceeds from the firft to the twelfth found. DIAPASON *Diateffaron*, a compound concord founded on the proportion of 8 to 3. To this interval Martianus Capella allows 8 tones and a femitone; 17 femitones, and 34 diefes.

This is when the voice proceeds from its first to its eleventh sound. The moderns would rather call it the *eleventh*. DIAPASON *Ditone*, a compound concord, whose terms are as 10·4, or as 5·2. DIAPASON *Semiditone*, a compound concord, whose terms are in the proportion of 12·5.

DIAPEDESIS, a term in medicine, signifying a transudation of the fluids through the sides of the vessels that contain them.

DIAPENTE, in the ancient music, an interval marking the second of the concords, and with the diatessaron an octave. This is what in the modern music is called a *fifth*.

DIAPHANOUS, an appellation given to all transparent bodies, or such as transmit the rays of light.

DIAPHORESIS, in medicine, a slight degree of perspiration. See PERSPIRATION.

DIAPHORETICS, among physicians, are medicines which promote perspiration.

DIAPHRAGM, DIAPHRAGMA, in anatomy, a muscular septum dividing the thorax from the abdomen. See ANATOMY, p. 191.

DIAPORESIS, Διαπορησις, in rhetoric, is used to express the hesitation or uncertainty of the speaker. We have an example in Homer, where Ulysses, going to relate his sufferings to Alcinoüs, begins thus:

Τι πρωτον, τι δ'επειτα, τι δ'υςατιον καταλεξω?
Quid primum, quid deinde, quid postremo alloquar?

This figure is most naturally placed in the exordium or introduction to a discourse.

DIARBECK, or DIARBEKAR, a province of Turkey in Asia, between the rivers Tigris and Euphrates. It is bounded on the N. by Turcomania, on the E. by Persia, on the S. by Irac-Arabia, and on the W. by Syria. It was the ancient Mesopotamia.

DIARBEKER, a large and ancient town of Turkey in Asia, capital of a province of the same name, and seated on the river Tigris. The Turks are more affable here than in other places, with regard to the Christians, who are above 20,000 in number. They carry on a great trade in red Turkey leather, and cotton cloth of the same colour. It is 150 miles N. W. of Aleppo. Lon. 39. 40. E. Lat. 37. 18. N.

DIARRHŒA, or LOOSENESS, in medicine, is a frequent and copious evacuation of liquid excrement by stool. See MEDICINE.

DIARTHROSIS, in anatomy, a kind of articulation or juncture of the bones; which affords room for a manifest motion. The word comes from δια, and αρθρον, *juncture, assemblage*. It is opposed to *synarthrosis*, wherein the articulation is so close that there is no sensible motion at all. See ANATOMY.

DIARY, a term sometimes used for a journal or day-book, containing an account of every day's proceedings. Thus we say, *diaries of the weather*, &c.

DIARY *Fever*, is a fever of one day. See EPHEMERA.

DIASCHISM, among musicians, denotes the difference between the comma and enharmonic diesis, commonly called the *lesser comma*.

DIASCORDIUM, in pharmacy, a once celebrated composition, so called from *scordium*, which was one of its ingredients. It is now expunged from the dispensatories.

DIASTOLE, among physiologists, signifies the dilatation of the heart, auricles, and arteries; and stands opposed to the SYSTOLE, or contraction of those parts. See ANATOMY, p. 193.

DIASTOLE, in grammar, a figure in prosody whereby a syllable naturally short is made long. Such is the first syllable of *Priamides* in the following verse of Virgil:

Atque hic Priamides! nihil o tibi, amice, relictum.

DIASYRMUS, in rhetoric, a kind of hyperbole, being an exaggeration of some low, ridiculous thing.

DIATESSARON, among ancient musicians, a concord or harmonical interval, composed of a greater tone, a less tone, and one greater semitone: its proportion in numbers is as 4 : 3.

DIATONICK, in music, (compounded of two Greek words, *viz*. the proposition δια, signifying a transition from one thing to another, and the substantive τονος, importing a given degree of tension or musical note), is indifferently applied to a scale or gammut, to intervals of a certain kind, or to a species of music, whether in melody or harmony, composed of these intervals. Thus we say the *diatonick* series, a *diatonick* interval, *diatonick* melody or harmony. As the diatonick scale forms the system of diatonick music, and consists of diatonick intervals, it will be necessary, for understanding the former, that we should explain the latter. See INTERVAL.

DIATRAGACANTH, in pharmacy, the old name of a certain powder, of which, gum tragacanth formed the chief ingredient. It is now disused.

DIAUGOPHRAGMIA, in natural history, a genus of fossils of the order of septariæ, whose partitions or septa consist of spar with an admixture of crystal. Of this genus there are three species. 1. A red kind, with brownish yellow partitions. 2. A brownish yellow kind, with whitish partitions. 3. A blueish-white kind, with straw-coloured partitions.

DIBBLE, or DIBBER, a simple but useful implement in gardening, used for planting out not only young plants, but some kinds of grain also. Dibbling of wheat has now become very general, and is a most important improvement in agriculture. See HUSBANDRY.

DICE, amongst gamesters, certain cubical pieces of bone or ivory, marked with dots on each of their faces, from one to six, according to the number of faces. Sharpers have several ways of falsifying dice. 1. By sticking a hog's bristle in them, so as to make them run high or low as they please. 2. By drilling and loading them with quicksilver: which cheat is found out by holding them gently by two diagonal corners; for, if false, the heavy sides will always turn down. 3. By filing and rounding them. But all these ways fall far short of the art of the dice-makers; some of whom are so dexterous this way, that your sharping gamesters will give any money for them. Dice are required to be stamped, and pay a very considerable duty.

DICÆARCHUS, a scholar of Aristotle, composed a great number of books which were much esteemed. Cicero and his friend Pomponius Atticus valued him highly. He wrote a book to prove, that men suffer more mischief from one another than from all evils beside. And the work he composed concerning the republic of Lacedemon was extremely honoured, and read every year before the youth in the assembly of the ephori. Geography was one of his principal studies, on which science there is a fragment of a treatise of his still extant, and preserved among the *Veteris geographiæ scriptores minores*.

DICHOTOMOUS, in botany: Forked stalks are called *dichotomous* when the divisions come by two and two.

DICHOTOMY, a term used by astronomers for that phasis or appearance of the moon, wherein she is bisected, or shows just half her disk. In this situation the moon is said to be in a quadrate aspect, or to be in her quadrature.

DICKER, in old writers, denotes the quantity of ten hides of skins, whereof 20 made a last: also 10 pair of gloves, ten bars of iron, and the like, are sometimes expressed by the term *dicker*.

DICKINSON (Edmund), a celebrated English physician and chemist, born in 1624. He studied and took his degrees at Merton-college, Oxford; and in 1655 published there his *Delphi Phœnicizantes*, &c. a most learned piece, in which he attempted to prove, that the Greeks borrowed the story of the

Pythian Apollo, and all that rendered the oracle at Delphos famous, from the Holy Scriptures, and the book of Joshua in particular: a work that procured him great reputation both at home and abroad. He practised physic first at Oxford; but removing to London in 1684, his good fortune in recovering the earl of Arlington from a dangerous sickness, procured his promotion to be physician in ordinary to Cha. II. and to his household. As that prince understood and loved chemistry, Dr. Dickinson grew into great favour at court; and was continued in his appointments under James II. After the abdication of his unfortunate master, being then in years, and afflicted with the stone, he retired from practice, and died in 1707. He published many other things, particularly *Physica vetus & vera*, &c. containing a system of philosophy chiefly framed on principles collected from the Mosaic history.

DICTAMNUS, WHITE DITTANY, or *Fraxinella*; a genus of the monogynia order belonging to the decandria class of plants; and in the natural method ranking under the 26th order, *Multisiliquæ*. The calyx is pentaphyllous; the petals are five, and patulous; the filaments sprinkled with glandulous points; the capsules five, coalited. There is only one species. It has thick, penetrating, perennial roots, collected into a head at top, sending up erect stalks annually, two or three feet high, garnished with pinnated alternate leaves, of three or four pair of oblong stiff lobes, terminated by an odd one; and the stalks crowned by long, pyramidal, loose spikes of flowers, of white, red, and purple colours. They are very ornamental plants, and succeed in any of the common borders. The dittany which grows in Crete, Dalmatia, and the Morea, formerly constituted an article in the materia medica. The leaves in smell and taste somewhat resemble lemon-thyme, but have more of an aromatic flavour, as well as a greater degree of pungency; when fresh, they yield a considerable quantity of essential oil.

DICTATOR, a magistrate at Rome invested with regal authority. This officer was first chosen during the Roman wars against the Latins. The consuls being unable to raise forces for the defence of the state, because the plebeians refused to inlist if they were not discharged of all the debts they had contracted with the patricians, the senate found it necessary to elect a new magistrate with absolute and uncontroulable power to take care of the state. The dictator remained in office for six months, after which he was again elected if the affairs of the state seemed to be desperate; but if tranquillity was re-established, he generally laid down his power before the time was expired. He knew no superior in the republic, and even the laws were subjected to him. He was called dictator, because *dictus*, named by the consul, or *quoniam dictis ejus parebat populus*, because the people implicitly obeyed his command. He was named by the consul in the night *viva voce*, and his election was confirmed by the auguries. As his power was absolute, he could proclaim war, levy forces, conduct them against an enemy, and disband them at his pleasure. He punished as he pleased, and from his decision there lay no appeal, at least till later times. He was preceded by 24 lictors with the *fasces*; during his administration, all other officers, except the tribunes of the people, were suspended, and he was the master of the republic. But amidst all this independence, he was not permitted to go beyond the borders of Italy, and he was always obliged to march on foot in his expeditions, and he never could ride in difficult and laborious marches without previously obtaining a formal leave from the people. He was chosen only when the state was in imminent danger from foreign enemies or inward seditions. In the time of a pestilence a dictator was sometimes elected, as also to hold the *comitia*, or to celebrate the public festivals, or drive a nail in the capitol, by which superstitious ceremony the Romans believed that a plague could be averted, or the progress of an enemy stopped. This office, so respectable and illustrious in the first ages of the republic, became odious by the perpetual usurpations of Sylla and J. Cæsar; and after the death of the latter, the Roman senate passed a decree which for ever forbade a dictator to exist in Rome. The dictator, as soon as elected, chose a subordinate officer called his master of horse, *magister equitum*. This officer was respectable; but he was totally subservient to the will of the dictator, and could do nothing without his express order. This subordination, however, was some time after removed; and during the second Punic war the master of the horse was invested with a power equal to that of the dictator. A second dictator was also chosen for the election of magistrates at Rome after the battle of Cannæ. The dictatorship was originally confined to the patricians; but the plebeians were afterwards admitted to share it. Titus Largius Flavus was the first dictator, in the year of Rome 253.

DICTION, the phrase, elocution or style of a writer or speaker. See ORATORY.

DICTIONARY, in its original acceptation, is the arranging all the words of a language according to the order of the alphabet, and annexing a definition or explanation to each word. When arts and sciences began to be improved and extended, the multiplicity of technical terms rendered it necessary to compile dictionaries, either of science in general, or of particular sciences, according to the views of the compiler.

DICTIONARY *of the English Language*. The design of every dictionary of language is to explain, in the most accurate manner, the meaning of every word; and to show the various ways in which it can be combined with others, in as far as this tends to alter its meaning. The dictionary which does this in the most accurate manner, is the most complete. Therefore the principal study of a lexicographer ought to be, to discover a method which will be best adapted for that purpose. Dr. Johnson, with great labour, has collected the various meanings of every word, and quoted the authorities: but, would it not have been an improvement if he had given an accurate definition of the precise meaning of every word; pointed out the way in which it ought to be employed with the greatest propriety; showed the various deviations from that original meaning, which custom had so far established as to render allowable; and fixed the precise limits beyond which it could not be employed without becoming a vicious expression? With this view, it would have been necessary to exhibit the nice distinctions that take place between words which are nearly synonymous. Without this, many words can only be defined in such a manner as that they must be considered exactly synonymous. We might point out these defects in many instances; but shall content ourselves with giving the following example, to show how a dictionary of the English language might be more advantageously compiled.

FORM. *subst.* The external appearance of any object, when considered only with respect to shape or figure. This term therefore, in the literal sense, can only be applied to the objects of the sight and touch; and is nearly synonymous with *figure*: but they differ in some respects. *Form* may be employed to denote more rude and unfinished shapes; *figure*, those which are more perfect and regular. *Form* can never be employed without denoting matter; whereas *figure* may be employed in the abstract: thus we say, a square or a triangular *figure*; but not a square or triangular *form*. And in the same manner we say, the *figure* of a house; but we must denote the substance which forms that figure, if we use the word *form*; as, *a cloud of the form of a house*, &c. See FIGURE.

2. In contraſt to irregularity or confuſion. As beauty cannot exiſt without order, it is by a figure of ſpeech employed to denote beauty, order, &c.
3. As *form* reſpects only the external appearance of bodies, without regard to their internal qualities, it is, by a figure of ſpeech, employed in contraſt to theſe qualities, to denote empty ſhow, without eſſential qualities. In this ſenſe it is often taken when applied to religious ceremonies, &c.
4. As *form* is employed to denote the external appearance of bodies; ſo, in a figurative ſenſe, it is applied to reaſoning, denoting the particular mode or manner in which this is conducted; as, *the form of a ſyllogiſm*, &c.
5. In the ſame manner it is employed to denote the particular mode of procedure eſtabliſhed in courts of law; as, *the forms of law, religion*, &c.
6. *Form* is ſometimes, although improperly, uſed to denote the different circumſtances of the ſame body; as, *water in a fluid or a ſolid form.* But as this phraſe regards the internal qualities rather than the external figure, it is improper; and ought to be, *water in a fluid or a ſolid ſtate.*
7. But when bodies of different kinds are compared with one another, this term may be employed to denote other circumſtances than ſhape or figure: for we may ſay, *a juice exſuding from a tree in the form of wax or roſin*; although, in this caſe, the conſiſtence, colour, &c. and not the external arrangement of parts, conſtitute the reſemblance.
8. From the regular appearance of a number of perſons arranged in one long ſeat, ſuch perſons ſo arranged are ſometimes called a *form*; as, *a form of ſtudents*, &c. And,
9. By an eaſy tranſition, the ſeat itſelf has alſo acquired the name of *form.*

This may perhaps ſerve to give ſome idea of the plan of an Engliſh Dictionary compoſed upon philoſophical principles: but, beſides the circumſtances we have enumerated, there are many others which would require particular attention in the execution of a work of this kind. In the Engliſh language, a great variety of terms occur, which denote matter under certain general forms or circumſtances, without regarding the minute diverſities that may take place; as the word *cloth*, which denotes matter as manufactured into a particular form, including under it all the variety of ſtuffs manufactured in that particular way, of whatever materials, colours, texture, or fineneſs, they may be. The ſame may be ſaid of *wood, iron, yarn*, and a great variety of terms of the ſame nature, ſome of which cannot aſſume any plural; while others admit of it in all caſes, and others admit or refuſe it according to the different circumſtances in which they are conſidered. In a dictionary, therefore, all this variety of caſes ought to be clearly and diſtinctly pointed out under each particular article: this is the more neceſſary, as ſome of theſe words have others formed from them, which might be readily miſtaken for their plurals, although they have a very different ſignification; as *clothes*, which does not denote any number of pieces or different kinds of *cloth*, but *wearing apparel*. The following example will illuſtrate this head.

WOOD. *ſubſt.* A ſolid ſubſtance, of which the trunks and branches of trees conſiſt.

1. This term is employed to denote the ſolid parts of vegetables of all kinds, in whatever form or circumſtances they are found. Nor does this term admit of a plural with propriety, unleſs in the circumſtances after mentioned: for we ſay, *many different kinds of wood*, in preference to *many kinds of woods*; or, we ſay, *oak, aſh*, or *elm wood*, not *woods*.
2. But where we want to contraſt *wood* of one quality or country with that of another, it admits of a plural: for we ſay, *white woods are in general ſofter than red*; or *Weſt Indian woods are in general of greater ſpecific gravity than the European woods*: but unleſs where the colour, or ſome quality which diſtinguiſhes it from growing wood, is mentioned, this plural ought as much as poſſible to be avoided, as it always ſuggeſts an idea of growing wood.
3. *Wood* likewiſe denotes a number of trees growing near one another; being nearly ſynonymous with *foreſt*: ſee Forest. In this ſenſe it always admits of a plural; as, *Ye woods and wilds whoſe ſolitary gloom*, &c.

Farther, it is evident that a dictionary cannot be reckoned complete without explaining obſolete words; and if the terms of the ſeveral provincial dialects were likewiſe given, it would be of great utility: nor would this take much time; becauſe a number of theſe words need no other explanation than to mark along with them the words which had come in their place, when there happened to be one perfectly ſynonymous: and in thoſe caſes where the ſame idea could not be expreſſed in modern language without a periphraſis, it would be of uſe to explain them diſtinctly; ſo that, when a writer found himſelf at a loſs for a term, and obliged to ſearch for one beyond the bounds of our own language, he might take one of theſe, when he found that it was expreſſive and energetic, in preference to another drawn from a foreign language. This would at leaſt have one good effect: it would make our language more fixed and ſtable; not to ſay more accurate and preciſe, than by borrowing from foreign languages.

As the Engliſh language is ſo exceedingly irregular in the pronunciation, the ſame letter in the ſame ſituation often aſſuming ſounds totally different in different words, it is impoſſible to eſtabliſh any general rules on this ſubject, which do not admit of many exceptions: therefore, a dictionary is the beſt means of aſcertaining and pointing out the proper pronunciation of words. For, if the writer firſt pointed out all the different ſounds that the ſame letter could ever be made to expreſs, and aſſigned to every particular ſound which each letter could be made to aſſume, a particular mark, which was appropriated to denote that particular ſound of the letter whenever it occurred; by placing theſe particular marks above the letters in the dictionary, the ſound of each letter would be pointed out in all caſes with the utmoſt certainty. It would be impoſſible for us to illuſtrate this by examples, without firſt aſcertaining all the ſounds of each letter; which would lead us into a diſcuſſion too long for this place.

All we ſhall obſerve farther is, that, beſides having the accented ſyllable of every word *properly* diſtinguiſhed in a dictionary to aſſiſt in the pronunciation, the Engliſh language requires another eſſential improvement, *viz.* the uſe of accents to diſtinguiſh the meaning of *words* and *phraſes*: which, although not very properly confined to a lexicographer, yet it is not entirely beyond his province, though it is more immediately within that of the grammarian.

DICTYMNIA, or Dictynnia, in mythology, were feaſts celebrated at Lacedæmon and in Crete, in honour of Diana Dictymnia or Dictynnia, or of a nymph taken for her, who, having plunged herſelf into the ſea, to eſcape the paſſion of Minos, was caught in a fiſherman's net or δίκτυον; whence the name.

DICTYS (Cretenſis), a very ancient hiſtorian, who ſerving under Idomeneus king of Crete in the Trojan war, wrote the hiſtory of that expedition in nine books; and Tzetzes tells us,

that Homer formed his Iliad upon the plan of that history. It is however maintained, that the Latin history of Dictys which we have at present is spurious.

DIDACTIC, in the schools, signifies the manner of speaking or writing, adapted to teach or explain the nature of things. The word is formed from the Greek διδασκω, *doceo*, "I teach." There are many words that are only used in the didactic and dogmatic way; and there are many works, ancient and modern, both in prose and verse, written after this method: such are the Georgics of Virgil, Lucretius's Poem De Rerum Natura, and Pope's Essays on Criticism and on Man, &c. &c.

DIDAPPER, in ornithology. See COLYMBUS.

DIDELPHIS, or OPOSSUM, in zoology; a genus of quadrupeds belonging to the order of feræ, the characters of which are these: they have ten fore-teeth in the upper jaw, and eight in the under one. The dog-teeth are long; the tongue is somewhat ciliated; and they have a pocket formed by a duplicature of the skin of the belly, in which the dugs are included. See Pl. I.

1. The *marsupialis*, or Virginian opossum, has a long sharp-pointed nose; large, round, naked, and very thin ears; small, black, lively eyes; long stiff hairs on each side the nose, and behind the eyes: the hind part of the neck and back covered with hair two inches long; the bottoms of a yellowish white, middle part black, ends whitish: the sides covered with hair of a dirty and dusky colour; the belly with soft, woolly, dirty white hair: the tail, for near three inches, clothed with long hairs like those on the back; the rest of the tail covered with small scales. The tail of this animal has a disagreeable appearance, looking like the body of a snake, and has the same prehensile quality with that of some monkeys; the body is round and pretty thick, the legs short: on the lower part of the belly of the female is a large pouch, in which the teats are lodged, and where the young shelter as soon as they are born. The length of the body is 16 or 17 inches; that of the tail 14. This creature inhabits many parts of America and the East Indies. It is very destructive to poultry, and sucks the blood without eating the flesh; it feeds also on roots and wild fruits, and is very active in climbing trees. It hunts eagerly after birds and their nests; and will hang suspended from the branches of a tree by its tail; then, by swinging its body, it will fling itself among the trees that grow in the neighbourhood. It walks very slow; and when pursued and overtaken will feign itself dead. It is not easily killed, being as tenacious of life as a cat. When the female is about to bring forth, she makes a thick nest of dry grass in some close bush at the foot of a tree; and brings four, five, or six young at a time. As soon as the young are brought forth, they take shelter in the pouch or false belly; and fasten so closely to the teats, that they cannot be separated without difficulty. They are blind, naked, and very small, when new-born, and resemble fetuses: it is therefore necessary that they should continue in that false belly till they attain proper strength and sight; and are prepared to undergo what may be called a *second birth*. After this they run into the pouch as into an asylum in time of danger; and the parent carries them about with her. During the time of this second gestation, the female shows an excessive attachment to her young, and will suffer any torture rather than allow this receptacle to be opened; for she has the power of opening or closing it by the assistance of some very strong muscles. The flesh of the old animal is very good, like that of a sucking pig: the hair is dyed by the Indian women, and wove into garters and girdles: the skin is very fetid.

2. The *Molucca* opossum has long, oval, and naked ears: the mouth is very wide: the lower side of the upper jaw, throat, and belly, is of a whitish ash colour; rest of the hair a cinereous brown tipt with tawny, darkest on the back: the tail is as long as the body; near the base covered with hai the rest naked: the claws are hooked. On the belly of the female is a pouch, in which the young (like those of the former) shelter. Marcgrave found six young within the pouch. It has ten cutting teeth above and eight below. The length of the animal from nose to tail is ten inches; and the tail exceeds the length of head and body. Its whole figure is of a much more slender and elegant make than the former. The tail pulverised, and taken in a glass of water, is reckoned in New Spain a sovereign remedy against the gravel, colic, and several other diseases. This species is found in great numbers in Aroe and Solor: it is called in the Indies *pelandor aroe*, or the *aroe rabbit*. They are reckoned very delicate eating; and are very common at the tables of the great, who rear the young in the same places in which they keep their rabbits. It inhabits also Surinam, and the hot parts of America.

3. The *murina*, or murine opossum, has the face and upper parts of the body of a tawny colour; the belly of a yellowish white: the tail is slender, and covered with minute scales to the very rump: the length of the animal from nose to tail, about six inches and a half; the tail of the same length: the female wants the false belly of the former; but on the lower part the skin forms on each side a fold, between which the teats are lodged. It inhabits the hot parts of South America; agrees with the others in its food, manners, and the prehensile power of its tail. It brings from 10 to 14 young ones at a time: they affix themselves to the teats as soon as they are born, and remain attached like inanimate things, till they attain growth and vigour to shift a little for themselves.

4. The *Mexican* opossum, is of an ash-colour on the head and upper parts of the body: the belly and legs are whitish: the tail is long and pretty thick, varied with brown and yellow; it is hairy near an inch from its origin, the rest naked: the length of the animal from nose to tail, about seven inches and a half; of the tail, more than 11. It inhabits the mountains of Mexico, and lives in trees, where it brings forth its young: when in any fright, they embrace the parent closely. The tail is prehensile, and serves instead of a hand.

5. The *phalanger*, or Surinam opossum of Buffon, has the upper part of the body reddish, mixed with a light ash-colour and yellow: the under parts are of a dirty yellowish white; the bottom of the tail is covered with hair, for near two inches and a half; the rest naked: the length of the animal from nose to tail is near nine inches; the tail ten. It inhabits Surinam, according to Buffon; who supposes it may be the species called by the colonists the *cane rat*, which is so destructive to the sugar-canes. According to Dr. Pallas, it inhabits the East India islands, but is not found in Surinam.

6. The *dorsigera*, or merian opossum, has the head and upper part of the body of a yellowish brown colour; the belly white, and tinged with yellow; the tail very long and slender, and, except at the base, quite naked. It is a native of Surinam, and burrows under ground: it brings five or six young at a time, which follow their parent: on any apprehension of danger, they all jump on her back; and twisting their tails round hers, she immediately runs with them into her hole.

7. The *kanguroo*. This animal has a small head, neck, and shoulders; the body increasing in thickness to the rump. The head is oblong, formed like that of a fan, and tapering from the eyes to the nose; end of the nose naked and black; the upper lip divided. The nostrils are wide and open; the lower jaw is shorter than the upper; and the aperture of the mouth small: there are whiskers on both jaws, those on the upper longest; and strong hairs above and below the eyes. The eyes are not large; the irides are dusky; the pupil is of a blueish black. The ears are erect, oblongly ovated, rounded at the ends, and thin, covered with short hairs; four inches long. There are no canine teeth; but six broad cutting teeth

in the upper jaw; two long lanceolated teeth in the lower, pointing forward; and four grinding teeth in each jaw, remote from the others. The belly is convex and great. That of the female has a cavity opening externally like other animals of the opoſſum tribe, for the nurture and protection of its young. The fore legs are very ſhort, ſcarcely reaching to the noſe; and uſeleſs for walking. The hind legs are almoſt as long as the body; and the thighs are very thick: on the fore feet are five toes, with long conic and ſtrong claws; on the hind feet, only three: the middle toe is very long and thick, like that of an oſtrich; the two others are placed very diſtinct from it, and are ſmall: the claws are ſhort, thick, and blunt: the bottom of the feet, and hind part, black, naked, and tuberculated, as the animal reſts often on them. The tail is very long, extending as far as the ears; thick at the baſe, tapering to a point. The ſcrotum is large and pendulous. The hair on the whole animal is ſoft, and of an aſh-colour; lighteſt on the lower parts. The dimenſions of a full grown animal are not correctly known; but the following are thoſe of a male lately ſent to Lord Sidney by Governor Phillip.

	f.	in.
The length from the point of the noſe to the end of the tail, of this animal, was	8	5
Length of the tail,	3	1
——— head,	0	11
——— fore legs,	2	0
——— hind legs,	3	7
Circumference of the fore part by the legs,	1	9
——— lower parts ———	4	5
Round the thicker part of the tail, which gradually tapers to the end	1	1

The above is the largeſt kanguroo that has yet been ſeen, and there is reaſon to believe that even this had not nearly attained its full growth.

It inhabits the weſtern ſide of New Holland, and has as yet been diſcovered in no other part of the world. It lurks among the graſs; and feeds on vegetables: it goes entirely on its hind legs; making uſe of the fore feet only for digging, or bringing its food to its mouth. The dung is like that of a deer. It is very timid: at the ſight of men it flies from them by amazing leaps, ſpringing over buſhes ſeven or eight feet high; and going progreſſively from rock to rock. It carries its tail quite at right angles with its body when it is in motion; and when it alights, often looks back. Theſe animals feed in herds of about 30 or 40; one being always apparently on the watch at a diſtance from the reſt. The largeſt kanguroo that has yet been ſhot, weighed about 140 pounds. But it has been diſcovered that there are two kinds, one of which ſeldom exceeds 60 pounds in weight: theſe live chiefly on the high grounds: their hair is of a reddiſh caſt, and the head is ſhorter than the larger ſort. Young kanguroos which have been taken, have in a few days grown very tame, but none have lived more than two or three weeks. A ſhort time ago, however, two male and ſeveral female kanguroos were brought to this country, and depoſited in the Royal Menagerie at Richmond, where ſome of them have bred. The females breed at all ſeaſons, and produce only a ſingle young at a time; and this goes into the falſe belly occaſionally, and ſucks its mother a long time after it appears capable of procuring its own food. If the old one is purſued, however, in attending to her own ſafety, ſhe will force out the young one, although incapable of making its eſcape. The tail of the kanguroo, which is very large, is found to be uſed as a weapon of offence, and has given ſuch ſevere blows to dogs as to oblige them to deſiſt from purſuit. Its fleſh is coarſe and lean, nor would it probably be uſed for food in any place where there was not a ſcarcity of freſh proviſions.

8. The *quoll*, or ſpotted opoſſum, is deſcribed as in length from the noſe to the beginning of the tail about 15 inches, and the tail about nine or ten. The general colour black, inclining to brown beneath; the neck and body ſpotted with irregular roundiſh patches of white, the ears pretty large and erect: the viſage pointed, the muzzle furniſhed with long ſlender hairs; the legs, from the knees downward, almoſt naked, and aſh coloured; on the fore feet are five claws, and on the hind, four, and a thumb without a claw; the tail, for about an inch and an half from the root, is covered with hairs of the ſame length as thoſe on the body, from thence to the end with long ones not unlike that of a ſquirrel. The female has ſix teats placed in a circle within the pouch.

9. The *kanguroo* rat is deſcribed as ſimilar, both in the general ſhape of the body and the conformation of the legs, to the kanguroo; but the viſage having a ſtrong reſemblance to that of the rat, and the colour of the whole not ill reſembling that animal, it has obtained the name of the *kanguroo rat*. It is an inhabitant of New Holland; and two of the ſpecies are now to be ſeen alive at the curious exhibition of animals over Exeter Exchange; where one of them, being a female, has brought forth young. This ſpecies has two cutting teeth in front of the upper jaw, with three others on each ſide of them; and at a diſtance one falſe grinder, ſharp at the edge, and channelled or fluted on the ſides; and cloſe to theſe, two true grinders: in the lower jaw there are two long cutting teeth formed like thoſe of the ſquirrel, with three grinders correſponding with thoſe in the upper jaw.

10. The *flying opoſſum*, a beautiful ſpecies, and clothed with fur of the moſt exquiſite texture, is an inhabitant of New Wales. In length, from the tip of the noſe to the root of the tail, it is 20 inches; the tail itſelf is 22 inches, at the baſe quite light, increaſing gradually to black at the end: the ears are large and erect: the coat or fur is of a rich and moſt delicate texture; appearing, on the upper parts of the body, at firſt ſight, of a gloſſy black, but on a nicer inſpection ſeems to be mixed with grey; the under parts are white, and on each hip is a tan-coloured ſpot nearly as big as a ſhilling; at this part the fur is thinneſt, but at the root of the tail it is ſo rich and cloſe that the hide cannot be felt through it. The fur is alſo continued to the claws. On each ſide of the body is a broad flap or membrane (as in the flying ſquirrels), which is united to both the fore and hind legs. The jaws are furniſhed with teeth, placed as in ſome others of this genus: in the upper jaw forwards are four ſmall cutting teeth, then two canine ones, and backwards five grinders: the under jaw has two long large cutting teeth, five grinders, with no intermediate canine ones, the ſpace being quite vacant. The fore-legs have five toes on each foot, with a claw on each; the hinder ones four toes, with claws (the three outſide ones without any ſeparation), and a thumb without a claw, enabling the animal to uſe the foot as a hand, as many of the opoſſum tribe are obſerved to do.

11. The *Cayenne* opoſſum has a long ſlender face: ears erect, pointed, and ſhort: the coat woolly, mixed with very coarſe hairs, three inches long, of a dirty white from the roots to the middle; from thence to the ends, of a deep brown; ſides and belly of a pale yellow; legs of a duſky brown; thumb on each foot diſtinct; on the toes of the fore feet, and thumb of the hind, are nails; on the toes of the hind feet crooked claws; tail very long, taper, naked, and ſcaly. Length 17 French inches; of the tail fifteen and a half. The ſubject meaſured was young. It inhabits Cayenne; is very active in climbing trees, on which it lives the whole day: in marſhy places, it feeds on crabs, which, when it cannot draw out of their holes with its feet, it hooks them by means of its long tail. If the crab pinches its tail, the animal ſets up a loud cry,

which may be heard afar: its common voice is a grunt like a young pig. It is well furnifhed with teeth, and will defend itfelf ftoutly againft dogs; brings forth four or five young, which it fecures in fome hollow tree. The natives eat thefe animals, and fay their flefh refembles a hare. They are eafily tamed, and will then refufe no kind of food.

12. The *New Holland* opoffum has the upper part of the head, and the back and fides, covered with long, foft, gloffy hairs, of a dark cinereous colour at the bottoms, and of a rufty brown towards the ends: the belly is of a dirty white. The tail is taper, covered with fhort brown hairs, except for four inches and a half of the end, which is white, and naked underneath; the toes like thofe of the former. It is defcribed by Pennant from a fkin, the length of which, from the head to the tail, was 13 inches, and the tail the fame. The animal was found near Endeavour river, on the eaftern coaft of New Holland, with two young ones. It lodges in the grafs, but is not common. There are two or three other fpecies.

DIDUS, or DODO, in ornithology, a genus belonging to the order of gallinæ. The bill is contracted in the middle by two tranfverfe rugæ; each mandible is inflected at the point; and the face is bare behind the eyes. Only one fpecies, the ineptus, is mentioned by Linnæus; but three are defcribed by Buffon: though it is doubted whether, on further obfervation, they may not all prove one and the fame fpecies, differing only in fex or age. See Plate 2.

1. The *dronte*, or hooded dodo, (ineptus, *Lin.*) is fomewhat bigger than a fwan, and near three feet in length. The bill is ftrong, large, and hooked at the end; the gape ftretches beyond the eyes: the colour of it is a very pale blue; except the end of the upper mandible, which is yellowifh, and has a red fpot on the bend of it; the end of the lower is blackifh; the irides are white. The general colour of the plumage is cinereous, and foft to the touch; the belly and thighs are whitifh. The head is large, and feems as it were covered with a black hood or cowl. The wings are very fhort, and of a yellowifh afh-colour: the tail feathers are curled, ftand up on the rump, and incline to yellow. The legs have four toes, three before and one behind; are very ftout, fhort, and yellowifh: the claws are black. It inhabits the iflands of Mauritius and Bourbon in the Indian Ocean.

2. The *folitaire*, or folitary dodo, is a large bird, and the male is faid to weigh fometimes 45 pounds. The neck is of a proportionable length, and the eye black and lively: the head is not crefted, and the general colour of the plumage is grey and brown mixed: it has fcarce any tail, and the baftard wing fwells out into a round knob: the wings are too fhort for flight; and the hind parts are rounded like a horfe's rump, being clothed with feathers, which may be termed *coverts.*—The females are covered with fometimes brown and fometimes light yellow feathers, and appear very beautiful. The feathers on each fide of the breaft enlarge into two white tufts, fomewhat refembling the bofom of a woman. Thofe of the thighs are rounded at the end like fhells; and, according to Leguat, the bird has altogether a noble and elegant gait. This is an inhabitant of the ifle of Rodrigue, where it is not uncommon; but not met with in flocks, fcarcely more than two being found together. It makes its neft in by-places, of leaves of the palm, a foot and a half in thicknefs; and lays one egg, bigger than that of a goofe. The male fits in his turn; and does not fuffer any bird to approach within 200 yards of the fpot while the hen is fitting, which is feven weeks. The young is fome months before it can fhift for itfelf; the old ones, in the mean time, are affectionate to it, and faithful to each other afterwards, though they occafionally may mix with others of their kind. The young birds, though timid, are ftupid enough to fuffer the approach of any one; but when grown up are more fhy, and will not be tamed. They are chafed in the winter feafon, viz. from March to September; being then fat, and the young birds are much efteemed for the table.

3. The *Nazarene* dodo is bigger than a fwan. The bill is a little bent downwards, and large: inftead of feathers, the whole is covered over with a black down; but the wings are feathered, and it has fome frizzled ones upon the rump, which ferve inftead of a tail: the legs are long and fcaly, and there are three toes on each foot. This was met with in the Ifle of France, and defcribed as above by Fr. Cauche; who adds, that the female lays only one egg, which is white, and as big as a penny loaf, and that there is always found with it a white ftone of the fize of an hen's egg; that it makes the neft of leaves and dry herbs, in the forefts, on the ground; and that there is likewife found a grey ftone in the gizzard of the young bird.

DIDYMUS of Alexandria, an ecclefiaftical writer of the fourth century; who, though he is faid to have loft his eyes at five years of age, when he had fcarcely learned to read, yet applied fo earneftly to ftudy, that he attained all the philofophic arts in a high degree, and was thought worthy to fill the chair in the famous divinity-fchool at Alexandria. He was the author of a great number of works: but all we have now remaining are, a Latin tranflation of his book upon the Holy Spirit, in the works of St. Jerome, who was the tranflator; fhort ftrictures on the Canonical Epiftles; and a book againft the Manichees.

DIDYNAMIA (from δὶς *twice*, and δυναμις *power*), the name of the 14th clafs in Linnæus's fexual method, confifting of plants with hermaphrodite flowers, which have four ftamina or male organs, two of which are long and two fhort. See BOTANY.

DIEMEN's LAND, the fouthern coaft or point of New Holland, S. lat. 43° 21′ 20″. E. long. 147° 29′. This coaft was difcovered in November 1642 by Tafman, who gave it the name of *Van Diemen's Land.* Captain Furneaux touched at it in March 1773, and the country has been fince further explored by our late navigators. Here is a very fafe road, named by Captain Cook *Adventure Bay.* The parts adjoining to the bay are moftly hilly, and form an entire foreft of tall trees, rendered almoft impaffable by brakes of fern, fhrubs, &c. The foil on the flat land, and on the lower part of the hills, is fandy, or confifts of a yellowifh earth, and in fome parts of a reddifh clay; but further up the hills it is of a tough grey fort. This country, upon the whole, bears many marks of being very dry, and the heat appears to be great. No mineral bodies, nor ftones of any other kind than the white fand-ftone, were obferved: nor any vegetables that afforded fubfiftence for man. The foreft-trees are all of one kind, generally quite ftraight, and bearing clufters of fmall white flowers. The principal plants obferved were wood-forrel, milk-wort, cudweed, bell-flower, gladiolus, famphire, and feveral kinds of fern. The only quadruped feen diftinctly was a fpecies of opoffum, about twice the fize of a large rat. The kanguroo, found farther northward in New Holland, may alfo be fuppofed to inhabit here, as fome of the inhabitants had pieces of the fkin of that animal. The principal forts of birds in the woods are brown hawks or eagles, crows, large pigeons, yellowifh paroquets, and a fpecies which was called *motacilla cyanea,* from the beautiful azure colour of its head and neck. On the fhore were feveral gulls, black oyfter-catchers or fea-pies, and plovers of a ftone-colour. In the woods were feen fome blackifh fnakes of a pretty large fize; and a fpecies of lizard fifteen inches long and fix round, beautifully clouded with yellow and black. Among a variety of fifh caught, were fome large rays, nurfes, leather-jackets, bream, foles, flounders, gurnards, and elephant-fifh. Upon the rocks are mufcles and

other shell-fish, and upon the beach were found some pretty Medusa's heads. The most troublesome insects met with were the musquitoes; and a large black ant, the bite of which occasions extreme pain.

The inhabitants seemed mild and cheerful, with little of that wild appearance which savages in general have. They are almost totally devoid of personal activity or genius, and are nearly upon a par with the wretched natives of Terra del Fuego. They display, however, some contrivance in their method of cutting their arms and bodies in lines of different directions, raised above the surface of the skin. Their indifference for presents offered them, their general inattention and want of curiosity, were very remarkable, and testified no acuteness of understanding. Their complection is a dull black, which they sometimes heighten by smutting their bodies, as was supposed from their leaving a mark behind on any clean substance. Their hair is perfectly woolly, and is clotted with grease and red ochre like that of the Hottentots. Their noses are broad and full, and the lower part of the face projects considerably. Their eyes are of a moderate size; and though they are not very quick or piercing, they give the countenance a frank, cheerful, and pleasing cast. Their teeth are not very white nor well set, and their mouths are wide: they wear their beards long and clotted with paint. They are upon the whole well proportioned, though their belly is rather protuberant. Their favourite attitude is to stand with one side forward, and one hand grasping across the back the opposite arm, which on this occasion hangs down by the side that projects.

Near the shore in the bay were observed some wretched constructions of sticks covered with bark; but these seemed to have been only temporary, and they had converted many of their largest trees into more comfortable and commodious habitations. The trunks of these were hollowed out to the height of 6 or 7 feet by means of fire. That they sometimes dwell in them was manifest from their hearths in the middle, made of clay, round which four or five persons might sit. These places of shelter are rendered durable by their leaving one side of the tree sound, so that it continues growing with great luxuriance.

DIEMERBROEK (Isbrand), a learned professor of physic and anatomy at Utrecht, was born at Montfort, in Holland, in 1609, where he acquired great reputation by his lectures and his practice; and died at Utrecht in 1674. He wrote a treatise on the plague, which is esteemed; and several learned works in anatomy and medicine, which were printed at Utrecht in 1685 in folio.

DIEPPE, a town of France, in the department of Lower Seine and late province of Normandy, with a good harbour, formed by the mouth of the river Arques, an old castle, and two piers. Packet-boats pass between this port and Brighthelmstone, in time of peace. The church of St. James is a very fine structure, and there is a tower from which in fine weather the coast of England may be seen. The principal trade consists in herrings, whitings, mackarel, ivory toys, and laces. It was bombarded by the English in 1649, and is not now so considerable as formerly. It is 30 miles N. of Rouen, and 132 N. W. of Paris. Lon. 1. 9. E. Lat. 49. 55. N.

DIES MARCHIÆ, was the day of congress or meeting of the English and Scots, annually appointed to be held on the marches or borders, in order to adjust all differences between them.

DIESIS, in music, is the division of a tone less than a semitone; or an interval consisting of a less or imperfect semitone. *Diesis* is the smallest and softest change or inflexion of the voice imaginable: it is called a *faint*, expressed thus X, by a St. Andrew's cross or saltier.

DIESPITER, in antiquity, a name given to Jupiter; and signifying *diei pater*, "father of the day." St. Augustin derives the name from *dies* "day," and *partus* "production, bringing forth;" it being Jupiter that brings forth the day. Of this opinion were Servius and Macrobius; the former adding, that in the language of the Osci they called him *Lucentius*, as *Diespiter* in Latin.

DIET, in medicine, according to some, comprehends the whole regimen or rule of life with regard to the six non-naturals; air, meats and drinks, sleep and watching, motion and rest, passions of the mind, retentions and excretions. Others restrain the term *diet* to what regards eating and drinking, or solid aliments and drinks. See FOOD.

The natural constitution of the body of man is such, that it can easily bear some changes and irregularities without much injury. Had it been otherwise, we should be almost constantly put out of order by every slight cause. It is certain, however, that we constantly do a violence to nature by the inordinate way in which our appetites are indulged. Indeed there are few possessed of the opportunity, who, tempted no less by the varieties of the table than by luxurious habits, do not fall into excesses that tend to produce diseases and abridge the term of their existence.

DIET-*Drinks*, a form in physic, including all the medicated wines, ales, and wheys, used in chronic cases. They require a course or continuation to answer any good intention.

DIET, or *Dyet*, in matters of policy, signifies the general assembly of the states or circles of an empire, to deliberate and concert measures proper to be taken for the good of the public. The general diet of the empire of Germany is usually held at Ratisbon. It consists of the emperor, the nine electors, and the ecclesiastical princes; viz. the archbishops, bishops, abbots, and abbesses; the secular princes, who are dukes, marquises, counts, viscounts, or barons; and the representatives of imperial cities. It meets on the emperor's summons, and any of the princes may send their deputies thither in their stead. The diet makes laws, raises taxes, determines differences between the several princes and states, and can relieve the subjects from the oppressions of their sovereigns.

Before that unfortunate country became a prey to the despots concerned in its partition, the diet of Poland, or the assembly of the states, consisted of the senate and deputies, or representatives of every palatinate or county and city; and usually met every two years, but oftener upon extraordinary occasions, if summoned by the king, or in his absence, by the archbishop of Gnesna. The general diet of Poland sat but six weeks, and often broke up in a tumult much sooner: for one dissenting voice prevented their passing any laws, or coming to any resolutions on what was proposed to them from the throne. Switzerland has also a general diet, which is usually held every year at Baden, and represents the whole Helvetic body: it seldom lasts longer than a month. Besides this general diet, there are diets of the Protestant cantons, and diets of the Catholic ones: the first assemble at Araw, and are convoked by the canton of Zurich; the second at Lucern, convoked by the canton of that name.

DIETETIC, denotes something belonging to diet, but particularly that part of physic which treats of this subject. See DIET, FOOD, and DRINK.

DIETRICH, or DIETRICY (Christian William Ernest), a modern artist, who was born at Wiemar in 1712. He resided chiefly at Dresden, where he was professor of the academy of arts. He was a painter of very extensive abilities, and succeeded both in history and landscape. We have, by him, a great number of small subjects, to the amount of 150 or more, which he engraved from his own compositions, in the style, says Basan, of Ostade of Lairesse, and of Salvator Rosa. Sixty of these etchings are exceedingly rare.

DIETS, a town in the circle of the Upper Rhine in Germany situated on the river Lohn, twenty miles north of Mentz, and subject to the house of Nassau-Orange. E. long. 7. 40. N. lat. 50. 28.

DIEU ET MON DROIT, i. e. *God and my right*, the motto of the royal arms of England, first assumed by king Richard I. to intimate that he did not hold his empire in vassalage of any mortal. It was afterwards taken up by Edward III. and was continued without interruption to the time of the late king William, who used the motto *Je main tiendray*, though the former was still retained upon the great seal. After him queen Anne used the motto *Semper eadem*, which had been before used by queen Elizabeth; but ever since queen Anne, *Dieu et mon droit* continues to be the royal motto.

DIFF, is the name of an instrument of music among the Arabs, serving chiefly to beat time to the voice: it is a hoop, sometimes with pieces of brass fixed to it to make a jingling, over which a piece of parchment is distended. It is struck with the fingers, and is the true *tympanum* of the ancients.

DIFFARREATION, among the Romans, a ceremony whereby the divorce of their priests was solemnized. The word comes from the preposition *dis*; which is used, in composition, for *division* or *separation*; and *farreatio*, a ceremony with wheat, of *far* "wheat." Diffarreation was properly the dissolving of marriages contracted by confarreation; which were those of the pontifices or priests. Festus says, it was performed with a wheaten cake. Vigenere will have confarreation and diffarreation to be the same thing.

DIFFERENCE, in mathematics, is the remainder when one number or quantity is subtracted from another.

DIFFERENCE, in logic, an essential attribute belonging to some species, and not found in the genus; being the idea that defines the species. Thus, body and spirit are the two species of substance, which in their ideas include something more than is included in the idea of substance. In body, for instance, is found impenetrability and extension; in spirit, a power of thinking and reasoning: so that the difference of body is impenetrable extension, and the difference of spirit is cogitation.

DIFFERENCE, in heraldry, a term given to a certain figure added to coats of arms, serving to distinguish one family from another, and to show how distant younger branches are from the elder or principal branch.

DIFFERENTIAL, DIFFERENTIALE, in the higher geometry, an infinitely small quantity, or a particle of quantity so small as to be less than any assignable one. It is called a *differential*, or *differential quantity*, because frequently considered as the difference of two quantities; and, as such, is the foundation of the *differential calculus*. Sir Isaac Newton, and the English, call it a *moment*, as being considered as the momentary increase of quantity. See FLUXIONS.

DIFFORM, DIFFORMIS (from *forma* "shape"), is a word used in opposition to *uniform*; and signifies, that there is no regularity in the form or appearance of a thing. The botanists use it as a distinction of the flowers of several species of plants.

DIFFUSE, an epithet applied to such works as are written in a prolix manner. Among historians, Sallust is reckoned sententious, and Livy diffuse. Thus also among the orators, Demosthenes is close and concise; Cicero, on the other hand, is diffuse.

DIFFUSION, the dispersion of the subtile effluvia of bodies into a kind of atmosphere all round them. Thus the light diffused by the rays of the sun, issues all round from that amazing body of fire.

DIGASTRICUS, in anatomy, a muscle of the lower jaw, called also *Biventer*. See ANATOMY, *Table of the Muscles*.

DIGBY (Sir Kenelm), became very illustrious in the 17th century for his virtue and learning. He was descended of an ancient family in England. His great-grandfather, accompanied by six of his brothers, fought valiantly at Bosworth-field on the side of Henry VII. against the usurper Richard III. His father, Everard, suffered himself to be engaged in the gun-powder plot against king James I. and for that crime was beheaded. His son wiped off that stain, and was restored to his estate. King Charles I. made him gentleman of the bed-chamber, commissioner of the navy, and governor of the Trinity-house. He granted him letters of reprisal against the Venetians, by virtue whereof he took several prizes with a small fleet which he commanded. He fought the Venetians near the port of Scanderoon, and bravely made his way through them with his booty. He was a great lover of learning, and translated several authors into English; and his "Treatise of the Nature of Bodies and the Immortality of the Soul," discovers great penetration and extensive knowledge. He applied to chemistry; and found out several useful medicines, which he gave freely away to people of all sorts, especially to the poor. He degraded himself, however, by his sympathetic powder for the cure of wounds at a distance; his discourse concerning which made a great noise for a while. He had conferences with Des Cartes about the nature of the soul. In the beginning of the civil wars, he exerted himself very vigorously in the king's cause; but he was afterwards imprisoned, by the parliament's order, in Winchester house, and had leave to depart thence in 1643. He afterwards compounded for his estate, but was ordered to leave the nation; when he went to France, and was sent on two embassies to pope Innocent X. from the queen, widow to Charles I. whose chancellor he then was. On the restoration of Charles II. he returned to London; where he died in 1665, aged 60.

DIGEST, DIGESTUM, a collection of the Roman laws, ranged and digested under proper titles, by order of the emperor Justinian. That prince gave his chancellor Tribonianus a commission for this purpose; who, in consequence thereof, chose sixteen jurisconsulti, or lawyers, to assist in the work. These, accordingly, took out the best and finest decisions from the two thousand volumes of the ancient jurisconsulti, and reduced them all into one body; which was published in the year 533, under the name of the *Digest*. To this the emperor gave the force of a law, by a letter at the head of the work, which serves it as a preface. The Digest makes the first part of the Roman law, and the first volume of the corpus or body of the civil law, contained in fifty books. It was translated into Greek under the same emperor, and called *Pandecta*. See PANDECTS. Cujus says, that *Digest* is a common name for all books disposed in a good order and œconomy; and hence it is that Tertullian calls the Gospel of St. Luke a Digest. Hence also abridgments of the common law are denominated *digests* of the numerous cases, arguments, readings, pleadings, &c. dispersed in the year-books, and other reports and books of law, reduced under proper heads or common places. The first was that of Statham; which descends as low as Henry VI.

DIGESTION, in the animal œconomy, is the dissolution of the aliments into such minute parts as are fit to enter the lacteal vessels, and circulate with the mass of blood. See ANATOMY, page 189.

DIGESTION, in chemistry, is an operation which consists in exposing bodies to a gentle heat, in proper vessels, and during a certain time. This operation is very useful to favour the action of certain substances upon each other. See CHEMISTRY.

DIGESTIVE, in surgery, denotes any sort of unguent, plaster, or poultice, that improves the suppuration of ulcers.

DIGGING, among miners, is appropriated to the opera-

tion of freeing any kind of ore from the bed or ſtratum in which it lies, where every ſtroke of their tools turns to account: in contradiſtinction to the openings made in ſearch of ſuch ore, which are called *hatches*, or *eſſay-hatches*; and the operation itſelf, *tracing of mines*, or *hatching*. When a bed of ore is diſcovered, the beele-men, ſo called from the inſtrument they uſe, which is a kind of pick-axe, free the ore from the foſſils around it; and the ſhovel-men throw it up from one ſhamble to another, till it reaches the mouth of the hatch. In ſome mines, to ſave the expence as well as fatigue of the ſhovel-men, they raiſe the ore by means of a winder and two buckets, one of which goes up as the other comes down.

DIGIT, in aſtronomy, the twelfth part of the diameter of the ſun or moon, uſed to expreſs the quantity of an eclipſe. Thus an eclipſe is ſaid to be of ſix digits, when ſix of theſe parts are hid.

Digits, or *Monades*, in arithmetic, ſignify any integer under 10; as 1, 2, 3, 4, 5, 6, 7, 8, 9.

Digit is alſo a meaſure taken from the breadth of the finger. It is properly ¾ths of an inch, and contains the meaſure of four barley-corns laid breadthwiſe.

DIGITALIS, fox glove; a genus of the angioſpermia order, belonging to the didynamia claſs of plants; and in the natural method ranking under the 28th order, *Luridæ*. The calyx is quinquepartite; the corolla campanulated, quinquefid, and ventricoſe; the capſule ovate and bilocular.—There are ſix ſpecies; five of which are hardy, herbaceous, biennial, and perennial plants, and the ſixth a tender ſhrubby exotic. The herbaceous ſpecies riſe two or three feet high, crowned with ſpikes of yellow iron-coloured or purple flowers. The ſhrubby ſort riſes five or ſix feet high, having ſpear-ſhaped rough leaves, four or five inches long, and half as broad; the branches being all terminated with flowers growing in looſe ſpikes. All the ſpecies are eaſily raiſed by ſeeds. An ointment made of the flowers of purple fox-glove and freſh butter, is much commended by ſome ſurgeons for ſcrophulous ulcers, which run much and are ill conditioned. Taken internally, this plant is a violent purgative and emetic; and is therefore only to be adminiſtered to robuſt conſtitutions. An infuſion of two drams of the leaf in a pint of water, given in half-ounce doſes every two hours or ſo, till it begin to puke or purge, is recommended in dropſy, particularly that of the breaſt. It is ſaid to have produced an evacuation of water ſo copious and ſudden, in aſcites, by ſtool and urine, that the compreſſion of bandages was found neceſſary. The uſe of this remedy, however, is thought dangerous by many phyſicians, yet the Edinburgh pharmacopœia has retained it.

DIGITATED, among botaniſts. See Botany, *Gloſſary*; and Plate 55. fig. 4.

DIGLYPH, in architecture, a kind of imperfect triglyph, conſole, or the like; with two channels or engravings, either circular or angular.

DIGNE, a handſome town of France, in the department of the Lower Alps and late province of Provence, with a biſhop's ſee. It is famous for the hot baths that are near it, and is ſeated on the river Bleone, 30 miles S. by W. of Embrun. Lon. 6. 12. E. Lat. 44. 10. N.

DIGNITARY, in the canon law, a perſon who holds a dignity, that is a benefice which gives him ſome pre-eminence over mere prieſts and canons. Such is a biſhop, dean, archdeacon, prebendary, &c.

DIGNITY, as applied to the titles of noblemen, ſignifies honour and authority. And dignity may be divided into ſuperior and inferior; as the titles of duke, earl, baron, &c. are the higheſt names of dignity; and thoſe of baronet, knight, ſerjeant at law, &c. the loweſt. Nobility only can give ſo high a name of dignity as to ſupply the want of a ſurname in legal proceedings; and as the omiſſion of a name of dignity may be pleaded in abatement of a writ, &c. ſo it may be where a peer who has more than one name of dignity, is not named by the moſt noble. No temporal dignity of any foreign nation can give a man a higher title here than that of esquire.

Dignity, in the human character, the oppoſite of *Meanneſs*. Man is endued with a sense of the worth and excellence of his nature: he deems it more perfect than that of the other beings around him; and he perceives that the perfection of his nature conſiſts in virtue, particularly in virtues of the higheſt rank. To expreſs that ſenſe, the term *dignity* is appropriated. Further, to behave with dignity, and to refrain from all mean actions, is felt to be, not a virtue only, but a duty: it is a duty every man owes to himſelf. By acting in that manner, he attracts love and eſteem: by acting meanly, or below himſelf, he is diſapproved and contemned. This ſenſe of the dignity of human nature reaches even our pleaſures and amuſements. If they enlarge the mind by raiſing grand or elevated emotions, or if they humanize the mind by exerciſing our ſympathy, they are approved as ſuited to the dignity of our nature: if they contract the mind by fixing it on trivial objects, they are contemned as not ſuited to the dignity of our nature. Hence, in general, every occupation, whether of uſe or amuſement, that correſponds to the dignity of man, is termed *manly*; and every occupation below his nature, is termed *childiſh*.

Dignity, in oratory, is one of the three parts of general elocution; and conſiſts in the right uſe of tropes and figures. See Oratory.

DIGRESSION, in oratory, is defined by Quintilian, agreeably to the etymology of the word, to be, a going off from the ſubject we are upon to ſome different thing, which, however, may be of ſervice to it. See Oratory.

DIGYNIA, from δις *twice*, and γυνη a *woman*, the name of an order or ſecondary diviſion in each of the firſt 13 claſſes, except the 9th, in Linnæus's ſexual method; conſiſting of plants, which to the claſſic character, whatever it is, add the circumſtance of having two ſtyles or female organs.

DII, in the ancient mythology, a train of divinities which imagination arrayed in different forms, and armed with different powers. They were endowed with underſtanding, and were actuated by the ſame paſſions which daily afflict the human race. The Romans, generally ſpeaking, reckoned two claſſes of the gods, the *dii majorum gentium*, or *dii conſulentes*, and the *dii minorum gentium*. It is obſervable, that all the gods of the ancients have lived upon earth as mere mortals. Even Jupiter, who was the ruler of heaven, is repreſented by the mythologiſts as a helpleſs child: and we are acquainted with all the particulars that attended the birth and education of Juno. In proceſs of time, not only good and virtuous men, who had been the patrons of learning and the ſupporters of liberty, but alſo thieves and pirates, were admitted among the gods, and the Roman ſenate courteouſly granted immortality to the moſt cruel and abandoned of their emperors.

DIJAMBUS, in poetry, the foot of a Latin verſe of four ſyllables; it is compounded of two *iambics*, as *ſĕvērĭtās*.

DIJON, an ancient, handſome, and rich town of France, in the department of Côte d'Or and late province of Burgundy. It was lately an archbiſhopric, but is now the epiſcopal town of the department, and contains 20,000 inhabitants. It has an academy of ſciences and belles-lettres. The public ſtructures, and particularly the churches, are very fine. In front of the former Place Royale, is the ancient palace of the dukes of Burgundy; and at the gates of Dijon is a late Chartreuſe, in which are ſome magnificent tombs of thoſe princes. Dijon is ſeated in a pleaſant plain, which produces excellent wine,

between two ſmall rivers, 48 miles N. E. of Autun. Lon. 5. 7. E. Lat. 47. 19. N.

DIKE, a ditch or drain, made for the paſſage of waters. The word ſeems formed from the verb to *dig;* though others chooſe to derive it from the Dutch, *diik,* a dam, ſea-bank, or wall.

DIKE, or *Dyke,* alſo denotes a work of ſtone, timber or faſcines, raiſed to oppoſe the entrance or paſſage of the waters of the ſea, a river, lake, or the like.—The word comes from the Flemiſh *dyk,* or *diik,* a heap of earth to bound or ſtem the water. Junius and Menage take the Flemiſh to have borrowed their word from the Greek τειχος, *wall.* Guichard derives it from the Hebrew *daghah.* Theſe dikes are uſually elevations of earth, with hurdles of ſtakes, ſtones, and other matters.—The dike of Rochelle is made with veſſels faſtened to the bottom. The dikes of Holland are frequently broken through, and deluge large tracts of land.

DILAPIDATION, in law, a waſteful deſtroying or letting buildings, eſpecially parſonage-houſes, &c. run to decay, for want of neceſſary reparation. If the clergy neglect to repair the houſes belonging to their benefices, the biſhop may ſequeſter the profits thereof for that purpoſe. And in theſe caſes, a proſecution may be brought either in the ſpiritual court or at common law, againſt the incumbent himſelf, or againſt his executor or adminiſtrator.

DILATATION, in phyſics, a motion of the parts of any body, by which it is ſo expanded as to occupy a greater ſpace. This expanſive motion depends upon the elaſtic power of the body; whence it appears that dilatation is different from rarefaction, this laſt being produced by the means of heat.

DILATATORES, in anatomy, a name given to ſeveral muſcles in the human body.

DILATORY, PLEAS, in law, are ſuch as are put in merely for delay; and there may be a demurrer to a dilatory plea, or the defendant ſhall be ordered to plead better, &c. The truth of dilatory pleas is to be made out by affidavit of the fact, &c. by ſtat. 4 and 5 Anne. See PLEA.

DILATRIS, in botany; a genus of the monogynia order, belonging to the triandria claſs of plants. There is no calyx; the corolla has ſix petals, and is ſhaggy; the ſtigma ſimple.

DILEMMA, in logic, an argument equally concluſive by contrary ſuppoſitions. See LOGIC.

DILL, in botany. See ANETHUM.

DILLEMBURGH, a town of Germany, in Wetteravia, and capital of a county of the ſame name. It is ſubject to a prince of the houſe of Naſſau, and is ſituated in E. long. 8. 24. N. lat. 50. 45.

DILLENGEN, a town of Germany, in the circle of Suabia, with an univerſity, and where the biſhop of Augſburg reſides. It is ſeated near the Danube, in E. long. 11. 35. N. lat. 48. 38.

DILLENIA, in botany, a genus of the polygynia order belonging to the polyandria claſs of plants. The calyx is pentaphyllous; the petals five; the capſules numerous, polyſpermous, coalited, and full of pulp.

DIMACHÆ, from δις *double,* and μαχω *I fight,* in antiquity, a kind of horſemen, firſt inſtituted by Alexander. Their armour was lighter than that of the infantry, and at the ſame time heavier than that uſed by horſemen, ſo that they could act as horſe or foot as occaſion required.

DIMENSION, in geometry, is either length, breadth, or thickneſs; hence, a line hath one dimenſion, viz. length; a ſuperficies two, viz. length and breadth; and a body, or ſolid, has three, viz. length, breadth, and thickneſs.

DIMINUTION, in architecture, a contraction of the upper part of a column, by which its diameter is made leſs than that of the lower part.

DIMINUTIVE, in grammar, a word formed from ſome other, to ſoften or diminiſh the force of it, or to ſignify a thing as little in its kind. Thus, *cellule* is a diminutive of *cell,* globule of *globe,* hillock of *hill,* &c.

DIMISSORY LETTERS, *Literæ Dimiſſoriæ,* in the canon law, a letter given by a biſhop to a candidate for holy orders, having a title in his dioceſe, directed to ſome other biſhop, and giving leave for the bearer to be ordained by him. When a perſon produces letters of ordination or tonſure, conferred by any other than his own dioceſan, he muſt at the ſame time produce the letters dimiſſory given by his own biſhop, on pain of nullity. Letters dimiſſory cannot be given by the chapter, *ſede vacante;* this being deemed an act of voluntary juriſdiction, which ought to be reſerved to the ſucceſſor.

DIMŒRITÆ, a name given to the Apollinariſts, who at firſt held, that the Word only aſſumed a human body, without taking a reaſonable ſoul like ours; but being at length convinced by formal texts of ſcripture, they allowed that he did aſſume a ſoul, but without underſtanding; the Word ſupplying the want of that faculty. From this way of ſeparating the underſtanding from the ſoul, they became denominated *dimœrites,* q. d. *dividers, ſeparaters,* of δια and μοιραω, *I divide.*

DINGWAL, a parliament town of Scotland in the ſhire of Roſs. W. long. 4. 15. N. lat. 57. 45.

DINNER, the meal taken about the middle of the day.—The word is derived from the French *diſner,* which Du Cange derives from the barbarous Latin *diſnare.* Henry Stephens derives it from the Greek δειπνειν; and will have it wrote *dipner.* Menage deduces it from the Italian *deſinare* "to dine;" and that from the Latin *deſinere* "to leave off work." It is generally agreed to be the moſt ſalutary to make a ſufficient dinner, and to eat ſparingly at ſupper. This is the general practice among us. The French, however, in imitation of the ancient Romans, defer their good cheer till the evening; and Bernardinus Paternus, an eminent Italian phyſician, maintains it to be the moſt wholeſome method, in a treatiſe expreſsly on the ſubject. The grand Tartar emperor of China, after he has dined, makes publication by his heralds, that he gives leave for all the other kings and potentates of the earth to go to dinner; as if they waited for his leave.

DINOCRATES, a celebrated architect of Macedonia, who rebuilt the temple of Epheſus, when burnt by Eroſtratus, with much more magnificence than before. Vitruvius informs us, that Dinocrates propoſed to Alexander the Great to convert mount Athos into the figure of a man, whoſe left hand ſhould contain a walled city, and all the rivers of the mount flow into his right, and from thence into the ſea? He alſo conceived a ſcheme for building the dome of the temple of Arſinoe at Alexandria, of loadſtone; that ſhould, by its attraction, uphold her iron image in the centre, ſuſpended in the air! projects which at leaſt ſhowed a vaſt extent of imagination.

DIO CHRYSOSTOM, that is, *Golden Mouth,* a celebrated orator and philoſopher of Greece, in the firſt century, was born at Pruſa in Bithynia. He attempted to perſuade Veſpaſian to quit the empire; was hated by Domitian; but acquired the eſteem of Trajan. This laſt prince took pleaſure in converſing with him, and made him ride with him in his triumphal chariot. There are ſtill extant 80 of Dio's orations, and ſome other of his works; the beſt edition of which is that of Hermand Samuel Raimarus, in 1750, in folio.

DIOCESE, or DIOCESS, the circuit or extent of the juriſdiction of a BISHOP.—The word is formed from the Greek διοικησις *government, adminiſtration;* formed of διοικεω, which the ancient gloſſaries render *adminiſtro, moderor, ordino:* hence διοικησις της πολεως, the *adminiſtration* or *government of a city.*

Diocese is alſo uſed in ancient authors, &c. for the province of a metropolitan. *Diocæſis*, διοικησις, was originally a civil government, or prefecture, compoſed of different provinces. The firſt diviſion of the empire into dioceſes is ordinarily aſcribed to Conſtantine; who diſtributed the whole Roman ſtate into four, viz. the dioceſe of Italy, the dioceſe of Illyria, that of the Eaſt, and that of Africa. And yet, long before Conſtantine, Strabo, who wrote under Tiberius, takes notice, that the Romans had divided Aſia into dioceſes; and complains of the confuſion ſuch a diviſion occaſioned in geography, Aſia being no longer divided by people, but by dioceſes, each whereof had a tribunal or court, where juſtice was adminiſtered. Conſtantine, then, was only the inſtitutor of thoſe large dioceſes, which comprehended ſeveral metropoles and governments; the former dioceſes only comprehending one juriſdiction or diſtrict, or the country that had reſort to one judge, as appears from this paſſage in Strabo, and (before Strabo) from Cicero himſelf, lib. iii. *epiſt. ad famil.* 9. and lib. xiii. *ep.* 67.

Thus, at firſt, a province included many dioceſes; and afterwards a dioceſe came to compriſe ſeveral provinces. In after times the Roman empire became divided into 13 dioceſes or prefectures; though, including Rome, and the ſuburbicary regions, there were 14. Theſe 14 dioceſes comprehended 120 provinces: each province had a proconſul, who reſided in the capital or metropolis; and each dioceſe of the empire had a conſul, who reſided in the principal city of the diſtrict. On this civil conſtitution, the eccleſiaſtical one was afterwards regulated: each dioceſe had an eccleſiaſtical vicar or primate, who judged finally of all the concerns of the church within his territory. At preſent there is ſome further alteration: for dioceſe does not now ſignify an aſſemblage of provinces; but is limited to a ſingle province under a metropolitan, or more commonly to the ſingle juriſdiction of a biſhop. Gul. Brito affirms dioceſe to be properly the territory and extent of a baptiſmal or parochial church, whence ſome authors uſe the word to ſignify a ſimple pariſh. See Parish.

DIOCLEIA, Διοκλεια, in antiquity, a ſolemnity kept in the ſpring at Megara, in memory of the Athenian hero, who died in the defence of the youth he loved.

DIOCLESIANUS (Caius Valerius Jovius), a celebrated Roman emperor born of an obſcure family in Dalmatia in 245. He was firſt a common ſoldier, and by merit and ſucceſs gradually roſe to the rank of a general; and at the death of Numerian in 284 he was inveſted with imperial power.

DIOCTAHEDRIA, in natural hiſtory, a genus of pellucid and cryſtalliform ſpars, compoſed of two octangular pyramids, joined baſe to baſe, without any intermediate column. Of theſe ſome have long pyramids, others ſhort and ſharp-pointed ones, and others ſhort and obtuſe-pointed ones; the two former ſpecies being found in the Hartz-foreſt, and the laſt in the mines of Cornwall.

DIODATI (John), a famous miniſter, and profeſſor of theology at Geneva, was born at Lucca in 1579, and died at Geneva in 1652. He is diſtinguiſhed by tranſlations, 1. of the Bible into Italian, with notes, Geneva 1607, 4to. the beſt edition at Geneva in 1641, folio. This is ſaid to be more a paraphraſe than a tranſlation, and the notes rather divine meditations than critical reflections. 2. Of the Bible into French, Geneva, 1644. 3. Of Father Paul's Hiſtory of the Council of Trent into French.

DIODIA, in botany, a genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 47th order, *Stellatæ*. The corolla is monopetalous and funnel-ſhaped; the capſule bilocular and diſpermous.

DIODON, or sun-fish, in ichthyology, a genus belonging to the order of amphibia nantes.

There are three *ſpecies*. 1. The *oblong* ſun-fiſh grows to a great bulk: one examined by Sylvianus was above 100 pounds in weight; and Dr. Borlaſe mentions another taken at Plymouth in 1734, that weighed 500. In form it reſembles a bream or ſome deep fiſh cut off in the middle. The mouth is very ſmall, and contains in each jaw two broad teeth, with ſharp edges. The eyes are little; before each is a ſmall ſemilunar aperture; the pectoral fins are very ſmall, and placed behind them. The colour of the back is duſky, and dappled; the belly ſilvery: between the eyes and the pectoral fins are certain ſtreaks pointing downwards. The ſkin is free from ſcales. When boiled, it has been obſerved to turn into a glutinous jelly, reſembling boiled ſtarch when cold, and ſerved the purpoſes of glue on being tried on paper and leather. The meat of this fiſh is uncommonly rank: it feeds on ſhell-fiſh. There ſeems to be no ſatisfactory reaſon for the old Engliſh name. Care muſt be taken not to confound it with the ſun-fiſh of the Iriſh (ſee Squalus), which differs in all reſpects from this. 2. The *mola*, or ſhort ſun-fiſh, differs from the former, in being much ſhorter and deeper. The back and the anal fins are higher, and the aperture to the gills not ſemilunar, but oval. The ſituation of the fins is the ſame in both; and both are taken on the weſtern coaſts of this kingdom, but in much greater numbers in the warmer parts of Europe. 3. The *levigatus*, or globe, is common to Europe and South Carolina. As yet only a ſingle ſpecimen has been diſcovered in our ſeas; taken at Penzance in Cornwall. See Plate 2. The length was one foot ſeven: the length of the belly, when diſtended, one foot; the whole circumference in that ſituation two feet ſix. The form of the body is [illegible]ally oblong; but when alarmed, it has the power of inflating its belly to a globular ſhape of great ſize. This ſeems deſigned as a means of defence againſt fiſh of prey; as they have leſs means of laying hold of it; and are beſides terrified by the number of ſpines with which that part is armed, and which are capable of being erected on every part. The mouth is ſmall: the irides white, tinged with red: the back from head to tail almoſt ſtraight, or at leaſt very ſlightly elevated; of a rich deep blue colour. It has the pectoral, but wants the ventral fins: the tail is almoſt even, divided by an angular projection in the middle; tail and fins brown. The belly and ſides are white, ſhagreened or wrinkled: and beſet with innumerable ſmall ſharp ſpines, adhering to the ſkin by four proceſſes.

DIODORUS, an hiſtorian, ſurnamed *Siculus*, becauſe he was born at Argyra in Sicily. He wrote an hiſtory of Egypt, Perſia, Syria, Media, Greece, Rome, and Carthage; and it is ſaid that he viſited all the places of which he has made mention in his hiſtory. It was the labour of 30 years. He is, however, too credulous in ſome of his narrations; and often wanders far from the truth. He often dwells too long upon fabulous reports and trifling incidents; while events of the greateſt importance to hiſtory are treated with brevity, and ſometimes paſſed over in ſilence. He lived in the age of Julius Cæſar and Auguſtus; and ſpent much time at Rome to procure information, and authenticate his hiſtorical narrations. This important work, which he compoſed in Greek, contained 40 books, of which there are only 15 remaining. The ſtyle is clear and neat, and very ſuitable to hiſtory. The beſt edition is that of Amſterdam, 1743, in two vols. folio.

DIŒCIA, from δις *twice*, and οικια a *houſe* or *habitation*, two houſes. The name of the 22d claſs in Linnæus's ſexual method; conſiſting of plants which, having no hermaphrodite flowers, produce male and female flowers on ſeparate roots. Theſe latter only ripen ſeeds; but require for that purpoſe, according to the ſexualiſts, the vicinity of a male plant; or the aſperſion, that is, ſprinkling, of the male duſt. From the ſeeds of the female flowers are raiſed both male and female plants. The plants then in the claſs diœcia are all male and female; not hermaphrodite, as in the greater

number of classes; nor with male and female flowers upon one root, as in the class monœcia of the same author. See BOTANY.

DIOGENES of Apollonia, in the island of Crete, held a considerable rank among the philosophers who taught in Ionia before Socrates appeared at Athens. He was the scholar and successor of Anaximenes, and in some measure rectified his master's opinion concerning air being the cause of all things. It is said that he was the first who observed that air was capable of condensation and rarefaction. He passed for an excellent philosopher, and died about the 450th year before the Christian æra.

DIOGENES, the Cynic, a famous philosopher, was the son of a banker of Sinope in Pontus. Being banished with his father for coining false money, he retired to Athens, where he studied philosophy under Antisthenes. He added new degrees of austerity to the sect of the Cynics, and never did any philosopher carry so far a contempt for the conveniencies of life. He was one of those extraordinary men who run every thing to extremity, without excepting even reason itself; and who confirm the saying, that "there is no great genius without a tincture of madness." He lodged in a tub; and had no other moveables besides his staff, wallet, and wooden bowl, which last he threw away on seeing a boy drink out of the hollow of his hand. He used to call himself a vagabond, who had neither house nor country; was obliged to beg, was ill clothed, lived from hand to mouth: and yet, says Ælian, he took as much pride in these things as Alexander could in the conquest of the world. He was not indeed a jot more humble than those who are clothed in rich apparel, and fare sumptuously every day. He looked down on all the world with scorn; he magisterially censured all mankind, and thought himself unquestionably superior to all other philosophers. Alexander one day paid him a visit, and made him an offer of riches or any thing else: but all that the philosopher requested of him was, to stand from betwixt the sun and him. As if he had said, "Do not deprive me of the benefits of nature, and I leave to you those of fortune." The conqueror was so affected with the vigour and elevation of his soul, as to declare, that "if he was not Alexander he would choose to be Diogenes:" that is, if he was not in possession of all that was pompous and splendid in life, he would, like Diogenes, heroically despise it.

DIOGENES *Laertius*, so called from Laerta in Cilicia where he was born, an ancient Greek author, who wrote ten books of the Lives of the Philosophers, still extant. In what age he flourished, is not easy to determine. The oldest writers who mention him are Sopater Alexandrinus, who lived in the time of Constantine the Great, and Hesychius Milesius, who lived under Justinian. There have been several editions of his Lives of the Philosophers; but the best is that printed in two volumes 4to, at Amsterdam, in 1693.

DIOMEDIA, in ornithology, a genus belonging to the order of anseres. The bill is straight; the superior mandible is crooked at the point, and the lower one is truncated; the nostrils are oval, open, a little prominent, and placed on the sides. There are two species, viz. 1. The *exulans*, has pinnated wings, and three toes on each foot. It is the albatross of Edwards; and is about the size of a pelican. These birds are found in the ocean betwixt the tropics and at the Cape of Good Hope. They are also often seen in vast flocks in Kamtschatka, and adjacent islands, about the end of June, where they are called *Great Gulls*; but it is chiefly in the bay of Penschinensi, the whole inner sea of Kamtschatka, the Kurile isles, and that of Bering; for on the eastern coasts of the first they are scarce, a single straggler only appearing now and then. Their chief motive for frequenting these places seems to be plenty of food; and their arrival is a sure presage of shoals of fish following. At their first coming they are very lean, but soon grow immensely fat. They are voracious birds, and will often swallow a salmon of four or five pounds weight; but as they cannot take the whole of it into the stomach at once, part of the tail end will often remain out of the mouth; and the natives, finding the bird in this situation, make no difficult matter of knocking it on the head on the spot. Before the middle of August they migrate elsewhere. They are often taken by means of a hook baited with a fish; but it is not for the sake of their flesh that they are valued, it being hard and unsavoury, but on account of the intestines, a particular part of which they blow up as a bladder, to serve as floats to buoy up their nets in fishing. Of the bones they make tobacco-pipes, needle-cases and other useful things. When caught, they defend themselves stoutly with their bills. Their cry is harsh and disagreeable, not unlike the braying of an ass. The breeding places of the albatross, if at all in the northern hemisphere, have not yet been pointed out; but we are certain of their multiplying in the southern, viz. Patagonia and Falkland islands: to this last place they come about the end of September or beginning of October, among other birds, in great abundance. The nests are made on the ground with earth, are round in shape, a foot in height, indented at top. The egg is larger than that of a goose, four inches and a half long, white, marked with dull spots at the large end; and is thought to be good food, the white never growing hard with boiling. While the female is sitting, the male is constantly on the wing, and supplies her with food: during this time they are so tame as to suffer themselves to be shoved off the nest while their eggs are taken from them; but their chief destruction arises from the hawk, which, the moment the female gets off the nest, darts thereon, and flies away with the egg. The albatross itself likewise has its enemy, being greatly persecuted, while on the wing, by the dark grey gull called *skua*. 2. The *demersa*, has no quill-feathers on the wings; and the feet have four toes, connected together by a membrane. It is the black penguin of Edwards, about the size of a goose, and is found at the Cape of Good Hope. It is an excellent swimmer and diver; but hops and flutters in a strange awkward manner on the land, and, if hurried, stumbles perpetually, and frequently runs for some distance like a quadruped, making use of the wings instead of legs, till it can recover its upright posture; crying out at the same time like a goose, but in a much hoarser voice. It is said to clamber some way up the rocks in order to make its nest; in doing which, it has been observed to assist with its bill. The eggs are two in number, white, as large as those of a duck, and reckoned delicious eating; at least they are thought so at the Cape, where they are brought in great numbers for that purpose. At this place the birds are often kept tame; but in general they do not survive the confinement many months.

DIOMEDES, son of Tydeus and Deiphyle, was king of Ætolia, and one of the bravest of the Grecian chiefs in the Trojan war.

DION, a Syracusan, son of Hipparinus, famous for his power and abilities. He was related to Dionysius, and often advised him, together with the Philosopher Plato, to lay aside the supreme power. His great popularity rendered him odious in the eyes of the tyrants, who banished him to Greece. There he collected a numerous force, and actually freed his country from tyranny; though he was at last shamefully betrayed and murdered by one of his familiar friends called *Callicrates*, or *Callippus*, 354 years before the Christian æra.

DION CASSIUS, a native of Nicæa in Bithynia. His father's name was Apronianus. He was raised to the greatest offices of state in the Roman empire by Pertinax, and his three

fucceſſors. He was naturally fond of ſtudy, and he improved himſelf by unwearied application. He wrote an elaborate hiſtory of Rome, which began with the arrival of Æneas in Italy, and was carried down to the reign of the emperor Alexander Severus. His ſtyle is pure and elegant, and his reflections learned; but, upon the whole, he is credulous, and the bigoted ſlave of partiality, ſatire, and flattery.

DIONIS (Peter), a famous ſurgeon, born at Paris, diſtinguiſhed himſelf by his ſkill in his profeſſion, and by his works; the principal of which are, 1. A courſe of operations in ſurgery; 2. The anatomy of man; and, 3. A treatiſe on the manner of aſſiſting women in child-birth. He died in 1718.

DIONÆA MUSCIPULA, or *Venus's Fly-trap*, in botany, a newly diſcovered ſenſitive plant, in the conſtruction of which nature ſeems to have had ſome view towards its nouriſhment, in forming the upper joint of its leaf like a machine to catch food; and placing upon the middle of it the bait for the unhappy inſect that becomes its prey. Many minute red glands that cover its inner ſurface, and which perhaps diſcharge ſome ſweet liquor, tempt the poor inſect to taſte them; and the inſtant theſe tender parts are irritated by its feet, the two lobes riſe up, graſp it faſt, lock the two rows of ſpines together, and ſqueeze it to death. And further, leſt the ſtrong efforts for life, in the creature thus taken, ſhould ſerve to diſengage it, three ſmall erect ſpines are fixed near the middle of each lobe among the glands, that effectually put an end to all its ſtruggles. Nor do the lobes ever open again, while the dead animal continues there. But it is nevertheleſs certain, that the plant cannot diſtinguiſh an animal from any other ſubſtance; for if we put a ſtraw or a pin between the lobes, it will graſp it full as faſt as if it was an inſect.—The plant is one of the monogynia order, belonging to the decandria claſs. It grows in America, about 35 deg. N. lat. in wet ſhady places, and flowers in July and Auguſt. The largeſt leaves are about three inches long, and an inch and a half acroſs the lobes: the glands of thoſe expoſed to the ſun are of a beautiful red colour; but thoſe in the ſhade are pale and inclining to green. The roots are ſquamous, ſending forth but few fibres, and are perennial. The leaves are numerous, inclining to bend downwards, and are placed in a circular order; they are jointed and ſucculent; the lower joint, which is a kind of ſtalk, is flat, longiſh, two-edged, and inclining to heart-ſhaped. In ſome varieties they are ſerrated on the edges near the top. The upper joint conſiſts of two lobes; each lobe is of a ſemi-oval form, with their margins furniſhed with ſtiff hairs like eye-brows, which embrace or lock in each other when they cloſe: this they do when they are inwardly irritated. The upper ſurfaces of theſe lobes are covered with ſmall red glands; each of which appears, when highly magnified, like a compreſſed arbutus berry.—Among the glands, about the middle of each lobe, are three very ſmall erect ſpines. When the lobes incloſe any ſubſtance, they never open again while it continues there. If it can be ſhoved out ſo as not to ſtrain the lobes, they expand again; but if force is uſed to open them, ſo ſtrong has nature formed the ſpring of their fibres that one of the lobes will generally ſnap off rather than yield. The ſtalk is about ſix inches high, round, ſmooth, and without leaves; ending in a ſpike of flowers. The flowers are milk white, and ſtand on footſtalks, at the bottom of which is a little painted bractea or flower-leaf. The ſoil in which it grows, as appears from what comes about the roots of the plants when they are brought over, is a black light mould, intermixed with white ſand, ſuch as is uſually found in our mooriſh heaths. Being a ſwamp plant, a north-eaſt aſpect will be propereſt for it at firſt, to keep it from the direct rays of the ſun; and in winter, till we are acquainted with what cold weather it can endure, it will be neceſſary to ſhelter it with a bell glaſs, ſuch as is uſed for melons. This ſhould be covered with ſtraw or a mat in hard froſts. By this means ſeveral of theſe plants have been preſerved through the winter in a very vigorous ſtate. Its ſenſitive quality will be found in proportion to the heat of the weather, as well as the vigour of the plant. Our ſummers are not warm enough to ripen the ſeed; or poſſibly we are not yet ſufficiently acquainted with the culture of it.

DIONYSIA, in Grecian antiquity, ſolemnities in honour of Bacchus, ſometimes called by the general name of *Orgia*; and by the Romans *Bacchanalia*, and *Liberalia*. See BACCHANALIA and BACCHUS.

DIONYSIACA, in antiquity, was a deſignation given to plays and all manner of ſports acted on the ſtage; becauſe play-houſes were dedicated to Dionyſius, *i. e.* Bacchus and Venus, as being the deities of ſports and pleaſure.

DIONYSIAN PERIOD. See CHRONOLOGY.

DIONYSIUS I. from a private ſecretary became general and tyrant of Syracuſe and all Sicily. He was likewiſe a poet; and having, by bribes, gained the tragedy-prize at Athens, he indulged himſelf ſo immoderately at table from exceſs of joy, that he died of the debauch, 386 B. C. but ſome authors relate, that he was poiſoned by his phyſicians. His ſon and ſucceſſor, a greater tyrant than his father, was conquered by Timoleon and fled to Athens, where he was obliged to keep a ſchool for ſubſiſtence. He died 343 B. C.

DIONYSIUS (Halicarnaſſenſis), a celebrated hiſtorian, and one of the moſt judicious critics of antiquity, was born at Halicarnaſſus; and went to Rome after the battle of Actium, where he ſtaid 22 years under the reign of Auguſtus. He there compoſed in Greek his Hiſtory of the Roman Antiquities, in 20 books, of which the firſt 11 only are now remaining. There are alſo ſtill extant ſeveral of his critical works. The beſt edition of the works of this author is that of Oxford, in 1704, in Greek and Latin, by Dr. Hudſon.

DIONYSIUS, a learned geographer, to whom is attributed a Periegeſis, or Survey of the earth, in Greek verſe. Some ſuppoſe that he lived in the time of Auguſtus; but Scaliger and Saumaſius place him under the reign of Severus, or Marcus Aurelius.

DIOPHANTINE PROBLEMS, in mathematics, certain queſtions relating to ſquare and cube numbers, and right-angled triangles, &c. the nature of which was determined by Diophantus, a mathematician of Alexandria, who is believed to have lived about the third century. In theſe queſtions it is endeavoured to find commenſurable numbers to anſwer indeterminate problems; which bring out an infinite number of incommenſurable quantities. For example, it is propoſed to find a right-angled triangle, whoſe ſides x, y, z, are expreſſed by commenſurable numbers; it is known that $x^2+y^2=z^2$, z being the ſuppoſed hypothenuſe. But it is poſſible to aſſume x and y ſo, that z will be incommenſurable; for if $x=1$, and $y=2$, $z=\sqrt{5}$. The art of reſolving ſuch problems conſiſts in managing the unknown quantity or quantities in ſuch a manner, that the ſquare or higher power may vaniſh out of the equation, and then by means of the unknown quantity in its firſt dimenſion, the equation may be reſolved without having recourſe to incommenſurables. For the reſolution of ſuch kind of problems, ſee Saunderſon's Algebra, vol. ii. book 6.

DIOPTRICS,

THAT part of Optics which treats of the laws of refraction, and the effects which the refraction of light has in viſion. The word is originally Greek, formed of δια *per*, "through," and οπτομαι *I ſee.*—As this and the other branches of Optics are fully treated under the collective name, we ſhall here, 1. juſt give a ſummary of the general principles of the ſcience, in a few plain aphoriſms, with ſome preliminary definitions; and, 2. preſent our readers with a ſet of entertaining experiments illuſtrative of, or dependent upon, thoſe principles.

Definitions.—1. When a ray of light paſſing out of one medium into another of a different denſity, is turned from that ſtraight line in which it would otherwiſe proceed into one of a different direction, it is ſaid to be refracted. Thus the rays AB, AC, &c. Pl. 3. fig. 1. by paſſing out of air into the glaſs BGC, are turned from their natural courſe into that of BF, CF, &c. and are therefore ſaid to be refracted by the lens BGC.—2. Any ſpherical tranſparent glaſs, that converges or diverges the rays of light as they paſs through it, is called a *lens*.—3. Of lenſes there are five ſorts: 1. A plane or ſingle convex lens, which is plane on one ſide and convex on the other; as AZ, fig. 2. 2. A double convex lens, as B. 3. A plano-concave lens, that is, plane on one ſide and concave on the other, as C. 4. A double concave, as D. And, 5. A meniſcus, which is convex on one ſide and concave on the other, as E.——4. The point C, round which the ſpherical ſurface of a lens, as AZ, is deſcribed, is called its *centre*; the line XY, drawn from that centre perpendicular to its two ſurfaces, is the axis; and the point V, to which the axis is drawn, is the vertex of that lens.—5. When the rays of light that paſs through a ſingle or double convex lens are brought into their ſmalleſt compaſs, that point is the focus of the lens.—6. In optical inſtruments, that lens which is next the object is called the *object-glaſs*; and that next the eye, the *eye-glaſs*.—7. The diſtance between the line AB fig. 3. and the perpendicular EF, is called the *angle of incidence*; and the diſtance between the line BD and the perpendicular EF, is called the *angle of refraction*.

Aphorisms.—1. A ray of light paſſing obliquely out of one medium into another that is denſer, will be refracted toward the perpendicular; as the ray AB, by paſſing out of air into glaſs, is refracted into BD, inclined to the perpendicular EF. On the contrary, a ray paſſing out of a denſer into a rarer medium, will be refracted from the perpendicular; as the ray BD, paſſing out of the glaſs GH into air, is refracted into D I.—2. The ſines of the angles of incidence and refraction, when the lines that contain them are all equal, will have a determinate proportion to each other, in the ſame mediums: which between air and water will be as 4 to 3; between air and glaſs, as 3 to 2, nearly; and in other mediums in proportion to their denſities.—3. Any object viewed through a glaſs, whoſe two ſurfaces are parallel, will appear of its natural ſhape and dimenſions, provided it be only of the ſize of the pupil of the eye, and the light proceeding from it be received directly through the glaſs by one eye only. In all other ſituations an alteration will be perceived not only in its apparent ſituation, but its dimenſions alſo. This alteration will be greater in proportion to the thickneſs of the glaſs, and the obliquity of the rays; in general, it is ſo ſmall as to be overlooked.—4. All the rays of light which fall upon a convex lens, whether parallel, converging, or diverging to a certain degree, will be made to meet in a focus on the other ſide; but if they diverge exceſſively, they will not do ſo. Thus if rays diverge from a point placed before the glaſs, at the focal diſtance from it, they will become parallel after paſſing through it; and if the point from which they proceed be nearer the glaſs than its focal diſtance, they will ſtill continue to diverge, though in a leſs degree than before.—5. When parallel rays fall upon a concave lens, they will be made to diverge after paſſing through it. If they are diverging already before they fall upon the glaſs, they will diverge more after paſſing through it; or even if they are converging to a certain degree, they will diverge upon paſſing through a concave lens; but if the convergence is very great, they will converge after paſſing through the glaſs, though to a more diſtant point than that at which they would otherwiſe have met.—6. When an object is viewed through two convex lenſes, its apparent diameter ought to be to its real one as the diſtance of the focus of the object-glaſs is to that of the eye-glaſs; but by reaſon of the aberration of the rays of light, the magnifying power will be ſomewhat greater or leſs in proportion to the diameter of the object.—By theſe aphoriſms we are enabled to account for the various effects of dioptric machines, as refracting teleſcopes, microſcopes, the camera obſcura, &c. See Optics.

ENTERTAINING EXPERIMENTS.

I. *Optical Illuſions.*—On the bottom of the veſſel ABCD, Pl. 3. fig. 4. place three pieces of money, as a ſhilling, a half-crown, and a crown; the firſt at E, the ſecond at F, and the laſt at G. Then place a perſon at H, where he can ſee no farther into the veſſel than I: and tell him, that by pouring water into the veſſel you will make him ſee three different pieces of money; bidding him obſerve carefully whether any money goes in with the water. Here you muſt obſerve to pour in the water very gently, or contrive to fix the pieces, that they may not move out of their places by its agitation. When the water comes up to K, the piece at E will become viſible; when it comes up to L, the pieces at E and F will appear; and when it riſes to M, all the three pieces will be viſible. From what has been ſaid of the refraction of light, the cauſe of this phenomenon will be evident: for while the veſſel is empty, the ray HI will naturally proceed in a ſtraight line: but in proportion as it becomes immerſed in water, it will be neceſſarily refracted into the ſeveral directions NE, OF, PG, and conſequently the ſeveral pieces muſt become viſible.

II. *Optical Augmentation.*—Take a large drinking-glaſs of a conical figure, that is, ſmall at bottom and wide at top; in which put a ſhilling, and fill the glaſs about half full with water: then place a plate on the top of it, and turn it quickly over, that the water may not get out. You will then ſee on the plate, a piece of the ſize of a half-crown; and ſomewhat higher up, another piece of the ſize of a ſhilling. This phenomenon ariſes from ſeeing the piece through the conical ſurface of the water at the ſide of the glaſs, and through the flat ſurface at the top of the water, at the ſame time: for the conical ſurface dilates the rays, and makes the piece appear larger;

but by the flat furface the rays are only refracted, by which the piece is feen higher up in the glafs, but ftill of its natural fize. That this is the caufe will be farther evident by filling the glafs with water; for as the fhilling cannot be then feen from the top, the large piece only will be vifible.

III. *Optical Subtraction.*—Againft the wainfcot of a room fix three fmall pieces of paper, as A. B, C, fig. 5, at the height of your eye; and placing yourfelf directly before them, fhut your right eye and look at them with the left; when you will fee only two of thofe papers, fuppofe A and B; but altering the pofition of your eye, you will then fee the third and one of the firft, fuppofe A; and by altering your pofition a fecond time, you will fee B and C; but never all three of them together. The caufe of this phenomenon is, that one of the three pencils of rays that come from thefe objects, falls conftantly on the optic nerve at D; whereas to produce diftinct vifion, it is neceffary that the rays of light fall on fome part of the retina E, F, G, H. We fee by this experiment, one of the ufes of having two eyes; for he that has only one, can never fee three objects placed in this pofition, nor all the parts of one object of the fame extent, without altering the fituation of his eye.

IV. *Alternate Illufion.*—With a convex lens of about an inch focus, look attentively at a filver feal, on which a cipher is engraved. It will at firft appear cut in, as to the naked eye; but if you continue to obferve it fome time, without changing your fituation, it will feem to be in relief, and the lights and fhades will appear the fame as they did before. If you regard it with the fame attention ftill longer, it will again appear to be engraved: and fo on alternately.

If you look off the feal for a few moments, when you view it again, inftead of feeing it, as at firft, engraved, it will appear in relief. If, while you are turned toward the light, you fuddenly incline the feal, while you continue to regard it, thofe parts that feemed to be engraved will immediately appear in relief: and if, when you are regarding thefe feeming prominent parts, you turn yourfelf fo that the light may fall on the right hand, you will fee the fhadows on the fame fide from whence the light comes, which will appear not a little extraordinary. In like manner the fhadows will appear on the left, if the light fall on that fide. If, inftead of a feal, you look at a piece of money, thefe alterations will not be vifible, in whatever fituation you place yourfelf.

It has been fufpected that this illufion arifes from the fituation of the light: it ftill, however, remains to be explained, why we fee it alternately hollow and prominent, without changing either the fituation or the light.

V. *The Dioptrical Paradox.*—A new and curious optical deception has been made by Mr. Jones. Its effect is, that a print, or an ornamented drawing, with any object, fuch as an *ace of diamonds*, &c. in the centre F, will be feen as the *ace of clubs* when it is placed in the machine fig. 6, ABDC, and viewed through a fingle glafs only, contained in the tube E. The conftruction of this machine is truly fimple. The glafs in the tube E, which brings about this furprifing change, is fomewhat on the principle of the common multiplying glafs, as reprefented at G, which by the number of its inclined furfaces, and from the refractive power of the rays proceeding from the objects placed before it, fhows it in a multiplied ftate or quantity. Its only difference is, that the fides of this glafs are flat, and diverge upwards from the bafe to a point in the axis of the glafs like a cone: the number of the fides is fix; and each fide, from its angular pofition to the eye, has the property of refracting, from the border of the print F, fuch a portion of it (defignedly there placed), as will make a part in the compofition of the figure to be reprefented: for the hexagonal and conical figure of this glafs prevents any part of the ace of diamonds in the centre being feen; confequently the ace of clubs being previoufly and mechanically drawn in the circle of refraction in fix different parts of the border, at 1, 2, 3, 4, 5, 6, and artfully difguifed in the ornamental border by blending them with it, the glafs in the tube at E will change the appearance of the ace of diamonds F, into the ace of clubs G. In the fame manner may other prints undergo fimilar changes, according to the will of an ingenious draughtfman who may defign them. The figure of the glafs is clearly fhown at H.

VI. *The Camera Obfcura, or Dark Chamber.*—Make a circular hole in the fhutter of a window, from whence there is a profpect of the fields, or any other object not too near; and in this hole place a convex glafs, either double or fingle, whofe focus is at the diftance of five or fix feet *. Take care that no light enter the room but by this glafs: at a diftance from it, equal to that of its focus, place a pafteboard, covered with the whiteft paper; which fhould have a black border, to prevent any of the fide rays from difturbing the picture. Let it be two feet and a half long, and 18 or 20 inches high: bend the length of it inwards, to the form of part of a circle, whofe diameter is equal to double the focal diftance of the glafs. Then fix it on a frame of the fame figure, and put it on a moveable foot, that it may be eafily fixed at that exact diftance from the glafs where the objects paint themfelves to the greateft perfection. When it is thus placed, all the objects that are in the front of the window will be painted on the paper, in an inverted pofition †, with the greateft regularity and in the moft natural colours.

If you place a moveable mirror without the window; by turning it more or lefs, you will have on the paper all the objects that are on each fide of the window. If inftead of placing the mirror without the window, you place it in the room, and above the hole (which muft then be made near the top of the fhutter), you may receive the reprefentation on a paper placed horizontally on a table; and draw, at your leifure, all the objects that are there painted. Nothing can be more pleafing than this experiment, efpecially when the objects are ftrongly enlightened by the fun: and not only land-profpects, but a fea-port, when the water is fomewhat agitated, or at the fetting of the fun, prefents a very delightful appearance.

This reprefentation affords the moft perfect model for painters, as well for the tint of colours, as that degradation of fhades, occafioned by the interpofition of the air, which has been fo juftly expreffed by fome modern painters. It is neceffary that the paper have a circular form; for otherwife, when the centre of it was in the focus of the glafs, the two fides would be beyond it, and confequently the images would be

* The diftance fhould not be lefs than three feet; for, if it be, the images will be too fmall, and there will not be fufficient room for the fpectators to ftand conveniently. On the other hand, the focus fhould never be more than 15 or 20 feet, for then the images will be obfcure, and the colouring faint. The beft diftance is from 6 to 12 feet.

† This inverted pofition of the images may be deemed an imperfection, but it is eafily remedied: for if you ftand above the board on which they are received, and look down on it, they will appear in their natural pofition: or if you ftand before it, and, placing a common mirror againft your breaft in an oblique direction, look down in it, you will there fee the images erect, and they will receive an additional luftre from the reflection of the glafs; or place two lenfes, in a tube that draws out; or, laftly, if you place a large concave mirror at a proper diftance before the picture, it will appear before the mirror, in the air, and in an erect pofition.

confuſed. If the frame were contrived of a ſpherical figure, and the glaſs were in its centre, the repreſentation would be ſtill more accurate. If the object without be at the diſtance of twice the focal length of the glaſs, the image in the room will be of the ſame magnitude with the object. The lights, ſhades, and colours, in the camera obſcura, appear not only juſt, but, by the images being reduced to a ſmaller compaſs, much ſtronger than in nature. Add to this, that theſe pictures exceed all others, by repreſenting the motion of the ſeveral objects: thus we ſee the animals walk, run, or fly; the clouds float in the air; the leaves quiver; the waves roll, &c. and all in ſtrict conformity to the laws of nature. The beſt ſituation for a dark chamber is directly north, and the beſt time of the day is noon.

VII. *To ſhow the Spots on the Sun's Diſk, by its Image in the Camera Obſcura.*—Put the object glaſs of a 10 or 12 feet teleſcope into the ſcioptric ball, and turn it about till it be directly oppoſite to the ſun. Then place the paſteboard, mentioned in the laſt experiment, in the focus of the lens; and you will ſee a clear bright image of the ſun, of about an inch diameter, in which the ſpots on the ſun's ſurface will be exactly deſcribed. As this image is too bright to be ſeen with pleaſure by the naked eye, you may view it through a lens whoſe focus is at ſix or eight inches diſtance; which, at the ſame time that it prevents the light from being offenſive, will, by magnifying both the image and the ſpots, make them appear to greater advantage.

VIII. *To magnify ſmall Objects by means of the Sun's Rays let into a Dark Chamber.*—Let the rays of light paſſing through the lens in the ſhutter be thrown on a large concave mirror, properly fixed in a frame. Then take a ſlip or thin plate of glaſs; and ſticking any ſmall object on it, hold it in the incident rays, at a little more than the focal diſtance from the mirror; and you will ſee, on the oppoſite wall, amidſt the reflected rays, the image of that object, very large, and extremely clear and bright. This experiment never fails to afford amuſement.

IX. *The Portable Camera Obſcura.*—The great pleaſure produced by the camera obſcura in the common form, has excited ſeveral to render it more univerſally uſeful by making it portable. A camera obſcura of this ſort, with a drawer to draw out in the front, is repreſented at fig. 7. The images of the objects before the inſtrument, are reflected upon a glaſs ground rough on its upper ſide, and that is placed at top of the hinder part of the box, under the moveable cover repreſented in the figure. The images repreſented thereon will afford a moſt beautiful and perfect piece of perſpective or landſcape of whatever is before the camera, and more particularly ſo if the ſun ſhines upon the objects. The outlines of them may eaſily be traced on the glaſs by a black-lead pencil. There is ſometimes a ſcale of proportions *a* placed in the upper ſurface of the drawer, by which any particular building or other object may be drawn in a given proportion or magnitude, and according to the figures inſerted on the ſcale, which are adapted to the focus or foci of the lenſes made uſe of in the camera. The glaſſes that are made uſe of in this camera are only three, viz. the convex glaſs, A, placed in the front of the drawer of the camera, and of a focus agreeable to the length of the box; the mirror CE, placed in the box in an angle of 45 degrees; and the ground glaſs placed horizontally, at CD, on which the different images appear, ſo as to be eaſily traced on paper.

X. *The Magic Lantern.*—This very remarkable machine, which is now known all over the world, cauſed great aſtoniſhment at its origin. The invention of it is attributed to the celebrated Kircher, who has publiſhed, on various ſciences, works equally learned, curious, and entertaining. Its deſign is to repreſent at large, on a cloth or board, placed in the dark, the images of ſmall objects, painted with tranſparent colours on plates of glaſs.

The conſtruction is as follows. Let ABCD, fig. 8. be the ſide of a tin box, eight inches high, eight inches long, and ten broad, the top of which muſt have a funnel, with a cover, as repreſented at fig. 9; which at the ſame time that it gives a paſſage to the ſmoke, prevents the light from coming out of the box. In the middle of the bottom of the box muſt be placed a low tin lamp E, which is to be moveable. It ſhould have three or four lights, that muſt be at the height of the centre of the glaſſes in the tubes N and O. In the largeſt of theſe tubes muſt be placed a glaſs ſemiglobular lens N, about four inches diameter; and in the ſmaller one a double convex lens O, about $2\frac{1}{4}$ inches diameter, and ſix inches focus, the length of the tubes holding them about $4\frac{1}{2}$ inches each. The inner tube containing the ſmall lens O muſt be a ſliding one, in order to adjuſt it at a proper diſtance from the painted ſliders, ſo that the objects thereon may be diſtinctly repreſented on the cloth or white wall. A ſlit or opening between the glaſs N and the front ſide BGDH of the box muſt be made large enough to admit the ſliders, on which are painted the different images, to be paſſed through, as at *a* in fig. 9. The clearneſs of the light, and of the objects upon the cloth, will depend much upon the light of the lamp; Argand's Patent Lamp, therefore, will be found infinitely preferable to any other ſort of light.

From what we have ſaid, it is evident, that when the glaſs ſliders, with the painted figures, are placed in the groove or ſlit in the lantern for that purpoſe, and the room darkened, a quantity of light from the lamp at E will be collected by the lens N, and refracted upon a cloth placed oppoſite; and that by moving the ſliding tube containing the ſmall lens O gradually in or out as occaſion may require, this lens will form images of the figures on the ſliders in their diſtinct colours and proportions. The lantern, with one of the ſliders ready for uſe, is repreſented at fig. 9. By the aid of the new patent lamp, conſiderable additions have been made to this lantern. Jones the optician has contrived an apparatus to be applied to it, that converts it into a microſcope by night; which ſhows all the variety of tranſparent and many of the opaque objects magnified upon a cloth or ſkreen oppoſite, ſimilar to the figures above mentioned, though not on ſo large a ſcale; about one or two feet diameter being all that can at preſent be obtained.

With regard to the method of painting the *glaſſes for the Lantern*, it is ſimply that of drawing the outlines of the figures to be repreſented, and afterwards filling them up with different ſorts of tranſparent colour; laying it on thicker where there ſhould be ſhade, and thinner where the light ſhould penetrate. Whether this be done with water or oil colours is no otherwiſe material than as the latter are more laſting. The exhibition may be rendered ſtill more amuſing, by preparing figures to which different natural motions may be given, which every one may perform according to his own taſte; either by movements in the figures themſelves, or by painting the ſubject on two glaſſes, and paſſing them at the ſame time through the groove. In a word, the entertainment reſulting from the uſe of the Magic Lantern, may be varied in a thouſand different ways. By two plates of glaſs paſſing over each other and differently painted, a ſtorm at ſea may be repreſented, a ſhip loſt, &c. See fig. 10 and 11 By making ſome addition to the lantern, a ſquare tube, &c. the various ſcenes, characters, and decorations of a theatre may be repreſented in a lively manner. But ſince a great variety of theſe inventions may be ſeen at the ſhops of all the mathematical inſtrument-makers, we ſhall not enter into a minute deſcription of them in this place.

DIOSCOREA, in botany; a genus of the hexandria order, belonging to the diœcia claſs of plants; and in the natural method ranking under the 11th order, *Sarmentaceæ*. The male calyx is ſexpartite; there is no corolla: the female calyx is ſexpartite; no corolla; three ſtyles; the capſule trilocular and compreſſed; and there are two membranaceous ſeeds. There are eight ſpecies, of which the only remarkable one is the bulbifera, or yam. This has triangular winged ſtalks, which trail upon the ground, and extend a great way: theſe frequently put out roots from their joints as they lie upon the ground, by which the plants are multiplied. The roots are eaten by the inhabitants of both the Indies; and are particularly ſerviceable in the Weſt India iſlands, where they make the greateſt part of the negroes' food. The plant is ſuppoſed to have been brought from the Eaſt to the Weſt Indies; for it has never been obſerved to grow wild in any part of America; but in the iſland of Ceylon, and on the coaſt of Malabar, it grows in the woods, and there are in thoſe places a great variety of ſorts. It is propagated by cutting the root in pieces, obſerving to preſerve an eye in each, as is practiſed in planting potatoes. One plant will produce three or four large roots. The ſkin of theſe roots is pretty thick, rough, unequal, covered with many ſtringy fibres or filaments, and of a violet colour approaching to black. The inſide is white, and of the conſiſtence of red beet. It reſembles the potatoe in its mealineſs, but is of a cloſer texture. When raw, the yams are viſcous and clammy: when roaſted or boiled, they afford very nouriſhing food; and are often preferred to bread by the inhabitants of the Weſt Indies, on account of their lightneſs and facility of digeſtion. When firſt dug out of the ground, the roots are placed in the ſun to dry: after which, they are either put into ſand, dry garrets, or caſks; where, if kept from moiſture, they may be preſerved whole years, without being ſpoiled or diminiſhed in their goodneſs. The root commonly weighs 2lb. or 3lb. though ſome yams have weighed upwards of 20lb.

DIOSCORIDES, a phyſician of Cilicia, who lived, as ſome ſuppoſe, in the age of Nero. He was originally a ſoldier; but afterwards applied himſelf to ſtudy, and wrote a book upon medicinal herbs.

DIOSCURIA, διοσκουρια, from Διος *Jupiter*, and κουροι *infants*, in antiquity, a feſtival in honour of the Διοσκουροι, or Caſtor and Pollux, who were reputed to be the ſons of Jupiter. It was obſerved by the Cyreneans, but more eſpecially by the Spartans, whoſe country was honoured by the birth of theſe heroes. The ſolemnity was full of mirth, being a time wherein they ſhared plentifully the gifts of Bacchus, and diverted themſelves with ſports, of which wreſtling matches always made a part.

DIOSMA, African Spiræa; a genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking with thoſe of which the order is *doubtful*. The corolla is pentapetalous, the nectarium crown-ſhaped above the germen; there are five capſules coalited; the ſeeds hooded. There are 9 ſpecies; of which the moſt remarkable are the *hirſuta*, with narrow hairy leaves; and the *oppoſitifolia*, with leaves placed in the form of a croſs. The firſt is a very handſome ſhrub, growing to the height of five or ſix feet: the ſtalks are of a fine coral colour: the leaves come out alternately on every ſide of the branches, and are narrow-pointed and hairy: the flowers are produced in ſmall cluſters at the end of the ſhoots, and are of a white colour. They are ſucceeded by ſtarry ſeed-veſſels having five corners; in each of which corners is a cell, containing one ſmooth, ſhining, oblong, black ſeed: theſe ſeed-veſſels abound with a reſin which emits a grateful ſcent, as does alſo the whole plant. The ſecond ſpecies riſes to the height of three or four feet: the branches are ſlender, and produced from the ſtem very irregularly; the leaves are placed croſs-ways; the flowers are produced at the ends of the branches, between the leaves: the plants continue a long time in flower, and make a fine appearance when they are intermixed with other exotics in the open air. Both ſpecies are propagated by cuttings; which may be planted during any of the ſummer-months in pots, and plunged into a moderate hot-bed, where they ſhould be ſhaded from the ſun, and frequently watered. In about two months they will have taken root; when each ſhould be tranſplanted into a ſmall pot where they are to remain; but during winter, like moſt other exotic plants, they muſt be preſerved in a green-houſe.

DIOSPYROS, the Indian date-plum; a genus of the diœcia order, belonging to the polygamia claſs of plants; and in the natural method ranking under the 18th order, *Bicornes*. The calyx is hermaphrodite and quadrifid; the corolla urceolated and quadrifid; there are eight ſtamina; the ſtyle quadrifid; the berry octoſpermous: the male calyx, corolla, and ſtamina, as in the former. There are two ſpecies. 1. The *lotus*, which is ſuppoſed to be a native of Africa, from whence it was tranſplanted into ſeveral parts of Italy, and alſo into the ſouth of France. The fruit of this tree is ſuppoſed to be the lotus with which Ulyſſes and his companions were enchanted, and which made thoſe who ate of it forget their country and relations: ſee alſo Rhamnus. In the warm parts of Europe this tree grows to the height of 30 feet. In the botanic garden at Padua, there is one very old tree which has been deſcribed by ſome of the former botaniſts under the title of *guaiacum patavinum*. This tree produces plenty of fruit every year; from the ſeeds of which many plants have been raiſed. 2. The *Virginiana*, *pinſhamin*, *perſimon*, or *pitchumon* plum, is a native of America, but particularly of Virginia and Carolina. The ſeeds of this ſort have been frequently imported into Britain, and the trees are common in many nurſeries about London. It riſes to the height of 12 or 14 feet; but generally divides into many irregular trunks near the ground, ſo that it is very rare to ſee a handſome tree of this ſort. Though plenty of fruit is produced on theſe trees, it never comes to perfection in this country. In America the inhabitants preſerve the fruit till it is rotten, as is practiſed with medlars in England; when they are eſteemed very pleaſant. Both ſpecies are propagated by ſeeds: and the plants require to be treated tenderly while young; but when they are grown up, they reſiſt the greateſt cold of this country.

DIPHTHONG, in grammar, a double vowel, or the mixture of two vowels pronounced together, ſo as to make one ſyllable. The Latins pronounced the two vowels in their diphthongs ae or æ, oe or œ, much as we do; only that the one was heard much weaker than the other, though the diviſion was made with all the delicacy imaginable. Diphthongs, with regard to the eyes, are diſtinguiſhed from thoſe with regard to the ears: in the former, either the particular ſound of each vowel is heard in the pronunciation; or the ſound of one of them is drowned; or, laſtly, a new ſound, different from either, reſults from both: the firſt of theſe only are real diphthongs, as being ſuch both to the eye and ear. Diphthongs with regard to the ear are either formed of two vowels meeting in the ſame ſyllable, or whoſe ſounds are ſeverally heard; or of three vowels in the ſame ſyllable, which only afford two ſounds in the pronunciation. Engliſh diphthongs, with regard to the eye and ear, are *ai*, *au*, *ea*, *ee*, *oi*, *oo*, *ou*. Improper Engliſh diphthongs, with regard to the eye only, are *aa*, *ea*, *eo*, *eu*, *ie*, *ei*, *oa*, *oe*, *ue*, *ui*.

DIPLOE, in anatomy, the ſoft meditullium, or medullary ſubſtance, which lies between the two laminæ or tables of the bones of the cranium. See Anatomy.

DIPLOMA, in a peculiar ſenſe, is uſed for an inſtrument

or licence given by colleges, ſocieties, &c. to a clergyman to exerciſe the miniſterial function, or to a phyſician to practiſe medicine, after having paſſed an examination.

DIPLOMATICS, the ſcience of diplomas, or of ancient literary monuments, public documents, &c. It does not however, nor can it, abſolutely extend its reſearches to antiquity; but is chiefly confined to the middle age, and the firſt centuries of modern times. For though the ancients were accuſtomed to reduce their contracts and treaties into writing; yet they graved them on tables, or covered them over with wax, or braſs, copper, ſtone, or wood, &c. And all that in the firſt ages were not traced on braſs or marble, have periſhed by the length of time, and the number of deſtructive events. The word *diploma* ſignifies, properly, a letter or epiſtle, that is folded in the middle, and that is not open. But, in more modern times, the title has been given to all ancient epiſtles, letters, literary monuments, and public documents, and to all thoſe pieces of writing which the ancients called *Syngrapha*, *Chirographa*, *Codicilli*, &c. In the middle age, and in the diplomas themſelves, theſe writings are called *Litteræ*, *Præcepta*, *Placita*, *Chartæ indiculæ*, *Sigilla*, and *Bullæ*; as alſo *Panchartæ*, *Pantochartæ*, *Tractoriæ*, *Deſcriptiones*, &c. The originals of theſe pieces are named *Exemplaria*, or *Autographa*, *Chartæ authenticæ*, *Originalia*, &c. and the copies, *Apographa*, *Copiæ*, *Particulæ*, and ſo forth. The collections that have been made of them, are called *Chartaria* and *Chartulia*. The place where theſe papers and documents were kept, the ancients named *Scrinia*, *Tabularium*, or *Ærarium*, words that were derived from the tables of braſs, and, according to the Greek idiom, *Archeium* or *Archivum*. On this ſubject there are two works which furniſh the cleareſt lights on this matter, and which may ſerve as ſure guides in the judgment we may have occaſion to make on what are called *ancient diplomas*. The one is the celebrated treatiſe on the Diplomatic, by F. Mabillon; and the other, the firſt volume of the Chronicon Gotvicenſe. We there find ſpecimens of all the characters, the flouriſhes, and different methods of writing, of every age. For theſe matters, therefore, we muſt refer our readers to thoſe authors.

DIPONDIUS, in the ſcripture-language, is uſed by St. Luke to ſignify a certain coin which was of very little value. Our tranſlation of the paſſage is, *Are not two ſparrows ſold for two farthings?* In St. Matthew, who relates the ſame thing, we read, *Are not two ſparrows ſold for a farthing?* The Greek reads *aſſarion* inſtead of *as*. Now *aſſarion*, as ſome ſay, was worth half an *as*, that is to ſay, four French deniers and $\frac{1}{6}$th; and, according to others, two deniers and $\frac{5}{16}$ths. *Dipondius* ſeems rather to ſignify half an *as*. Dr. Arbuthnot, however, is of opinion, that *dipondius* denotes two aſſes.

DIPPING, among miners, ſignifies the interruption or breaking off of the veins of ore; an accident that gives them conſiderable trouble before they can diſcover the ore again. A great deal of the ſkill of the miners conſiſts in underſtanding this dipping of the veins, and knowing how to manage in it. In Cornwall they have this general rule to guide them in this reſpect; moſt of their tin-loads, which run from eaſt to weſt, conſtantly dip towards the north. Sometimes they underlie, that is, they ſlope down towards the north three feet in height perpendicular. This muſt carefully be obſerved by the miners, that they may exactly know where to make their air-ſhafts when occaſion requires; yet, in the higher mountains of Dartmaer, there are ſome conſiderable loads, which run north and ſouth; theſe always underlie toward the eaſt. Four or five loads may run nearly parallel to each other in the ſame hill; and yet, which is rare, they may meet all together in one hatch, as it were a knot, which well tins the place, and ſo ſeparate again, and keep their former diſtances.

DIPPING-*Needle*, or *Inclinatory Needle*, a magnetical needle, ſo hung, as that, inſtead of playing horizontally, and pointing out north and ſouth, one end dips, or inclines to the horizon, and the other points to a certain degree of elevation above it.

The inventor of the dipping-needle was one Robert Norman, a compaſs-maker at Ratcliffe, about the year 1580. This is not only teſtified by his own account, in his New Attractive, but alſo by Dr. Gilbert, Mr. William Burrowes, Mr. Henry Bond, and other writers of that time, or ſoon after it. The occaſion of the diſcovery he himſelf relates, viz. that it being his cuſtom to finiſh, and hang the needles of his compaſſes, before he touched them, he always found that, immediately after the touch, the north point would dip or decline downward, pointing in a direction under the horizon; ſo that, to balance the needle again, he was always forced to put a piece of wax on the ſouth end, as a counterpoiſe. The conſtancy of this effect led him at length to obſerve the preciſe quantity of the dip, or to meaſure the greateſt angle which the needle would make with the horizon. This, in the year 1576, he found at London was 71° 50′. It is not quite certain whether the dip varies, as well as the horizontal direction, in the ſame place. Mr. Graham made a great many experiments with the dipping-needle in 1723, and found the dip between 74 and 75 degrees. Mr. Nairne, in 1772, found it ſomewhat above 72°. And by many obſervations made ſince that time at the Royal Society, the medium quantity is 72°$\frac{1}{2}$. The trifling difference between the firſt obſervations of Norman, and the laſt of Mr. Nairne and the Royal Society, lead to the opinion that the dip is unalterable; and yet it may be difficult to account for the great difference between theſe and Mr. Graham's numbers, conſidering the well-known accuracy of that ingenious gentleman. Philoſ. Tranſ. vol. 45, pa. 279; vol. 62, pa. 476; vol. 69, 70, 71.

It is certain however, from many experiments and obſervations, that the dip is different in different latitudes, and that it increaſes in going northward. It appears from a table of obſervations made with a marine dipping-needle of Mr. Nairne's, in a voyage towards the North Pole, in 1773, that

in latitude 60° 18′ the dip was 75° 0′,
in latitude 70 45 the dip was 77 52,
in latitude 80 12 the dip was 81 52, and
in latitude 80 27 the dip was 82 2$\frac{1}{2}$.

See Phipps's Voyage, pa. 122. See alſo the Obſervations of Mr. Hutchins, made in Hudſon's Bay and Straits, Philoſ. Tranſ. vol. 65, pa. 129.

Burrowes, Gilbert, Ridley, Bond, &c. endeavoured to apply this diſcovery of the dip to the finding of the latitude; and Bond, going ſtill farther, firſt of any propoſed finding the longitude by it; but for want of obſervations and experiments, he could not go any length. Mr. Whiſton, being furniſhed with the farther obſervations of colonel Windham, Dr. Halley, Mr. Pound, Mr. Cunningham, M. Noel, M. Feuille, and his own, made great improvements in the doctrine and uſe of the dipping-needle, brought it to more certain rules, and endeavoured in good earneſt to find the longitude by it. For this purpoſe, he obſerves, 1ſt, That the true tendency of the north or ſouth end of every magnetic needle is not to that point of the horizon to which the horizontal needle points, but towards another, directly under it, in the ſame vertical, and in different degrees under it, in different ages, and at different places. 2dly, That the power by which the horizontal needle is governed, and all our navigation uſually directed, it is proved, is only one quarter of the power by which the dipping-needle is moved; which ſhould render the latter far the more effectual and accurate inſtrument. 3dly, That a dipping-

needle of a foot long will plainly ſhew an alteration of the angle of inclination, in theſe parts of the world, in half a quarter of a degree, or $7\frac{1}{2}$ geographical miles; and a needle of 4 feet, in 2 or 3 miles; i. e. ſuppoſing theſe diſtances taken along, or near a meridian. 4thly, A dipping-needle 4 feet long, in theſe parts of the world, will ſhew an equal alteration along a parallel, as another of a foot long will ſhew along a meridian; i. e. that will, with equal exactneſs, ſhew the longitude, as this the latitude.

This depends on the poſition of the lines of equal dip, in theſe parts of the world, which it is found do lie about 14 or 15 degrees from the parallels. Hence he argues, that as we can have needles of 5, 6, 7, 8, or more feet long, which will move with ſtrength ſufficient for exact obſervation; and ſince microſcopes may be applied for viewing the ſmalleſt diviſions of degrees on the limb of the inſtrument, it is evident that the longitude at land may thus be found to leſs than 4 miles.

And as there have been many obſervations made at ſea with the ſame inſtrument by Noel, Feuille, &c. which have determined the dip uſually within a degree, ſometimes within $\frac{1}{2}$ or $\frac{1}{3}$ of a degree, and this with ſmall needles, of 5 or 6, or at the moſt 9 inches long; it is inferred, that the longitude may be found, even at ſea, to leſs than half a quarter of a degree. This premiſed, the obſervation itſelf follows.

To find the Longitude or Latitude by the Dipping-Needle.—If the lines of equal dip, below the horizon, be drawn on maps, or ſea-charts, from good obſervations, it will be eaſy, from the longitude known, to find the latitude; and from the latitude known, to find the longitude either at ſea or land.

Suppoſe, for example, a perſon travelling or ſailing along the meridian of London, ſhould find that the angle of dip, with a needle of one foot, was 75°; the chart will ſhew that this meridian, and the line of dip, meet in the latitude of 53° 11′; which is therefore the latitude ſought.

Or if he be travelling or ſailing along the parallel of London, *i. e.* in 51° 31′ north latitude, and find the angle of dip 74°; then this parallel, and the line of this dip, will meet on the map in 1° 46′ of eaſt longitude from London; which therefore is the longitude ſought.

DIPSACUS, TEAZEL, in botany; a genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 48th order, *Aggregatæ*. The common calyx is polyphyllous, proper above; the receptacle paleaceous. There are four ſpecies; the moſt remarkable of which is the carduus fullonum, which grows wild in many parts of England. It is of ſingular uſe in raiſing the knap upon woollen cloth. For this purpoſe, the heads are fixed round the circumference of a large broad wheel, which is made to turn round, and the cloth is held againſt them. In the weſt of England, great quantities of the plant are cultivated for the uſe juſt now mentioned. It is propagated by ſowing the ſeeds in March, upon a ſoil that is well prepared. About one peck of ſeed is ſufficient for an acre, as the plants muſt have room to grow; otherwiſe the heads will not be large enough, nor in great quantity. When the plants come up, they muſt be hoed in the ſame manner as is practiſed for turnips, cutting down all the weeds, and thinning the plants to about eight inches diſtance; and as the plants advance, and the weeds begin to grow again, they muſt be hoed a ſecond time, cutting out the plants to a wider diſtance, ſo that they may finally ſtand a foot diſtant from each other. The ſecond year they will ſhoot up heads, which may be cut about the beginning of Auguſt. They are then to be tied up in bunches, and ſet in the ſun if the weather is fair; if not, in rooms, to dry them. The common produce is about 160 bundles or ſtaves upon an acre, which are ſold for one ſhilling each.

The powdered leaves of the common wild teazel have been thought very good as a ſtomachic; but its virtues are ſomewhat equivocal.

DIPSAS, a ſort of ſerpent, whoſe bite it is ſaid produces ſuch a thirſt as to prove mortal; whence its name *dipſas*, which ſignifies *thirſty*. In Latin it is called *ſitula*, a pail. Moſes ſpeaks of it in Deut. viii. 15.

DIPTERA, from δις, and πτερον *wing*, in zoology, an order of inſects, which have only two wings, and under each wing a ſtyle or oblong body, terminated by a protuberance or head, and called a *balancer*.

DIPTOTES, in grammar, are ſuch nouns as have only two caſes, as *ſuppetiæ*, *ſuppetias*, &c.

DIPTYCHA, in antiquity, a public regiſter, wherein were written the names of the conſuls, and other magiſtrates, among the heathens; and of biſhops, and defunct as well as ſurviving brethren among the chriſtians. The word is formed from the Greek διπτυχαν, or διπτυχα, and that from διπτυξ, a maſculine noun derived from πτυσσω *I fold* or *plait*. From its future πτυξω is formed πτυξ a *fold* or *plait*, to which adding δις *twice*, we have διπτυξ, in the genitive διπτυχος, whence the nominative neuter διπτυχον, q. d. *a book folded in two leaves*; though there were ſome in three, and others in four or five leaves. An ingenious author imagines this name to have been firſt given them to diſtinguiſh them from the books that were rolled, called *volumina*. It is certain there were profane diptycha in the Greek empire, as well as ſacred ones in the Greek church. The former were the matricula, or regiſter, wherein the names of the magiſtrates were entered; in which ſenſe diptycha is a term in the Greek chancery.

Sacred DIPTYCHA. The word is plural; diptycha being a double catalogue, in one whereof were written the names of the living, and in the other thoſe of the dead, which were to be rehearſed during the office. We meet with ſomething not unlike the ſacred diptychs of the Greeks in the canon of the maſs according to the Latin uſage; where the people are enjoined to pray once for the living, and once for the dead; ſeveral ſaints are invoked in different times, &c. In theſe diptycha were entered the names of biſhops, who had governed their flocks aright; and theſe were never expunged, unleſs convicted of hereſy, or ſome other groſs crime. In the diptycha were likewiſe entered the names of ſuch as had done any ſignal ſervice to the church, whether they were living or dead, and mention was made of them in the celebration of the liturgy. The *profane* diptycha were frequently ſent as preſents to princes, &c. on which occaſion they were finely gilt, and embelliſhed; as appears from Symmachus, lib. ii. ep. 81. Thoſe preſented were uſually of ivory. The firſt law, De Expenſ. Ludor. C. Theod. forbids all magiſtrates below conſuls to make preſents of diptycha of ivory in the public ceremonies.

DIRCA, in botany; a genus of the monogynia order, belonging to the octandria claſs of plants; and in the natural method ranking under the 1ſt order, *Vepreculæ*. There is no calyx; the corolla is tubular, with the limb indiſtinct; the ſtamina are longer than the tube; the berry is monoſpermous.

DIRÆ, the general name of the three Furies in the Pagan ſyſtem of theology. They were ſo called, as being *quaſi Deorum iræ*, the miniſters of divine vengeance in puniſhing guilty ſouls after death. They were the daughters of *Night* and *Acheron*.

DIRECTION, in mechanics, ſignifies the line or path of a body's motion, along which it endeavours to proceed according to the force impreſſed upon it. See MECHANICS.

DIRECTOR, in commercial polity, a perſon who has the management of the affairs of a trading company: thus we ſay, the directors of the India company, South-ſea company, &c. See COMPANY. The directors are conſiderable proprie-

tors in the ftocks of their refpective companies, being chofen by plurality of votes from among the body of proprietors. The Dutch Eaft India company have 60 fuch directors; that of France had 21: the Britifh Eaft India company has 24, including the chairman, who may be re-elected for four years fucceffively. Thefe laft have falaries of 150l. a-year each, and the chairman 200l. They meet at leaft once a-week, and commonly oftener, being fummoned as occafion requires. The directors of the Bank of England are 24 in number, including the governor and deputy governor.

Director, in furgery, a grooved probe, to direct the edge of the knife or fciffars in opening finufes or fiftulæ, that by this means the adjacent veffels, nerves, &c. may remain unhurt. See Surgery.

DIRIBITORES, among the Romans, officers appointed to diftribute tablets to the people at the comitia. See Comitia.

DIRIGENT, or Directrix, a term in geometry, fignifying the line of motion, along which the defcribent line or furface is carried in the genefis of any plane or folid figure.

DIS, an infeparable article prefixed to certain words. The effect of it is either to give them a fignification contrary to what the fimple words have, as *difoblige*, *difobey*, &c.; or to fignify a feparation, detachment, &c. as *difpofing*, *diftributing*.

Dis, a town of Norfolk, feated on the river Wavenay, on the fide of a hill. It is a neat flourifhing town, and carries on manufactories of fail-cloth, hofe, and the making of ftays. E. long. 1. 16. N. lat. 52. 25.

Dis, a god of the Gauls, the fame as Pluto the god of hell. The inhabitants of Gaul fuppofed themfelves defcended from that deity.

DISA, in botany, a genus of the diandria order, belonging to the gynandria clafs of plants. The fpatha is univalvular; the petals three; the third fmaller than the reft, bifid, and gibbous at the bafe.

DISABILITY, in law, is when a man is difabled, or made incapable to inherit any lands, or take that benefit which otherwife he might have done: and this may happen four ways; by the act of an anceftor, or of the party himfelf; by the act of God, or of the law. 1. Difability by the act of the anceftor, is where the anceftor is attainted of high treafon, &c. which corrupts the blood of his children, fo that they may not inherit his eftate. 2. Difability by the act of the party, is where a man binds himfelf by obligation, that upon furrender of a leafe, he will grant a new eftate to a leffee; and afterwards he grants over the reverfion to another, which puts it out of his power to perform it. 3. Difability by the act of God, is where a man is *non fanæ memoriæ*, whereby he is incapable to make any grant, &c. So that, if he paffeth an eftate out of him, it may after his death be made void; but it is a maxim in law, "That a man of full age fhall never be received to difable his own perfon." 4. Difability by the act of the law, is where a man, by the fole act of the law, without any thing by him done, is rendered incapable of the benefit of the law; as an alien born, &c.

DISANDRA, in botany, a genus of the digynia order, belonging to the heptandria clafs of plants. The calyx has feven leaves: the corolla is parted into feven, and flat; the capfule two-celled.

DISAPPOINTMENT, Islands of, are a clufter of fmall iflands, lying in S. lat. 14. 10. W. long. 141. 16. They were difcovered by Commodore Byron in 1765, who gave them their name from the fhores affording no anchorage for his fhips. There are cocoa-trees in great abundance, and the fhore abounds with turtle.

DISC, in antiquity, a quoit made of ftone, iron, or copper, five or fix fingers broad, and more than a foot long, inclining to an oval figure, which was hurled in form of a bowl, to a vaft diftance, by the help of a leathern thong tied round the perfon's hand who threw it, and put through a hole in the middle. Homer has made Ajax and Ulyffes great adepts at this fport.

Disc, in aftronomy, the body and face of the fun and moon, fuch as it appears to us on the earth; or the body and face of the earth, fuch as it appears to a fpectator in the moon.

Disc, in optics, is the width of the aperture of telefcopic glaffes, whatever their form be, whether plain, convex, concave, &c.

DISCERNING, or Discernment, a faculty of the mind, whereby it diftinguifhes between ideas. See Metaphysics.

DISCIPLE, one who learns any thing from another: thus, the followers of any teacher, philofopher, &c. are called *difciples*. In the Chriftian fenfe, they were followers of Jefus Chrift, in general; but in a more reftrained fenfe, the difciples denote thofe alone who were the immediate followers and attendants on his perfon, of which there were 70 or 72. The names *difciple* and *apoftle* are often fynonymoufly ufed in the gofpel hiftory; but fometimes the apoftles are diftinguifhed from difciples, as perfons felected out of the number of difciples, to be the principal minifters of his religion: of thefe there were only 12. The Latins kept the feftival of the 70 or 72 difciples on July 15th, and the Greeks on January 4th.

DISCIPLINE, in a general fenfe, denotes inftruction and government, as military difcipline, ecclefiaftical difcipline, &c. *Ecclefiaftical* difcipline confifts in putting thofe laws in execution by which the church is governed, and inflicting the penalties enjoined by them againft the feveral forts of offenders that profefs the religion of Jefus. The primitive church never pretended to exercife difcipline upon any but fuch as were within her pale, in the largeft fenfe, by fome act of their own profeffion; and even upon thefe fhe never pretended to exercife her difcipline fo far as to cancel or difannul their baptifm: all that fhe pretended to was to deprive men of the benefits of external communion, fuch as public prayer, receiving the eucharift, and other acts of divine worfhip. The church-difcipline was only confined to the admonition of the party, and to the leffer and greater excommunication. As to the objects of ecclefiaftical difcipline, they were all fuch delinquents as fell into great and fcandalous crimes after baptifm.—*Difcipline*, in a more peculiar fenfe, is ufed for the chaftifements or bodily punifhments inflicted on a religious of the Romifh church who has been found a delinquent; or even for that which the religious voluntarily undergo or inflict on themfelves, by way of mortification.

Book of Discipline, in the hiftory of the church of Scotland, is a common order drawn up by the affembly of minifters in 1650, for the reformation and uniformity to be obferved in the difcipline and policy of the church. In this book the government of the church by prelates is fet afide, church-feffions are eftablifhed, the fuperftitious obfervation of faft-days and faints days is condemned, and other regulations for the government of the church are determined. This book was approved by the privy-council, and is called *the firft book of difcipline*.

DISCORD, in mufic, every found which, joined with another, forms an affemblage difagreeable to the ear; or rather, every interval whofe extremes do not coalefce. Now, as there are no other concords or confonances, except thofe which form amongft themfelves, and with their fundamental found, perfect chords, it follows, that every other interval muft

be a real diſſonance or diſcord: even the third and ſixth were reckoned ſuch among the ancients, who excluded them from the number of conſonant chords.

The term *diſſonance*, which is ſynonymous with diſcord, is compounded of two words, the inſeparable prepoſition *dis* and the verb *ſonare*; which, both in a literal and metaphorical ſenſe, ſignifies *diſagreement* or *diſunion*. In reality, that which renders diſſonances grating, is, that the ſounds which form them, far from uniting in the ear, ſeem to repel each other, and are heard each by itſelf as two diſtinct ſounds, though produced at the ſame time. This repulſion or violent oſcillation of ſounds is heard more or leſs as the vibrations which produce it are more or leſs frequently coincideut. When two vocal ſtrings are gradually tuned, till they approach a conſonant interval, the pulſations become ſlower as the chord grows more juſt, till at laſt they are ſcarcely heard, if heard at all; from whence it appears certain, that the pleaſure produced in us by harmony, reſults from the more or leſs exact and frequent coincidence of vibrations; though the reaſon why this coincidence ſhould give pleaſure, more than any other modification or combination of ſounds, appears to us inſcrutable. The agreeable effects of diſſonance in harmony, are no objection to this theory; ſince it is allowed, that the ſenſations excited by diſcord are not in themſelves immediately and neceſſarily pleaſing, but only pleaſe by auricular deception. The ear is ſurpriſed with the ſhock it receives, without being able to imagine how it ſhould have happened; and in proportion as it is harſh and grating, we feel the pleaſure of returning harmony enhanced, and the diſappointment of being artfully and inſenſibly extricated more agreeable.

The name of *diſſonance* is given ſometimes to the interval, and ſometimes to each of the two ſounds which form it. But though two ſounds equally form a diſſonance between themſelves, the name is moſt frequently given to that ſound in particular which is moſt extraneous to the chord. The number of poſſible diſſonances is indefinite; but as in muſic we exclude all intervals which are not found in the ſyſtem received, the number of diſſonances is reduced to a very few: beſides, in practice, we can only ſelect from thoſe few, ſuch as are agreeable to the ſpecies, and the mode in which we compoſe; and from this laſt number we muſt exclude ſuch as cannot be uſed conſiſtently with the rules preſcribed. But what are theſe rules? Have they any foundation in nature, or are they merely arbitrary? This is what Rouſſeau, in his Muſical Dictionary, has attempted to inveſtigate, and to that work we refer the reader.

Discord (the goddeſs of), in Pagan theology, is repreſented by Ariſtides, with fiery eyes, a pale countenance, livid lips, and wearing a dagger in her boſom. It was ſhe who at the marriage of Peleus and Thetis threw in the golden apple, whereon was written "To the faireſt:" which occaſioned a contention between the goddeſſes Juno, Minerva, and Venus; each pretending a title to the apple. She was likewiſe called *Ate* and *Eris*.

DISCOVERY, in dramatic poetry, a manner of unravelling a plot or fable in tragedies, comedies, and romances; wherein, by ſome unforeſeen accident, a diſcovery is made of the name, fortune, quality, &c. of a principal perſon, which were before unknown. See Catastrophe.

DISCOUNT, in commerce, a term among traders, merchants, and bankers. It is uſed by the two former on occaſion of their buying commodities on the uſual time of credit, with a condition that the ſeller ſhall allow the buyer a certain diſcount at the rate of ſo much *per cent. per annum*, for the time for which the credit is generally given, upon condition that the buyer pays ready money for ſuch commodities, inſtead of taking the time of credit. Traders and merchants alſo frequently take promiſſory notes, for moneys due, payable to them or order at a certain time, and ſometimes having occaſion for money before the time is elapſed, procure theſe notes to be diſcounted by bankers before the time of payment. Bills of exchange are alſo diſcounted by bankers; and in this conſiſts one article of the profits of banking. See Bank.

DISCRETE, or disjunct, Proportion, is when the ratio of two or more pairs of numbers or quantities is the ſame, but there is not the ſame proportion between all the four numbers. Thus if the numbers 3 : 6 : : 8 : 16 be conſidered, the ratio between 3 : 6 is the ſame as that between 8 : 16, and therefore the numbers are proportional: but it is only diſcretely or disjunctly, for 3 is not to 6 as 6 to 8; that is, the proportion is broken off between 8 and 3, and is not continued as in the following continual proportionals, 3 : 6 : : 12 : 24.

DISCRETION, prudence, or knowledge to govern one's ſelf. Without this uſeful quality, learning is pedantry, and wit impertinence; virtue itſelf looks like weakneſs; and the beſt parts only enable a man to be more ſprightly in errors, and active to his own prejudice. If we look into particular communities and diviſions of men, we may obſerve that it is the diſcreet man, not the witty, nor the learned, nor the brave, who guides the converſation, and gives meaſures to the ſociety. A man with great talents, but void of diſcretion, is like Polyphemus in the fable, ſtrong and blind, endued with an irreſiſtible force, which for want of ſight is of no uſe to him. Though a man has all other perfections, and wants diſcretion, he will be of no great conſequence in the world; but if he has this ſingle talent in perfection, and but a common ſhare of others, he may do what he pleaſes in his particular ſtation of life. It is proper, however, to diſtinguiſh between *diſcretion* and *cunning*, the latter being the accompliſhment only of little, mean, ungenerous minds. Diſcretion has large and extended views, and, like a well-formed eye, commands a whole horizon: cunning is a kind of ſhort-ſightedneſs, that diſcovers the minuteſt objects which are near at hand, but is not able to diſcern things at a diſtance. Diſcretion, the more it is diſcovered, gives the greater authority to the perſon who poſſeſſes it: cunning, when once detected, loſes its force, and makes a man incapable of bringing about even thoſe events which he might have accompliſhed, had he paſſed only for a plain man. Diſcretion is the perfection of reaſon, and a guide to us in all the duties of life: cunning is a kind of inſtinct, that only looks out after our immediate intereſt and welfare. In ſhort, cunning is only the mimic of diſcretion, and may paſs upon weak men, in the ſame manner as vivacity is often miſtaken for wit, and gravity for wiſdom.

DISCUS, in antiquity. See Disc.

Discus, in botany, the middle part of a radiated compound flower, generally conſiſting of ſmall florets, with a hollow regular petal. It is commonly ſurrounded by large, plain, or flat, tongue-ſhaped petals, in the circumference or margin; as in daiſy, groundſel, and leopard's bane: ſometimes the circumference is naked, as in cotton-weed and ſome ſpecies of coltsfoot. Discus *Folii*, ſignifies the ſurface of the leaf.

DISCUSSION, in matters of literature, ſignifies the clear treating of or arguing any particular point or problem, ſo as to overcome the difficulties with which it is embarraſſed: thus we ſay, *ſuch a point was well diſcuſſed*, when it was well treated of and explained.

DISCUTIENTS, in ſurgery, are ſuch external remedies as, by their ſubtilty, diſſolve or diſperſe a ſtagnating or coagulated fluid in any part of the body.

DISDIACLASTIC crystal, in natural hiſtory, a name given by Bartholine and ſome others to the pellucid foſſile ſubſtance, more uſually called, from the place whence it was

first brought, *Island crystal;* though properly it is no crystal at all, but a fine pellucid spar, called by Dr. Hill, from its shape, *parallelopipedum*. See Island *Crystal*.

DISDIAPASON, or Bisdiapason, in music, a compound concord, described by F. Parran, in the quadruple ratio of 4 : 1, or 8 : 2—Disdiapason *Diapente*, a concord in a sextuple ratio of 1 : 6—Disdiapason *Semi-Diapente*, a compound concord in the proportion of 16 : 3—Disdiapason *Ditone*, a compound consonance in the proportion of 10 : 2—Disdiapason *Semi-Ditone*, a compound concord in the proportion of 24 : 5.

DISEASE, has been variously defined by physicians, almost every founder of a new system having given a definition of *disease*, different in some respects from his predecessors. For a particular account of these definitions, see Medicine. Of all animals, man is the most subject to diseases; and of men, the studious and speculative are most exposed thereto. Other animals have their diseases; but they are small in number: nor are plants without them; though their maladies scarce exceed half a score. The ancients deified their diseases. Some diseases only impair the use of the part immediately affected; as the ophthalmia, gout, &c. Others destroy it entirely; as the *gutta serena*, palsy, &c. Some affect the whole body; as in fever, apoplexy, epilepsy, &c. Others only impair a part; as the asthma, colic, dropsy, &c. Some only affect the body; as the gout: others disturb the mind; as hypochondria, delirium, &c. Lastly, others affect both the body and mind; as mania, phrenitis, &c.

Diseases *of Plants*. See Blight, Mildew, &c.

DISEMBOGUE. When a ship passes out of the mouth of any great gulf or bay, they call it *disemboguing*. They say also of a river, that at such a place, or after it has run so many leagues, it disembogues itself into the sea.

DISFRANCHISING, among civilians, signifies the depriving a person of the rights and privileges of a free citizen or subject.

DISGUISE, a counterfeit habit. Persons doing unlawful acts in disguise are by our statutes sometimes subjected to great penalties, and even declared felons. Thus, by an act commonly called the *black act*, persons appearing disguised and armed in a forest or grounds inclosed, or hunting deer, or robbing a warren or a fish-pond, are declared felons.

DISH, in mining, is a trough made of wood, about 28 inches long, four inches deep, and six inches wide; by which all miners measure their ore. If any be taken selling their ore, not first measuring it by the bar-master's dish, and paying the king's duty, the seller forfeits his ore, and the buyer forfeits for every such offence 40 shillings to the lord of the field or farmer.

DISJUNCTIVE, something that separates or disjoins. Thus, *or*, *neither*, &c. which in connecting a discourse yet separate the parts of it, are called *disjunctive conjunctions*.

DISK. See Disc.

DISLOCATION, the putting a bone out of joint by some violence, usually called by the surgeons *luxation*. See Surgery.

DISMISSION *of a* Bill, in chancery. If the plaintiff does not attend on the day fixed for the hearing, his bill is dismissed with costs. It may be also dismissed for want of prosecution, which is in the nature of a non-suit at law, if he suffers three terms to elapse without moving forward in the cause.

DISMOUNTING, in the military art, the act of unhorsing. Thus, to dismount the cavalry, the dragoons, or the like, is to make them alight. To dismount cannon, is to break their carriages, wheels, and axletrees, so as to render them unfit for service. Horses are also dismounted when they are rendered unfit for service.

DISPARAGEMENT, in law, is used for the matching an heir, &c. in marriage, below his or her degree or condition, or against the rules of decency. The word is a compound of the privative particle *dis*, and *par* "equal."

DISPART, in gunnery, is the setting a mark upon the muzzle-ring, or thereabouts, of a piece of ordnance, so that a sight-line taken upon the top of the base ring against the touch-hole, by the mark set on or near the muzzle, may be parallel to the axis of the concave cylinder. The common way of doing this, is to take the two diameters of the base ring, and of the place where the dispart is to stand, and divide the difference between them into two equal parts, one of which will be the length of the dispart which is set on the gun with wax or pitch, or fastened there with a piece of twine or marlin. By means of an instrument it may be done with all possible nicety.

DISPATCH, a letter on some affair of state, or other business of importance, sent with care and expedition by a courier express. The business of dispatches lies on the secretaries of state and their clerks. The king gives directions to his ministers abroad by dispatches. The word is also used for the packet or mail containing such letters. The French, during the reign of Louis XIV. had a *conseil des depêchés*, "council of dispatches," held in the king's presence, at which the dauphin, the duke of Orleans, the chancellor, and four secretaries of state, assisted.

DISPAUPER. A person suing *in forma pauperis*, is said to be dispaupered, if, before the suit is ended, he has any lands or other estate fallen to him, or if he has any thing to make him lose his privilege. See the article Forma *Pauperis*.

DISPENSARY, or Dispensatory, denotes a book containing the method of preparing the various kinds of medicines used in pharmacy. Such are the London and Edinburgh Pharmacopœias, &c.

Dispensary, a kind of charitable institution of late years very prevalent in England, particularly in the metropolis, where they are distinguished by different titles, as the *General* Dispensary, the *Royal Universal* Dispensary, &c. They are supported by voluntary subscriptions, have each one or more physicians and surgeons, whose business it is to attend at stated times, in order to prescribe for the poor; and, if necessary, to visit them at their own habitations. It is in this latter respect that the patients of a dispensary differ from those called *out-patients* at an hospital. The poor are supplied gratis with their medicines, and many of these institutions also afford gratuitous assistance to lying-in women. Formerly there were three dispensaries established in London, for *selling* medicines to the poor at prime cost, under the direction of the College of Physicians.

DISPENSATION, in law, the granting a licence for doing some certain action that otherwise is not permitted.

DISPERSION, in general, signifies the scattering or dissipating something. Hence, in optics, it denotes the same with the divergency of the rays of light.

Point of Dispersion, in dioptrics, the point from which refracted rays begin to diverge, where their refraction renders them divergent.

Dispersion *of Inflammation*, in surgery, is the removing an inflammation, and restoring the inflamed part to its natural state.

Dispersion *of Mankind*, in the history of the world, was occasioned by the confusion of tongues, and took place in consequence of the overthrow of Babel at the birth of Peleg; whence he derived his name: and it appears by the account given of his ancestors, Gen. chap. xi. 10—16, to have happened in the 101st year after the flood, according to the He-

brew chronology, and by the Samaritan computation, in the 401st. However, various difficulties have been suggested by chronologers concerning the true era of this event.

DISPLAYED, in heraldry, is understood of the position of an eagle, or any other bird, when it is erect, with its wings expanded or spread forth.

DISPONDEE, in the Greek and Latin poetry, a double spondee or foot, consisting of four long syllables; as jūrāmēntūm, cōnclūdēntēs, θαυμαζοντων.

DISPOSITION, in architecture, the just placing the several parts of an edifice according to their nature and design. See ARCHITECTURE.

DISPOSITION, in oratory. See ORATORY.

DISPOSITION, in painting. See PAINTING.

DISPOSITION, in human nature. In every man there is something original, that serves to distinguish him from others, that tends to form a character, and to make him meek or fiery, candid or deceitful, resolute or timorous, cheerful or morose. This original bent, termed *disposition*, must be distinguished from a *principle*: the latter, signifying a law of human nature, makes part of the common nature of man; the former makes part of the nature of this or that man. *Propensity* is a term common to both; for it signifies a principle as well as a disposition.

DISQUISITION, from *dis* and *quæro* "I inquire," an inquiry into the nature, kinds, and circumstances of any problem, question, or topic; in order to gain a right notion of it, and to discourse clearly about it.

DISSECTION, in anatomy, the cutting up a body with a view of examining the structure and use of the parts. See ANATOMY. Le Gendre observes, that the dissection of a human body, even dead, was held a sacrilege till the time of Francis I. And the same author assures us, he has seen a consultation held by the divines of Salamanca, at the request of Charles V. to settle the question whether or no it were lawful in point of conscience to dissect a human body in order to learn its structure.

DISSEISIN, in law, an unlawful dispossessing a person of his lands or tenements.

DISSENTERS, separatists from the service and worship of any established church. See NON-CONFORMISTS.

DISSEPIMENTUM, in botany, the name by which Linnæus denominates the partitions which in dry seed-vessels, as capsules and pods (siliqua), divide the fruit internally into cells.

DISSIDENTS, a denomination applied in Poland to persons of the Lutheran, Calvinistic, and Greek profession. The king of Poland engaged, by the *pacta conventa*, to tolerate them in the free exercise of their religion, but they have often had reason to complain of the violation of these promises.

DISSIMILITUDE, unlikeness or want of similitude. See the article RESEMBLANCE *and dissimilitude*.

DISSIMULATION, in morals, the act of dissembling, by fallacious appearances, or false pretensions. Great princes regard dissimulation as a necessary vice; and tyrants consider it as a virtue. It is evident that secrecy is often necessary, to oppose those who may be willing to circumvent our lawful intentions. But the necessity of precaution would become very rare, were no enterprizes to be formed, but such as could be avowed openly. The frankness with which we could then act, would engage people in our interests. Marshal Biron would have saved his life, by dealing ingenuously with Henry IV. With respect to dissimilation, three things are to be observed; 1. That the characters of those are not to be esteemed, who are reserved and cautious without distinction. 2. Not to make secrets of unimportant matters. 3. To conduct ourselves in such a manner as to have as few secrets as possible.

DISSIPATION, in physics, an insensible loss or consumption of the minute parts of the body; or that mode whereby they fly off, and are lost.

Circle of DISSIPATION, in optics, denotes that circular space upon the retina, which is taken up by one of the extreme pencils or rays issuing from an object.

DISSOLVENT, in general, whatever dissolves or reduces a solid body into such minute parts as to be sustained in a fluid. The principal dissolvents for metals are the mineral acids; for salts, earths, and gums, water; for coral, or bone, vinegar, &c. A dissolvent is the same with what the chemists call a *solvent* or *menstruum*. See the article MENSTRUUM.

Universal DISSOLVENT. See the article ALKAHEST.

DISSOLUTION, in physics: a discontinuation, or analysis, of the structure of a mixed body; whereby, what was one, and contiguous, is divided into little parts, either homogeneous or heterogeneous. Dissolution, then, is a general name for all reductions of concrete bodies into their smallest parts, without any regard either to solidity or fluidity: though in the usual acceptation of the word among authors, it is restrained to the reduction of solid bodies into a state of fluidity; which is more properly expressed by *solution*, as a branch of *dissolution*. According to the opinion of Fr. Tertius de Lanis, Boerhaave, and some other learned men, the power or faculty of dissolving exists in fire alone. Sir Isaac Newton accounts for all dissolutions, and the several phenomena thereof, from the great principle of attraction; and, in effect, the phenomena of dissolution furnish a great part of the arguments and considerations whereby he proves the reality of that principle. See CHEMISTRY.

DISSONANCE, in music. See DISCORD.

DISSYLLABLE, among grammarians, a word consisting only of two syllables: such are the words *nature*, *science*, &c.

DISTAFF, an instrument about which flax is tied in order to be spun.

DISTANCE, in general, an interval between two things, either with regard to time or place. *Accessible* DISTANCES, in geometry, are such as may be measured by the chain, &c: *Inaccessible* DISTANCES, are such as cannot be measured in that manner by reason of some river, or impediment, which obstructs our passing from one object to another. See GEOMETRY.

DISTANCE, in astronomy. The distance of the sun, planets, and comets, is found only from their parallax, as it cannot be found either by eclipses or their different phases: for, from the theory of the motions of the earth and planets we know, at any time, the proportion of the distances of the sun and planets from us; and the horizontal parallaxes are in a reciprocal proportion to these distances. See ASTRONOMY.

DISTASTE properly signifies an aversion or dislike to certain foods; and may be either constitutional, or owing to some disease of the stomach.

DISTEMPER, among physicians, the same with DISEASE.

DISTEMPER, in painting, a term used for the working up of colours with something besides water or oil. If the colours are prepared with water, that kind of painting is called *limning*; and if with oil, it is called *painting in oil*, and simply *painting*. If the colours are mixed with size, whites of eggs, or any such proper glutinous kind of matter, and not with oil, then they say it is done in *distemper*.

DISTENSION, in general, signifies the stretching or extending a thing to its full length or breadth.

DISTICH, a couplet of verses making a complete sense. Thus hexameter and pentameter verses are disposed in distichs. Cato's excellent morals are in distichs.

DISTICHIASIS, in surgery, a disease of the eye-lids.

when under the ordinary eye-lafhes there grows another extraordinary row of hairs, which frequently eradicate the former, and pricking the membrane of the eye, excite pain, and bring on inflammation. The remedy confifts in pulling out the fecond row of hairs with nippers, and if they grow again repeating the operation, and alfo cauterizing the pores out of which they iffued.

DISTILLATION. See CHEMISTRY. The objects of diftillation, confidered as a trade diftinct from the other branches of chemiftry, are chiefly fpirituous liquors, and thofe waters impregnated with the effential oils of plants, commonly called *fimple diftilled* waters. The diftilling compound fpirits and waters is reckoned a different branch of bufinefs, and they who deal in that way are commonly called *rectifiers*. This difference, however, though it exifts among commercial people, is not at all founded in the nature of the thing; compound fpirits being made, and fimple fpirits being rectified, by the very fame operations by which they are at firft diftilled, or at leaft with very trifling alterations.

The great object with every diftiller ought to be, to procure a fpirit perfectly flavourlefs, or at leaft as well freed from any particular flavour as may be; and in this country the procuring of fuch a fpirit is no eafy matter. The only materials for diftillation that have been ufed in large quantity, are malt, and molaffes or treacle. Both of thefe, efpecially the firft, abound with an oily matter, which, rifing along with the fpirit, communicates a difagreeable flavour to it, and from which it can fcarce be freed afterwards by any means whatever.

Previous to the operation of diftilling, thofe of brewing and fermentation are neceffary: but as thefe are treated of under the article BREWING, we fhall here only obferve, that the fermentation ought always to be carried on as flowly as poffible, and performed in veffels clofely ftopped; only having at the bung a valve preffed down by a fpring, which will yield with lefs force than is fufficient to burft the veffel. It fhould even be fuffered to remain till it has become perfectly fine and tranfparent; as by this means the fpirit will not only be fuperior in quantity, but alfo in fragrance, pungency, and vinofity, to that otherwife produced.

With regard to performing the operation of diftilling, there is only one general rule that can be given, namely, to let the heat in all cafes be as gentle as poffible. A water-bath, if fufficiently large, is preferable to any other mode, and will perform the operation with all the difpatch requifite for the moft extenfive bufinefs. As the end of rectification is to make the fpirit *clean* as well as *ftrong*, or to deprive it of the effential oil as well as the aqueous part, it will be proper to have regard to this even in the firft diftillation. For this purpofe, the fpirit, as it firft comes over, fhould be received into a quantity of cold water; as by this means the connection between it and the oily matter will be confiderably leffened. For the fame reafon, after it has been once rectified in the water-bath, it fhould be again mixed with an equal quantity of water, and diftilled a fecond time. Thus the fpirit will be freed from moft of the oily matter, even though it has been very much impregnated with it at firft. After the fpirit has been diftilled once or twice in this manner from water, it may be diftilled in a water-bath without any addition; and this laft rectification will free it from moft of the water it contains.

One very great defideratum among the diftillers of this country is, a method of imitating the foreign fpirits, brandy, rum, gin, &c. to a tolerable degree of perfection; and notwithftanding the many attempts that are daily made for this purpofe, our fuccefs in general has been but very indifferent. On this fubject, Mr. Cooper has fome valuable obfervations, in his Complete Syftem of Diftillation, of which, as they are applicable to all other fpirits as well as brandy, we fhall here avail ourfelves. The general method of diftilling brandies in France need not be formally defcribed, as it differs in nothing from that practifed here in working from malt-wafh or molaffes; nor are they in the leaft more cleanly or exact in the operation. They only obferve more particularly to throw in a little of the natural ley into the ftill along with the wine, as finding this gives their fpirit the flavour for which it is generally admired abroad. But, though brandy is extracted from wine, experience tells us, that there is a great difference in the grapes from which the wine is made. Every foil, every climate, every kind of grapes, varies with regard to the quantity and quality of the fpirits extracted from them. A large quantity of brandy is diftilled in France during the time of the vintage; for all thofe poor grapes that prove unfit for wine, are ufually firft gathered, preffed, their juice fermented, and directly diftilled. This rids them of their poor wines at once, and leaves their cafks empty for the reception of better. It is a general rule with them not to diftil wine that will fetch any price as wine; for, in this ftate, the profits obtained are vaftly greater than when reduced to brandies. This large ftock of fmall wines, with which they are almoft over-run in France, fufficiently accounts for their making fuch vaft quantities of brandy in that country, more than in others which lie in warmer climates and are much better adapted to the production of grapes. Nor is this the only fource of their brandies: for all the wine that turns eager, is alfo condemned to the ftill; and, in fhort, all that they can neither export nor confume at home, which amounts to a large quantity; fince much of the wine laid in for their family provifion is fo poor as not to keep during the time of drawing from the cafk. Hence our Englifh fpirits, with proper management, are convertible into brandies that fhall hardly be diftinguifhed from the foreign in many refpects, provided the operation be neatly performed.

The common method of rectifying fpirits from alkaline falts, deftroys their vinofity, and in its ftead gives an urinous or lixivious tafte. But as it is abfolutely neceffary to reftore, or at leaft to fubftitute in its room, fome degree of vinofity, feveral methods have been propofed, and a multitude of experiments performed, in order to difcover this great defideratum. But none has fucceeded equal to the fpirit of nitre, which has accordingly been ufed by moft diftillers. Several difficulties, however, occur in the method of ufing it; the principal of which is, its being apt to quit the liquor in a fhort time, and confequently depriving it of that vinofity it was intended to give. In order to obviate this, the dulcified fpirit of nitre, which is much better than the ftrong fpirit, fhould be prepared by a previous digeftion, continued for fome time, with alcohol; the longer the digeftion is continued, the more intimately will they be blended, and the compound rendered the milder and fofter.

After a proper digeftion, the dulcified fpirit fhould be mixed with the brandy, by which the vinofity will be intimately blended, and not difpofed to fly off for a very confiderable time. No general rule can be given for the quantity requifite to be employed; becaufe different proportions of it are neceffary in different fpirits. But though a fmall quantity of it will undoubtedly give an agreeable vinofity refembling that naturally found in the fine fubtile fpirits drawn from wines, yet an over dofe will not only caufe a difagreeable flavour, but alfo render the whole defign abortive, by difcovering the impofition.

But the beft, and indeed the only method of imitating French brandies to perfection, is by an effential oil of wine; this being the very thing that gives the French brandies their flavour. It muft, however, be remembered, that, in order to

ufe even this ingredient to advantage, a pure taftelefs fpirit muft firft be procured; for it is ridiculous to expect that this effential oil fhould be able to give the agreeable flavour of French brandies to our fulfome malt fpirit, already loaded with its own naufeous oil, or ftrongly impregnated with a lixivious tafte from the alkaline falts ufed in rectification.

To prepare the oil of wine, take fome cakes of dry wine-lees, fuch as are ufed by our hatters, diffolve them in fix or eight times their weight of water, diftil the liquor with a flow fire, and feparate the oil with a feparating glafs; referving for the niceft ufes only that which comes over firft, the fucceeding oil being coarfer and more refinous.—Having procured this fine oil of wine, it may be diffolved in alcohol; by which means it may be preferved a long time fully poffeffed of all its flavour; but otherwife it will foon grow rancid.

With a fine effential oil of wine thus procured, and a pure and infipid fpirit, French brandies may be imitated to perfection. The effential oil, however, muft be drawn from the fame kind of lees as the brandy to be imitated was procured from; *e. g.* in order to imitate Coniac brandy, it will be neceffary to diftil the effential oil from Coniac lees; and the fame for any other kind of brandy. For, as different brandies have different flavours, and as thefe flavours are entirely owing to the effential oil of the grape, it would be prepofterous to endeavour to imitate the flavour of Coniac brandy with an effential oil procured from the lees of Bourdeaux wine.—When the flavour of the brandy is well imitated by a proper dofe of the effential oil, and the whole reduced into one fimple and homogeneous fluid, other difficulties are ftill behind: the flavour, though the effential part, is not, however, the only one; the colour, the proof, and the foftnefs, muft alfo be regarded, before a fpirit that perfectly refembles brandy can be procured. With regard to the proof, it may be eafily hit, by ufing a fpirit rectified above proof; which, after being intimately mixed with the effential oil of wine, may be let down to a proper ftandard with fair water. And the foftnefs may, in a great meafure, be obtained by diftilling and rectifying the fpirit with a gentle fire; and what is wanting of this criterion in the liquor when firft made, will be fupplied by time: for it muft be remembered, that it is time alone that gives this property to French brandies; they being at firft acrid, foul, and fiery. But, with regard to the colour, a particular method is required to imitate it to perfection, which may be effected by means of treacle or burnt fugar. The treacle gives the fpirit a fine colour, nearly refembling that of French brandy; but as its colour is dilute, a large quantity muft be ufed: this is not, however, attended with any bad confequences; for notwithftanding the fpirit is really weakened by this addition, yet the bubble proof, the general criterion of fpirits, is greatly mended by the tenacity imparted to the liquor by the treacle. The fpirit alfo acquires from the mixture a fweetifh or lufcious tafte, and a fullnefs in the mouth; both which properties render it very agreeable to fome palates. A much fmaller quantity of burnt fugar than of treacle will be fufficient for colouring the fame quantity of fpirits: the tafte is alfo very different; for, inftead of the fweetnefs imparted by the treacle, the fpirit acquires from the burnt fugar an agreeable bitternefs, and by that means recommends itfelf to many who are offended with a lufcious fpirit. The burnt fugar is prepared by diffolving a proper quantity of fugar in a little water, and fcorching it over the fire till it acquires a black colour. Either treacle or burnt fugar will nearly imitate the genuine colour of old French brandy; but neither of them will fucceed when put to the teft of the vitriolic folution.

The fpirit diftilled from melaffes or treacle is very pure. It is made from common treacle diffolved in water, and fermented in the fame manner as the wafh for the common malt fpirit. But if fome particular art is not ufed in diftilling this fpirit, it will not prove fo vinous as malt fpirit, but more flat and lefs pungent and acid, though otherwife much cleaner tafted, as its effential oil is of a much lefs offenfive flavour. Therefore, if good frefh wine lees, abounding in tartar, be well fermented with the melaffes, the fpirit will acquire a much greater vinofity and brifknefs, and approach much nearer to the nature of foreign fpirits. Where the melaffes fpirit is brought to the common proof-ftrength, if it is found not to have a fufficient vinofity, it will be very proper to add fome dulcified fpirit of nitre; and if the fpirit be clean worked, it may, by this addition only, be made to pafs on ordinary judges for French brandy. Great quantities of this fpirit are ufed in adulterating foreign brandy, rum, and arrack. Much of it is alfo ufed alone in making cherry-brandy and other cordials by infufion; in all which, many, and perhaps with juftice, prefer it to foreign brandies. Melaffes, like all other fpirits, is entirely colourlefs when firft extracted; but diftillers always give it as nearly as poffible the colour of foreign fpirits.

If thefe principles hold good, the imitation of foreign fpirits of all kinds muft be practicable; if we only procure fome of thofe fubftances from which the fpirit is drawn, and diftil it with water, the effential oil will always give the flavour defired. Thus, to imitate Jamaica rum, it will only be neceffary to procure fome of the tops, or other ufelefs parts of the fugar-canes; from which an effential oil being drawn, and mixed with clean melaffes fpirit, will give it the true flavour. The principal difficulty muft lie in procuring a fpirit totally, or nearly, free from all flavour of its own. The fpirit drawn from the refufe of a fugar-houfe has been commended as fuperior to that drawn from melaffes; though it is very probable, that to procure an abfolutely flavourlefs fpirit is impoffible. The only method, therefore, of imitating foreign fpirits is, by choofing fuch materials as will yield a fpirit flavoured as much like them as poffible; and the materials moft recommended, and probably the beft that can be ufed, are raifins.

With regard to the diftillation of compound fpirits, it chiefly depends on obferving the following general rules:

1. To be careful to ufe a well cleanfed fpirit, or one freed from its own effential oil: for, as a compound water is nothing more than a fpirit impregnated with the effential oil of the ingredients, it is neceffary that the fpirit fhould have depofited its own. 2. Let the time of previous digeftion be proportioned to the tenacity of the ingredients, or the ponderofity of their oil. 3. Let the ftrength of the fire alfo be proportioned to the ponderofity of the oil intended to be raifed with the fpirit. 4. Let only a due proportion of the fineft parts of the effential oil be united with the fpirit; the groffer and lefs fragrant parts of the oil not giving the fpirit fo agreeable a flavour, and at the fame time rendering it unfightly. This may in a great meafure be effected by leaving out the faints, and making up to proof with fine foft water in their ftead.—A careful obfervation of thefe four rules will render this part of diftillation much more perfect than it is at prefent. Nor will there be any occafion for the ufe of burnt alum, white of eggs, ifinglafs, &c. to fine down cordial waters; for they will prefently be fine, fweet, and pleafant tafted, without any further trouble. We fhall now fubjoin particular receipts for making fome of thofe compound waters, or fpirits, that are moft commonly to be met with, and are in the moft general eftimation.

Strong Cinnamon-water. Take eight pounds of fine cinnamon bruifed, 17 gallons of clean rectified fpirit, and two gallons of water. Put them into the ftill, and digeft them 24 hours with a gentle heat; after which draw off 16 gallons with a pretty ftrong heat.—A cheaper fpirit, but of an inferior quality, may be obtained by ufing caffia lignea inftead of cinnamon. If

you would dulcify your cinnamon water, take double refined ſugar in what quantity you pleaſe; the general proportion is about two pounds to a gallon; and diſſolve it in the ſpirit, after you have made it up proof with clean water. One general caution is here neceſſary to be added, namely, that near the end of the operation, you carefully watch the ſpirit as it runs into the receiver, in order to prevent the faints from mixing with it. This you may diſcover by often catching ſome of it as it runs from the worm in a glaſs, and obſerving whether it is fine and tranſparent; for as ſoon as ever the faints begin to riſe, the ſpirit will have an azure or blueiſh caſt. As ſoon as this alteration in colour is perceived, the receiver muſt be immediately changed. Here we may obſerve, that the diſtillers call ſuch ſpirits as are made up proof, *double goods*: and thoſe below proof, *ſingle*. To make

Clove-water. Take of cloves bruiſed, four pounds; pimento, or all-ſpice, half a pound; proof-ſpirit, 16 gallons. Digeſt the mixture 12 hours in a gentle heat, and then draw off 15 gallons with a pretty briſk fire. The water may be coloured red, either by a ſtrong tincture of cochineal, alkanet, or corn-poppy flowers. It may be dulcified at pleaſure with double refined ſugar.

Lemon-water. Take of dried lemon-peel, four pounds: clean proof ſpirit 10 gallons and a half, and one gallon of water. Draw off 10 gallons by a gentle fire, and ſweeten with fine ſugar.

Citron-water. Take of dry yellow rhinds of citrons, three pounds; of orange-peel, two pounds; nutmegs bruiſed, three quarters of a pound; clean proof-ſpirit, ten gallons and a half; water, one gallon: digeſt with a gentle heat; then draw off ten gallons in balneo mariæ, and dulcify with fine ſugar.

Aniſeed water. Take of aniſeed bruiſed, two pounds; proof-ſpirit, 12 gallons and a half; water, one gallon: draw off ten gallons with a moderate fire.—This water ſhould never be reduced below proof; becauſe the large quantity of oil with which it is impregnated, will render the ſpirit milky when brought down below proof.

Orange-water. Take of the yellow part of freſh orange-peel, five pounds; clean proof-ſpirit, ten gallons and a half; water, two gallons: draw off ten gallons with a gentle fire.

Cedrat-water. The cedrat is a ſpecies of citron, and very highly eſteemed in Italy, where it grows naturally. The fruit is difficult to be procured in this country; but as the eſſential oil is often imported from Italy, it may be made with it according to the following receipt. Take of the fineſt loaf-ſugar reduced to powder, a quarter of a pound; put it into a marble mortar, with 120 drops of the eſſence of cedrat; rub them together with the peſtle; and put them into a glaſs alembic, with a gallon of fine proof-ſpirits and a quart of water. Place the alembic in balneo mariæ, and draw off one gallon, or till the faints begin to riſe; and ſweeten with fine ſugar. This is reckoned the fineſt cordial yet known; it will therefore be neceſſary to be particularly careful that the ſpirit is perfectly clean, and, as much as poſſible, freed from any flavour of its own.

Orange Cordial-water, or *Eau de Bigarade*. Take the outer or yellow part of the peels of 14 bigarades (a kind of oranges), half an ounce of nutmegs, a quarter of an ounce of mace, a gallon of fine proof-ſpirit, and two quarts of water. Digeſt all theſe together two days in a cloſe veſſel; after which draw off a gallon with a gentle fire, and dulcify with fine ſugar. This cordial is greatly eſteemed abroad, but is not ſo well known in this country.

Ros Solis. Take of the herb called *Ros Solis*, picked clean, four pounds; cinnamon, cloves, and nutmegs, of each three ounces and a half; marigold-flowers, one pound; caraway-ſeeds, ten ounces; proof-ſpirit, ten gallons; water, three gallons. Diſtil with a pretty ſtrong fire, till the faints begin to riſe. Then take of liquorice-root ſliced, half a pound; raiſins ſtoned, two pounds; red ſaunders, half a pound: digeſt theſe three days in two quarts of water; then ſtrain out the clear liquor, in which diſſolve three pounds of fine ſugar, and mix it with the ſpirit drawn by diſtillation.

Uſquebaugh. Take nutmegs, cloves, and cinnamon, of each two ounces; the ſeeds of aniſe, caraway, and coriander, of each four ounces; of liquorice-root ſliced, half a pound. Bruiſe the ſeeds and ſpices; and put them, together with the liquorice, into the ſtill with 11 gallons of proof-ſpirits, and two gallons of water. Diſtil with a pretty briſk fire till the faints begin to riſe. But, as ſoon as the ſtill begins to work, faſten to the noſe of the worm two ounces of Engliſh ſaffron tied up in a cloth, that the liquor may run through it, and extract all its tincture; and in order to this, you ſhould frequently preſs the ſaffron with your fingers. When the operation is finiſhed, ſweeten the ſpirit with fine ſugar.

Ratafia, is a liquor prepared from different kinds of fruits, and is of different colours according to the fruits made uſe of. Of red ratafia there are three kinds, the fine, the dry or ſharp, and the common. The fruits moſt proper for making red ratafia, are the black-heart cherry, the common red cherry, the black cherry, the merry or honey cherry, the ſtrawberry, the raſpberry, the red gooſeberry, and the mulberry. Theſe fruits ſhould be gathered when in their greateſt perfection, and the largeſt and moſt beautiful of them choſen for the purpoſe. The following is a receipt for making red ratafia, fine and ſoft. Take of the black-heart cherries 24 pounds; black cherries, four pounds; raſpberries and ſtrawberries, of each three pounds. Pick the fruits from their ſtalks, and bruiſe them; in which ſtate let them continue 12 hours: preſs out the juice; and to every pint of it add a quarter of a pound of ſugar. When the ſugar is diſſolved, run the whole through the filtrating bag, and add to it three quarts of clean proof-ſpirits. Then take of cinnamon, four ounces; of mace, one ounce; and of cloves, two drams. Bruiſe theſe ſpices; put them into an alembic with a gallon of clean proof-ſpirits and two quarts of water, and draw off a gallon with a briſk fire. Add as much of this ſpicy ſpirit to your ratafia as will render it agreeable to your palate; about one-fourth is the uſual proportion. Ratafia made according to the above receipt will be of a very rich flavour and elegant colour. It may be rendered more or leſs of a ſpicy flavour, by adding or diminiſhing the quantity of ſpirit diſtilled from the ſpices. It is alſo a method with ſome to tie the ſpices in a linen bag, and ſuſpend them in the ratafia. There is no great difference in the two methods of adding the ſpices, except that by ſuſpending them in the ratafia the liquor is rendered leſs tranſparent.

Dry or ſharp Ratafia. Take cherries and gooſeberries, of each 30 pounds; mulberries, ſeven pounds; raſpberries, ten pounds. Pick all theſe fruits clean from their ſtalks, &c. bruiſe them, and let them ſtand 12 hours; but do not ſuffer them to ferment. Preſs out the juice, and to every pint add three ounces of ſugar. When the ſugar is diſſolved, run it through the filtrating bag, and to every five pints of liquor add four pints of clean proof-ſpirit; together with the ſame proportion of ſpirit drawn from the ſpices in the foregoing compoſition.

Common Ratafia. Take of nutmegs, eight ounces; bitter almonds, ten pounds; Liſbon ſugar, eight pounds; ambergris, ten grains: infuſe theſe ingredients three days in ten gallons of clean proof-ſpirit, and filter through a flannel bag for uſe. The nutmegs and bitter almonds muſt be bruiſed, and the ambergris rubbed with the Liſbon ſugar in a marble mortar, before they are infuſed in the ſpirit.

Cardamom, or *All-fours*. Take of pimento, caraway, coriander feeds, and lemon-peel, each three pounds; of malt fpirits, eleven gallons; water, three gallons. Draw off with a gentle fire, fweeten with common fugar, and make up to the ftrength defired with clear water. This is a dram greatly ufed by the poorer fort of people in fome countries.

Geneva. There was formerly fold in the apothecaries fhops a diftilled fpirituous water of juniper; but the poor being fond of it as a dram, the diftillers fupplanted the apothecaries, and fold it under the name of *Geneva*. The common kind, however, is not made from juniper-berries, but from turpentine. The beft kind is made by the following receipt:—Take of juniper-berries, three pounds; proof fpirit, ten gallons; water, four gallons: draw off by a gentle fire till the faints begin to rife, and make up the fpirit to the ftrength required with clean water. There is a fort called *Hollands Geneva*, from its being imported from Holland, which is greatly efteemed. The ingredients ufed by the Dutch are the fame with thofe given in the laft receipt; only, inftead of malt-fpirits, they ufe French brandy. But from what has been already obferved concerning the nature of this kind of fpirits, it is eafy to fee, that by the help of a well rectified fpirit, geneva may be made in this country at leaft nearly equal to the Dutch, provided it is kept to a proper age; for all fpirituous liquors contract a foftnefs and mellownefs by age, impoffible to be attained in any other way.

DISTILLERY, the art of diftilling brandy and other fpirits. This art was firft brought into Europe by the Moors of Spain, about the year 1150: they learned it of the African Moors, who had it from the Egyptians: and the Egyptians are faid to have practifed it in the reign of the emperor Dioclefian, though it was unknown to the ancient Greeks and Romans. See DISTILLATION, and FERMENTATION.

DISTINCTION, in logic, is an affemblage of two or more words, whereby difparate things, or their conceptions, are denoted.

DISTORTION, in furgery, is when any part of the human body remarkably deviates from its natural fhape or pofition. Diftortions of different parts may arife either from an original defect in the formation, as in the *club foot* in new born infants, or it may refult from fome accident by which a limb is broken or diflocated.

DISTRESS, in law, the feizing or diftraining any thing for rent in arrear, or other duty unperformed. The effect of this diftrefs is to compel the party either to replevy the things diftrained, and conteft the taking, in an action of trefpafs againft the diftrainer; or rather to oblige him to compound and pay the debt or duty for which he was fo diftrained. There are likewife compulfory diftreffes in actions, to caufe a perfon to appear in court; of which kind there is a diftrefs perfonal of one's moveable goods, and the profits of his lands, for contempt in not appearing after fummons: there is likewife diftrefs real, of a perfon's immoveable goods. In thefe cafes none fhall be diftrained to anfwer for any thing touching their freeholds, but by the king's writ. Diftrefs may be either *finite* or *infinite*. Finite diftrefs is that which is limited by law, in regard to the number of times it fhall be made, in order to bring the party to a trial of the action. Infinite diftrefs is that which is without any limitation, being made till the perfon appears: it is farther applied to jurors that do not appear; as, upon a certificate of affife, the procefs is *venire facias*, *habeas corpora*, and diftrefs infinite. It is alfo divided into *grand* diftrefs and *ordinary* diftrefs; of thefe the former extends to all the goods and chattels that the party has within the county. A perfon, of common right, may diftrain for rents and all manner of fervices; and where a rent is referved on a gift in tail, leafe for life, or years, &c. though there be no claufe of diftrefs in the grant or leafe, fo as that he has the reverfion; but on a feoffment made in fee, a diftrefs may not be taken, unlefs it be exprefsly referved in the deed.

DISTRIBUTION, in architecture, the dividing and difpofing the feveral parts and pieces which compofe a building, as the plan directs. See ARCHITECTURE.

DISTRIBUTION, in rhetoric, a kind of defcription, whereby an orderly divifion and enumeration is made of the principal qualities of the fubject. David fupplies us with an example of this kind, when, in the heat of his indignation againft finners, he gives a defcription of their iniquity: "Their throat is an open fepulchre; they flatter with their tongues; the poifon of afps is under their lips; their mouth is full of curfing and lies; and their feet are fwift to fhed blood."

DISTRIBUTION, in printing, the taking a form afunder, feparating the letters, and difpofing them in the cafes again, each in its proper cell. See PRINTING.

DISTRICT, in geography, a part of a province, diftinguifhed by peculiar magiftrates, or certain privileges; in which fenfe it is fynonymous with hundred. See HUNDRED.

DISTRINGAS, in law, a writ commanding the fheriff, or other officer, that he diftrain a perfon for debt to the king, &c. or for his appearance at a certain day.

DISTRINGAS *Juratores*, a writ directed to the fheriff, whereby he is commanded to diftrain upon a jury to appear, and to return iffues on their lands, &c. for non-appearance. This writ of diftringas juratores iffues for the fheriff to have their bodies in court, &c. at the return of the writ.

DITCH, a common fence or inclofure in marfhes, or other wet land where there are no hedges. They allow thefe ditches fix feet wide next to highways that are broad; and againft commons, five feet. But the common ditches about inclofures, dug at the bottom of the bank on which the quick is raifed, are three feet wide at the top, one at the bottom, and two feet deep. By this means each fide has a flope, which is of great advantage; for where this is neglected, and the ditch is dug perpendicular, the fides are always wafhing down; befides, in a narrow-bottomed ditch, if cattle get down into it, they cannot ftand to turn themfelves to crop the quick: but where the ditch is four feet wide, it fhould be two and a half deep; and where it is five wide, it fhould be three deep; and fo in proportion.

DITCH, in fortification, called alfo *fofs* and *moat*, a trench dug round the rampart or wall of a fortified place, between the fcarp and counterfcarp. See FORTIFICATION.

DITHYRAMBUS, in ancient poetry, a hymn in honour of Bacchus, full of tranfport and poetical rage. This poetry owes its birth to Greece, and to the influence of wine; and yet art is not quite exploded, but delicately applied to guide and reftrain the dithyrambic impetuofity, which is indulged only in pleafing flights. Horace and Ariftotle tell us, that the ancients gave the name of dithyrambus to thofe verfes wherein none of the common rules or meafures were obferved. As we have now no remains of the dithyrambus of the ancients, we cannot fay exactly what their meafure was.

DITONE, in mufic, an interval comprehending two tones. The proportion of the founds that form the ditone is 4 : 5, and that of the femiditone is 5 : 6.

DITRIHEDRIA, in mineralogy, a genus of fpars with twice three fides, or fix planes; being formed of two trigonal pyramids joined bafe to bafe, without any intermediate column. See SPAR. The fpecies of ditrihedria are diftinguifhed by the different figures of thefe pyramids.

DITTANDER, in botany. See LEPIDIUM.

DITTANY, in botany. See DICTAMNUS.

DITTO, in books of accounts, ufually written D°, fignifies *the aforementioned*. The word is corrupted from the Italian

detto, "the ſaid :" as in our law-phraſe, "the ſaid premiſſes," meaning the ſame as were aforementioned.

DIVAL, in heraldry, the herb nightſhade, uſed by ſuch as blazon by flowers and herbs, inſtead of colours and metals, for ſable or black.

DIVALIA, in antiquity, a feaſt held among the ancient Romans, on the 21ſt day of December, in honour of the goddeſs Angerona; whence it is alſo called *Angeronalia.* On the day of this feaſt, the pontifices performed ſacrifice in the temple of Voluptia, or the goddeſs of joy and pleaſure; who, ſome ſay, was the ſame with Angerona, and ſuppoſed to drive away all the ſorrows and chagrins of life.

DIVAN, a council-chamber or court of juſtice among the eaſtern nations, particularly the Turks. The word is Arabic, and ſignifies the ſame with SOFA in the Turkiſh dialect. There are two ſorts of divans; that of the grand ſignior, called *the council of ſtate,* which conſiſts of ſeven of the principal officers of the empire; and that of the grand vizir, compoſed of ſix other vizirs or counſellors of ſtate, the chancellor, and ſecretaries of ſtate, for the diſtribution of juſtice. The word is alſo uſed for a hall in the private houſes of the orientals. The cuſtom of China does not allow the receiving of viſits in the inner parts of the houſe, but only at the entry, in a divan contrived on purpoſe for ceremonies. Travellers relate wonders of the ſilence and expedition of the divans of the Eaſt.

DIVAN-*Beghi,* the ſuperintendant of juſtice in Perſia, whoſe place is the laſt of the ſix miniſters of the ſecond rank, who are all under the athemadauler or firſt miniſter. To this tribunal of the divan-beghi he appeals from ſentences paſſed by the governors. He has a fixed ſtipend of 50,000 crowns for adminiſtering juſtice. All the ſerjeants, uſhers, &c. of the court are in his ſervice. He takes cogniſance of the criminal cauſes of the chams, governors, and other great lords of Perſia, when accuſed of any fault. There are divan-beghis not only at court and in the capital, but alſo in the provinces and other cities of the empire. The alcoran is the ſole rule of his adminiſtration of juſtice, which alſo he interprets at pleaſure. He takes no cogniſance of civil cauſes; but all differences ariſing between the officers of the king's houſehold and between foreign miniſters are determined by him.

DIVANDUROW, the name of ſeven iſlands which lie a league north of the Maldives, and 24 from the coaſt of Malabar, almoſt oppoſite to Cananor.

DIVER, in ornithology. See COLYMBUS.

DIVERGENT, or DIVERGING, LINES, in geometry, are thoſe which conſtantly recede from each other.

DIVERGENT *Rays,* in optics, are thoſe which, going from a point of the viſible object, are diſperſed, and continually depart one from another, in proportion as they are removed from the object: in which ſenſe it is oppoſed to convergent. See OPTICS.

DIVERSIFYING, in rhetoric, is of infinite ſervice to the orator; it is an accompliſhment eſſential to his character, and may fitly be called the ſubject of all his tropes and figures. Voſſius lays down ſix ways of diverſifying a ſubject. 1. By enlarging on what was briefly mentioned before. 2. By a conciſe enumeration of what had been inſiſted on at length. 3. By adding ſomething new to what is repeated. 4. By repeating only the principal heads of what had been ſaid 5. By tranſpoſing the words and periods. 6. By imitating them.

DIVERSION, in military affairs, is when the enemy is attacked in one place where they are weak and unprovided, in order to draw off their forces from another place where they have made or intend to make an irruption. Thus the Romans had no other way in their power of driving Hannibal out of Italy, but by making a diverſion in attacking Carthage.

DIVESTING, properly ſignifies undreſſing, or ſtripping off one's garment; in contradiſtinction to inveſting. In law, it is uſed for the act of ſurrendering or relinquiſhing one's effects. By a contract of donation or ſale, the donor or ſeller is ſaid to be diſſeiſed and diveſted of his property in ſuch a commodity, and the donee or purchaſer becomes inveſted therewith. See INVESTITURE. A demiſe is a general diveſtiture which the fathers and mothers make of all their effects in favour of their children.

DIVIDEND, in arithmetic, the number propoſed to be divided into equal parts. See ARITHMETIC.

DIVIDEND *of Stocks,* is a ſhare or proportion of the intereſt of ſtocks erected on public funds, as the ſouth-ſea, &c. divided among and paid to the ſtock-holders half-yearly.

DIVINATION, implies the knowledge of things obſcure or future, which cannot be attained by any natural means. It was a received opinion among the heathens, that the gods were wont to converſe familiarly with ſome men, whom they endowed with extraordinary powers, and admitted to the knowledge of their councils and deſigns. Plato, Ariſtotle, Plutarch, Cicero, and others, divide divination into two ſpecies, viz. *natural* and *artificial.* The former was ſo called, becauſe not attained by any rules of art, but infuſed or inſpired into the diviner, without his taking any farther care about it than to purify and prepare himſelf for the reception of the divine afflatus. Of this kind were all thoſe who delivered oracles, and foretold future events by inſpiration, without obſerving external ſigns or accidents. The ſecond ſpecies of divination was called *artificial,* becauſe it was not obtained by immediate inſpiration, but proceeded upon certain experiments and obſervations arbitrarily inſtituted, and moſtly ſuperſtitious. Of this ſort there were various kinds, as by ſacrifices, entrails, flame, cakes, flour, wine, water, birds, lots, verſes, omens, &c.

In holy ſcripture we find mention made of nine different kinds of divination. The firſt performed by the inſpection of planets, ſtars, and clouds: it is ſuppoſed to be the practiſers of this whom Moſes calls מעונן *meonen,* of ענן *anan* "cloud," Deuter. ch. xviii. v. 10. 2. Thoſe whom the prophet calls in the ſame place מנחש *menacheſch,* which the vulgate and generality of interpreters render *augur.* 3. Thoſe who in the ſame place are called מכשף *mecaſcheph,* which the ſeptuagint and vulgate tranſlate "a man given to ill practices." 4. Such authors whom Moſes in the ſame chapter, ver. 11. calls חובר *hhober.* 5. Thoſe who conſult the ſpirits called *Python*; or, as Moſes expreſſes it in the ſame book, אוב אשל "thoſe who aſk queſtions of Python." 6. Witches or magicians, whom Moſes calls ידעני *judeoni.* 7. Thoſe who conſult the dead, *necromancers.* 8. The prophet Hoſea, chap. iv. ver. 12. mentions ſuch as conſult ſtaves, שאל מקלי; which kind of divination may be called *rhabdomancy.* 9. The laſt kind of divination mentioned in ſcripture is *hepatoſcopy,* or the conſideration of the liver.

Divination of all kinds was neceſſarily made an occult ſcience, which naturally remained in the hands of the prieſts and prieſteſſes, the magi, the ſoothſayers, &c. Much to the honour of the 18th century, the pure doctrines of Chriſtianity, and the ſpirit of Philoſophy, which become every day more diffuſed, equally concur in baniſhing theſe viſionary opinions; though there are ſtill a few impoſtors of the loweſt order that practiſe their frauds on the ignorant and unthinking.

DIVINE, ſomething relating to God. The word is alſo uſed, figuratively, for any thing that is excellent, extraordinary, and that ſeems to go beyond the power of nature and the capacity of mankind. In this ſenſe, the compaſs, teleſcopes, clocks, &c. are ſaid to be *divine inventions*: Plato is called the *divine author,* the *divine Plato*; and the ſame appel-

lation is given to Seneca: Hippocrates is called "the divine old man," *divinus ſenex*, &c.

DIVING, the art or act of deſcending under water to conſiderable depths, and abiding there a competent time. The uſes of diving are very conſiderable, particularly in the fiſhing for pearls, corals, ſpunges, &c. See PEARL-*Fiſhing*, &c.

There have been various methods propoſed, and machines contrived, to render the practice of diving more ſafe and eaſy. The great point is to furniſh the diver with freſh air; without which he muſt either make a ſhort ſtay or periſh. Hence, where there has been occaſion to continue long at the bottom, ſome have contrived double flexible pipes, to circulate air down into a cavity, incloſing the diver as with armour, both to furniſh air and to bear off the preſſure of the water, and allow his breaſt to dilate upon inſpiration; the freſh air being forced down one of the pipes with bellows, and returning by the other pipe.

But this method is impracticable when the depth ſurpaſſes three fathoms; the water embracing the bare limbs ſo cloſely as to obſtruct the circulation of the blood in them; and alſo preſſing ſo ſtrongly on all the junctures where the armour is made tight with leather, that, if there be the leaſt defect in any of them, the water ruſhes in, and inſtantly fills the whole engine, to the great danger of the diver's life.

It is ſaid to be a fact, that people, by being accuſtomed to the water from their infancy, will at length be enabled, not only to ſtay much longer under water than could be ſuppoſed, but put on a kind of amphibious nature, ſo that they ſeem to have the uſe of all their faculties as well when their bodies are immerſed in water as when they are on dry land. Moſt ſavage nations are remarkable for this. According to the accounts of our late voyagers, the inhabitants of the South-ſea iſlands are ſuch expert divers, that when a nail or any piece of iron was thrown overboard, they would inſtantly jump into the ſea after it, and never failed to recover it, notwithſtanding the quick deſcent of the metal. Even among civilized nations, many perſons have been found capable of continuing an incredible length of time under water. The moſt remarkable inſtance of this kind is the famous Sicilian diver Nicolo Peſce, who, according to the marvellous account given by Kircher, had from his infancy been ſo uſed to the ſea, that at laſt it became his almoſt natural element. It is ſaid, he was frequently known to ſpend five days in the midſt of the waves, without any other proviſions than the fiſh which he caught there and ate raw. He often ſwam over from Sicily into Calabria, a tempeſtuous and dangerous paſſage, carrying letters from the king; and as frequently ſwam among the gulphs of the Lipari iſlands, no way apprehenſive of danger. "In order (ſays Kircher) to aid theſe powers of enduring in the deep, nature ſeemed to have aſſiſted him in a very extraordinary manner: for the ſpaces between his fingers and toes were webbed, as in a gooſe; and his cheſt became ſo very capacious, that he could take in, at one inſpiration, as much breath as would ſerve him for a *whole day*." At length, however, we are told, this extraordinary perſon met his fate in exploring the depths of Charybdis at the inſtance of the king; who, after he had once ſucceeded in fetching up a golden cup that had been thrown in, ordered him to repeat the experiment.

To obviate the inconveniences of diving to thoſe who have not the extraordinary powers attributed to poor *Nicholas*, different inſtruments have been contrived. The chief of theſe is the diving bell; which is moſt conveniently made in form of a truncated cone, the ſmaller baſe being cloſed, and the larger open. It is to be poiſed with lead; and ſo ſuſpended, that the veſſel may ſink full of air, with its open baſis downward, and as near as may be in a ſituation parallel to the horizon, ſo as to cloſe with the ſurface of the water all at once. The diver ſitting under this, ſinks down with the included air to the depth deſired: and if the cavity of the veſſel can contain a tun of water, a ſingle man may remain a full hour, without much inconvenience, at five or ſix fathoms deep. But the lower you go, ſtill the included air contracts itſelf according to the weight of the water which compreſſes it: ſo that at 33 feet deep the bell becomes half full of water, the preſſure of the incumbent water being then equal to that of the atmoſphere; and at all other depths the ſpace occupied by the compreſſed air in the upper part of the bell will be to the under part of its capacity filled with water, as 33 feet to the ſurface of the water in the bell below the common ſurface thereof. And this condenſed air being taken in with the breath ſoon accommodates itſelf to the exiſting circumſtances ſo as to have no ill effect, provided the bell be permitted to deſcend ſo ſlowly as to allow time for that purpoſe. But the greateſt inconvenience of this engine is, that the water entering it, contracts the bulk of air into ſo ſmall a compaſs, that it ſoon heats and becomes unfit for reſpiration: ſo that there is a neceſſity for its being drawn up to recruit it; beſides the uncomfortable ſituation of the diver, who muſt be almoſt covered with water.

To obviate theſe difficulties of the diving-bell, Dr. Halley, to whom we owe the preceding account, contrived a farther apparatus, whereby not only to recruit the air from time to time, but alſo to keep the water wholly out of the machine at any depth. This bell was made of wood, containing about 60 cubic feet in its concavity; and was of the form of a truncated cone, whoſe diameter at the top was 3 feet, and at the bottom 5. It was ſo loaded with lead, that it would go down in a perpendicular direction, and no other. In the top was a window, to let in light; and likewiſe a cock to let out the hot air that had been breathed: and below, about a yard under the bell, was a ſtage, ſuſpended by three ropes, each of which was charged with about one hundred weight to keep it ſteady. To ſupply air, the bell had a couple of barrels, ſo caſed with lead, as to ſink when empty; each having a bung-hole in its loweſt part to let in the water, as the air in them condenſed on their deſcent; and to let it out again when they were drawn up full from below. To a hole in the uppermoſt part of theſe, was fixed a leathern trunk or hoſe, long enough to fall below the bung-hole, and kept down by a weight in ſuch a way that the air in the upper part of the barrels could not eſcape, unleſs the lower ends of theſe hoſe were firſt lifted up. Theſe air-barrels were made to riſe and fall like two buckets in a well. By means of theſe barrels freſh air was continually ſupplied from above; and it was done with ſo much eaſe, that two men, with leſs than half their ſtrength, could perform all the labour required. By an additional contrivance, it was found practicable for a diver to go out of the engine to ſome diſtance from it; the air being conveyed to him in a continued ſtream, by ſmall flexible pipes. Some idea of Dr. Halley's machine may be formed from the inſpection of Plate 4. where the divers are ſeen at work. D, B, L, K, R, I, M, P, repreſent the body of the bell. D, the glaſs which ſerves as a window. B, the cock for letting out the air which has been breathed. L, M, the ſeats. C, one of the air-barrels. P, H, two of the divers. F, another diver at a diſtance from the bell, and breathing through the flexible tube K. This diver is ſuppoſed to have a head-piece of lead, made to fit quite cloſe about his ſhoulders: this head-piece was capable of containing as much air as would ſupply him for a minute or two. When he had occaſion for more air, he turned a cock at F, by which means a communication was opened with the air in the bell, and thus he could receive a new ſupply at pleaſure.

Since the invention of this diving-bell, there has been one contrived by Mr. Triewald, F. R. S. and military architect to the king of Sweden, which, for a ſingle perſon, is in ſome re-

ſpects thought to be more eligible than Dr. Halley's, and is conſtructed as follows. AB, Plate 4. is the bell, which is ſunk by leaden weights DD hung to its bottom. This bell is of copper, and tinned all over on the inſide, which is illuminated by three ſtrong convex lenſes, G, G, G, with copper lids H, H, H, to defend them. The iron ring or plate E ſerves the diver to ſtand on when he is at work; and is ſuſpended at ſuch a diſtance from the bottom of the bell by the chains F, F, F, that when the diver ſtands upright, his head is juſt above the water in the bell, where the air is much better than higher up, becauſe it is colder, and conſequently more fit for reſpiration. But as the diver muſt always be within the bell, and his head of courſe in the upper part, the inventor has contrived, that even there, when he has breathed the hot air as well as he can, he may, by means of a ſpiral copper tube *b*, *o*, placed cloſe to the inſide of the bell, draw the cooler and freſher air from the lowermoſt parts: for which purpoſe, a flexible leather tube, about two feet long, is fixed to the upper end of the copper tube at *b*; and to the other end of this tube is fixed an ivory mouth-piece, by which the diver draws in the air.

But the greateſt improvement which the diving-bell ever received, or probably can receive, was from the late Mr. Spalding of Edinburgh. A ſection of his improved diving-bell is repreſented in the Plate. This conſtruction ſeems deſigned to remedy ſome inconveniences of Dr. Halley's, which are very evident, and of a very dangerous tendency. Theſe are, 1. By Dr. Halley's conſtruction, the ſinking or raiſing of the bell depends entirely on the people who are at the ſurface of the water; and as the bell even when in the water has a very conſiderable weight, the raiſing it not only requires a great deal of labour, but there is a poſſibility of the rope breaking by which it is raiſed, and thus every perſon in the bell would inevitably periſh. 2. As there are, in many parts of the ſea, rocks which lie at a conſiderable depth, the figure of which cannot poſſibly be perceived from above, there is danger that ſome of their ragged prominences may catch hold of one of the edges of the bell in its deſcent, and thus overſet it before any ſignal can be given to thoſe above, which would infallibly be attended with the deſtruction of the people in the bell: and as it muſt always be unknown, before trial, what kind of a bottom the ſea has in any place, it is plain, that without ſome contrivance to obviate this laſt danger, the deſcent in Dr. Halley's diving-bell is not at all eligible.

How theſe inconveniences are remedied by Mr. Spalding's new contrivance will be eaſily underſtood from the following deſcription.—A B C D repreſents a ſection of the bell, which is made of wood; *e*, *e*, are iron hooks, by means of which it is ſuſpended by ropes Q B F *e*, and Q A E R *e*, and Q S, as expreſſed in the figure: *c*, *c*, are iron hooks, to which are appended leaden weights, that keep the mouth of the bell always parallel to the ſurface of the water, whether the machine taken altogether is lighter or heavier than an equal bulk of water. By theſe weights alone, however, the bell would not ſink: another is therefore added, repreſented at L; and which can be raiſed or lowered at pleaſure, by means of a rope paſſing over the pulley *a*, and faſtened to one of the ſides of the bell at M. As the bell deſcends, this weight, called by Mr. Spalding the *balance weight*, hangs down a conſiderable way below the mouth of the bell. In caſe the edge of the bell is caught by any obſtacle, the balance-weight is immediately lowered down ſo that it may reſt upon the bottom. By this means the bell is lightened, ſo that all danger of overſetting is removed; for being lighter, without the balance-weight, than an equal bulk of water, it is evident that the bell will riſe, as far as the length of the rope affixed to the balance-weight will allow it. This weight, therefore, will ſerve as a kind of anchor to keep the bell at any particular depth which the divers may think neceſſary; or by pulling it quite up, the deſcent may be continued to the very bottom.

By another very ingenious contrivance, Mr. Spalding rendered it poſſible for the divers to raiſe the bell, with all the weights appended to it, even to the ſurface, or to ſtop at any particular depth, as they think proper; and thus they could ſtill be ſafe, even though the rope deſigned for pulling up the bell were broke. For this purpoſe the bell is divided into two cavities, both of which are made as tight as poſſible. Juſt above the ſecond bottom E F, are ſmall ſlits in the ſides of the bell; through which the water, entering as the bell deſcends, diſplaces the air originally contained in its cavity, which flies out at the upper orifice of the cock G H. When this is done, the divers turn the handle G, which ſtops the cock; ſo that if any more air were to get into the cavity A E F B, it could no longer be diſcharged through the orifice H as before. When this cavity is full of water, the bell ſinks; but when a conſiderable quantity of air is admitted, it riſes. If therefore the divers have a mind to raiſe themſelves, they turn the ſmall cock *g*, by which a communication is made between the upper and under cavities of the bell. The conſequence of this is, that a quantity of air immediately enters the upper cavity, forces out a quantity of the water contained in it, and thus renders the bell lighter by the whole weight of the water which is diſplaced. Thus, if a certain quantity of air is admitted into the upper cavity, the bell will deſcend very ſlowly; if a greater quantity, it will neither aſcend nor deſcend, but remain ſtationary; and if a larger quantity of air be ſtill admitted, it will riſe to the top. It is to be obſerved, however, that the air which is thus let out into the upper cavity muſt be immediately replaced from the air-barrel; and the air is to be let out very ſlowly, or the bell will riſe to the top with ſo great velocity that the divers will be in danger of being ſhaken out of their ſeats. But, by following theſe directions, every poſſible accident may be prevented, and people may deſcend to great depths without the leaſt apprehenſion of danger. The bell alſo becomes ſo eaſily manageable in the water, that it may be conducted from one place to another by a ſmall boat with the greateſt eaſe, and with perfect ſafety to thoſe who are in it.

Inſtead of wooden ſeats uſed by Dr. Halley, Mr. Spalding made uſe of ropes ſuſpended by hooks *bbb*; and on theſe ropes the divers may ſit without any inconvenience. I and K are two windows made of thick ſtrong glaſs, for admitting light to the divers. N repreſents an air-caſk with its tackle, and O C P the flexible pipe through which the air is admitted to the bell. In the aſcent and deſcent of this caſk, the pipe is kept down by a ſmall appended weight, as in Dr. Halley's machine. R is a ſmall cock by which the hot air is diſcharged as often as it becomes troubleſome. Annexed is a repreſentation of the whole diving apparatus, which, no doubt, will be readily underſtood without any further explanation. Two air-barrels are repreſented in this figure; but Mr. Spalding was of opinion, that one capable of containing 30 gallons is ſufficient for an ordinary machine.

We are told of another method put in practice by a gentleman of Devonſhire. He has contrived a large caſe of ſtrong leather, perfectly water-proof, which may hold about half a hogſhead of air. This is ſo contrived, that, when he ſhuts himſelf up in this caſe, he may walk at the bottom of the ſea, and go into any part of a wrecked veſſel, and deliver out the goods. This method, we are told, he has practiſed for many years, and has thus acquired a large fortune. It would be a conſiderable improvement of this machine to condenſe the air in it as much as poſſible before the diver deſcended; as he would thus be furniſhed with an atmoſphere endued with elaſ-

ticity sufficient to resist the weight of the water, which otherwise would squeeze his case into much less room than it originally took up. The condensed air also would serve for respiration a much longer time than that which is in its ordinary state.

Diving-*Bladder*, a machine invented by Borelli, and by him preferred, though without any good reason, to the diving-bell. It is a globular vessel of brass or copper, about two feet in diameter, formed to contain the diver's head. It is fixed to a goat's-skin habit, exactly fitted to his person. Within the vessel are pipes; by means of which a circulation of air is contrived; and the person carries an air-pump by his side, by which he can make himself heavier or lighter as fishes do, by contracting or dilating their air bladders. By this means he thought all the objections to which other diving machines are liable were entirely obviated, and particularly that of want of air: the air which had been breathed, being, as he imagined, deprived of its noxious qualities by circulating through the pipes. These advantages, however, it is evident, are only imaginary. The diver's limbs, being defended from the pressure of the water only by a goat's-skin, would infallibly be crushed if he descended to any considerable depth; and from the discoveries now made by Dr. Priestley and others, it is abundantly evident, that air, which is once rendered foul by breathing, cannot in any degree be restored by circulation through pipes. Concerning the use of copper machines in general, Mr Spalding has remarked, that when a person has breathed in them a few minutes, he feels in his mouth a very disagreeable brassy taste, which continues all the time he remains in the vessel: so that, on this account, copper seems by no means an eligible material.

DIVINITY, properly signifies the nature, quality, and essence of God. *Divinity* is also used in the same sense with theology.

DIVISIBILITY, that property by which the particles of matter in all bodies are capable of a separation or disunion from each other. The Peripatetics and Cartesians hold divisibility to be an affection of all matter. The Epicureans, again, allow it to agree to every physical continuum; but they deny that this affection agrees to all bodies, for the primary corpuscles or atoms they maintain to be perfectly insecable and indivisible.

As it is evident that body is extended, so it is no less evident that it is divisible: for since no two particles of matter can exist in the same place, it follows, that they are really distinct from each other; which is all that is meant by being divisible. In this sense the least conceivable particle must still be divisible, since it will consist of parts which will be really distinct. To illustrate this by a familiar instance: Let the least imaginable piece of matter be conceived lying on a smooth plain surface, it is evident the surface will not touch it every where: those parts therefore which it does not touch may be supposed separable from the others, and so on as far as we please; and this is all that is meant when we say matter is infinitely divisible.

The infinite divisibility of mathematical quantity is demonstrated geometrically thus. Suppose the line AC Pl. 3. perpendicular to BF; and another, as GH, at a small distance from it, also perpendicular to the same line: with the centres CCC, &c. describe circles cutting the line G H in the points *e e e*, &c. Now the greater the radius A C is, the less is the part *e* H. But the radius may be augmented in infinitum; so long, therefore, the part *e* H may be divided into still less portions; consequently it may be divided in infinitum.

How far matter may actually be divided, may in some measure be conceived from hence; that a piece of wire, gilt with so small a quantity as eight grains of gold, may be drawn out to a length of 13,000 feet, the whole surface of it still remaining covered with gold. We have also a surprising instance of the minuteness of some parts of matter from the nature of light and vision. Let a candle be lighted, and placed in an open plain, it will then be visible two miles round; and consequently was it placed two miles above the surface of the earth, it would fill with luminous particles a sphere whose diameter was four miles, and that before it had lost any sensible part of its weight. A quantity of vitriol dye being dissolved, and mixed with 9000 times as much water, will tinge the whole; consequently will be divided into as many parts as there are visible portions of matter in that quantity of water. There are perfumes, which, without a sensible diminution of their quantity, shall fill a very large space with their odoriferous particles; which must therefore be of an inconceivable smallness, since there will be a sufficient number in every part of that space sensibly to affect the organ of smelling. Dr. Keill demonstrates, that any particle of matter, how small soever, and any finite space, how large soever, being given, it is possible for that small particle of matter to be diffused through all that space, and to fill it in such a manner as that there shall be no pore in it whose diameter shall exceed any given line.

The chief objections against the divisibility of matter in infinitum are, That an infinite cannot be contained by a finite; and that it follows from a divisibility in infinitum, either that all bodies are equal, or that one infinite is greater than another. But the answer to these is easy; for the properties of a determined quantity are not to be attributed to an infinite considered in a general sense; and who has ever proved that there could not be an infinite number of infinitely small parts in a finite quantity, or that all infinites are equal? The contrary is demonstrated by mathematicians in innumerable instances. See the article Infinite, and *'S Gravesande Elem. Mathem.* l. i. chap. 4.

DIVISION, in general, is the separating a thing into two or more parts. *Mechanical* Division signifies that separation which is occasioned in the parts of a body by the help of mechanical instruments. The mechanical division of bodies does indeed separate them into smaller, homogeneous, similar parts; but this separation cannot extend to the primary integrant molecules of any body; and consequently is incapable of breaking what is properly called their *aggregation:* also, no union is formed betwixt the divided and dividing bodies, in which respect division essentially differs from dissolution.

Division is not properly a chemical operation. It is only employed preparatorily, to facilitate other operations, and particularly solution. For this purpose it is very useful, as it increases the quantity of surface, and consequently the points of contact of any body.—Different methods are used to divide bodies, according to their nature, as cutting, pounding, rasping, &c. These methods, however, of mechanically dividing bodies are attended with some practical inconveniences; the most considerable of which is, that some parts of the dividing instruments are always struck off, and mixed with the matter to be divided; and this may greatly affect the operations. For instance, instruments of iron and copper furnish metallic colouring particles, and copper is very prejudicial to health. Porphyry is coloured by a reddish brown matter, which injures the colour of crystal glasses, enamels, and porcelains made with matters ground upon this stone. These matters therefore must be cleansed after their porphyrisation, or else no instruments capable of injuring the intended operations ought to be employed. The like remarks apply to the preparation of all medicines to be taken internally. No copper instruments, as mortars, pestles, &c. ought to be used; those made of iron being preferable. Instead of porphyries,

mortars, grinding-ſtones and mill-ſtones, made of hard and white ſtone, ought to be employed for ſubſtances which are to enter into the compoſition of enamels, cryſtal glaſs, or porcelain, the whiteneſs of which is a moſt neceſſary quality.

Division, in algebra. See Algebra, p. 100.

Division, in arithmetic. See Arithmetic, p. 314.

Divisions *of an army*, in the military art, the ſeveral brigades and ſquadrons into which it is cantoned.

Divisions *of a Battalion*, are the ſeveral platoons into which it is divided in marching or firing, each of which is commanded by an officer.

Division, in ſea affairs, a ſelect number of ſhips in a fleet or ſquadron of men of war, diſtinguiſhed by a particular flag or pendant, and uſually commanded by a general officer. A ſquadron is commonly ranged into three diviſions, the commanding officer of which is always ſtationed in the centre. When a fleet conſiſts of 60 ſail of the line, that is, of ſhips having at leaſt ſixty guns each, the admiral divides it into three ſquadrons, each of which has its diviſions and commanding officers. Each ſquadron has its proper colours, according to the rank of the admiral who commands it, and every diviſion its proper maſt. Thus the white flag denotes the firſt diviſion of France; the white and blue the ſecond; and the third is characteriſed by the blue. In Britain, the firſt admiral, or the admiral of the fleet, diſplays the union-flag at the main top-maſt head; next follows the white flag with St. George's croſs; and afterwards the blue. The private ſhips carry pendants of the ſame colour with their reſpective ſquadrons at the maſt of their particular diviſions; ſo that the laſt ſhip in the diviſion of the blue ſquadron carries a blue pendant at her mizen-top-maſt head.

DIVISOR, in arithmetic. See Arithmetic, p. 314.

DIVORCE, a breach or diſſolution of the bond of marriage. See Marriage; and Law. Divorce is of two kinds: the one, *a vinculo matrimonii*, which alone is properly *divorce;* the other, *a menſa & thoro*, "a ſeparation from bed and board." The woman divorced *a vinculo matrimonii* receives all again that ſhe brought with her: the other has a ſuitable ſeparate maintenance allowed her out of her huſband's effects. The firſt only happens through ſome eſſential impediment, as conſanguinity or affinity within the degrees forbidden, precontract, impotency, adultery, &c. of which impediments the canon law allows 14. Divorce is a ſpiritual judgment, and therefore is paſſed in the ſpiritual court. Under the old law, the woman divorced was to have of her huſband a writing, as St. Jerom and Joſephus teſtify, to this effect: *I promiſe, that hereafter I will lay no claim to thee;* which was called a *bill of divorce.* Divorce was allowed of in great latitude both among the Pagans and Jews. At Rome, barrenneſs, age, diſeaſe, madneſs, and baniſhment, were the ordinary cauſes of divorce.

The Roman lawyers diſtinguiſh between *repudium* and *divortium;* making the former to be the breaking of a contract of eſpouſal, and the latter ſeparation after matrimony. Romulus enacted a ſevere law, which ſuffered not a wife to leave her huſband, but gave the man the liberty of turning off his wife, for certain cauſes: however, in later times, the women as well as the men might ſue a divorce. The common way of divorcing was by ſending a bill to the woman, containing the reaſons of ſeparation, and the tender of all her goods which ſhe brought with her: and this was called *repudium mittere*; or elſe it was performed in her preſence, and before ſeven witneſſes, and accompanied with the formalities of tearing the writings, refunding the portion, taking away the keys, and turning the woman out of doors.

The Grecian laws concerning divorces were different: The Cretans allowed divorce to any man that was afraid of having too many children. The Spartans ſeldom divorced their wives; and it was extremely ſcandalous for a woman to depart from her huſband. The Athenians allowed divorce on very ſmall grounds, by a bill, containing the reaſon of the divorce, and approved, if the party appealed, by the chief magiſtrate; and women alſo were allowed to leave their huſbands on juſt occaſions. Perſons divorcing their wives were obliged to return their portions; otherwiſe, the Athenian laws obliged them to pay nine oboli a month for alimony. The terms expreſſing the ſeparation of men and women from each other were different; the men were ſaid αποπεμπειν or απολυειν, *to diſmiſs their wives;* but wives, απολειπειν, to *leave their huſbands.*

"The law of Moſes (ſays Paley), for reaſons of local expediency, permitted the Jewiſh huſband to put away his wife; but whether for every cauſe, or for what cauſe, appears to have been controverted amongſt the interpreters of thoſe times. Chriſt, the precepts of whoſe religion were calculated for more general uſe and obſervation, revokes this permiſſion, as given to the Jews 'for their hardneſs of heart,' and promulges a law which was thenceforward to confine divorces to the ſingle cauſe of adultery in the wife: Matt. xix. 9.

"Inferior cauſes may juſtify the ſeparation of huſband and wife, although they will not authoriſe ſuch a diſſolution of the marriage contract as would leave either at liberty to marry again: for it is that liberty in which the danger and miſchief of divorces principally conſiſt. The law of this country, in conformity to our Saviour's injunction, confines the diſſolution of the marriage contract to the ſingle caſe of adultery in the wife; and a divorce even in that caſe can only be brought about by the operation of an act of parliament, founded upon a previous ſentence in the ſpiritual court, and a verdict againſt the adulterer at common law: which proceedings, taken together, compoſe as complete an inveſtigation of the complaint as a cauſe can receive." It has been propoſed to the legiſlature to annex a clauſe to theſe acts, reſtraining the offending party from marrying with the companion of her crime, ſince the crime may be committed with that view; and it is alſo worth conſidering, whether a law might not be framed, directing *the fortune of the adultereſs to deſcend as in caſe of her natural death;* reſerving, however, a certain annuity from the produce of it, for her ſubſiſtence; and alſo ſo far ſuſpending the eſtate in the hands of the heir, as to preſerve the inheritance to any children ſhe might bear to a ſecond marriage, in caſe there was none to ſucceed in the place of their mother by the firſt. See *Paley's moral and political philoſophy*, p. 273. The Sentences of our eccleſiaſtical courts, which releaſe the parties *a vinculo matrimonii*, for impuberty, frigidity, conſanguinity within the prohibited degrees, prior marriage, or want of the conſent of parents or guardians, are not diſſolutions of marriage, but judicial declarations that there never was any marriage; ſuch impediment ſubſiſting at the time as rendered the celebration of the marriage rite a mere nullity; and indeed the rite itſelf contains an exception of theſe impediments.

DIURETICS, from δια, *by*, and ȣρον *urine*, medicines which provoke a diſcharge by urine. There are none hitherto known whoſe effects are in any degree uniform and certain. Alkaline or neutral ſalts of all kinds, and aqueous liquors, are generally diuretic, eſpecially if drunk plentifully when cold. Thin wines, as rheniſh, &c. ſome vegetables, as aſparagus, ſmallage, eryngium, eupatorium, ſaſſafras, &c. are in a limited degree diuretic. This claſs of remedies is chiefly reſorted to in the treatment of dropſies, for which ſee Medicine.

DIURNAL, in aſtronomy, ſomething relating to day; in oppoſition to *nocturnal*, which regards the night.

DIVUS, Diva, in antiquity, appellations given to men and women who had been deified, or ranked in the number of the gods. See Deification, &c.

Hence it is, that on medals ſtruck for the conſecration of an

emperor or empress, they give them the title of *divus* or *diva*: for example, DIVUS JULIUS. DIVO ANTONINO PIO. DIVO PIO. DIVO CLAUDIO. DIVA FAUSTINA AUG. &c.

DIZZINESS, in medicine. See VERTIGO.

DO, in music, a note of the Italian scale, corresponding to *ut* of the common gamut. See MUSIC.

DOBSON (William), an eminent English portrait and history painter, born at London in 1610. He served an apprenticeship with one Peck, a stationer and picture dealer; and owed his improvement to the copying some pictures of Titian and Van Dyck, whose manner he always retained. He had farther obligations to the latter of these artists; for it is said, that a picture of his painting being exposed at a shop on Snow-hill, Van Dyck passing by, was struck with it exceedingly; and inquiring after the artist, found him at work in a poor garret. Van Dyck had the generosity to equip him in a manner suitable to his merit, and presented him to king Charles I. who patronised him; but Dobson being of a dissipated turn, was far from improving the many opportunities he had of making his fortune; and died very poor in 1647, at his house in St. Martin's Lane.

DOBUNI, or BODUNI; an ancient people of Britain, who possessed the territory which now forms the counties of Oxford and Gloucester. Both the names of this British nation seem to have been derived from the low situation of a great part of the country which they inhabited: for both *Duvn* and *Bodun* signify "profound" or "low," in the ancient language of Gaul and Britain. The Dobuni are not mentioned among the British nations who resisted the Romans under Julius Cæsar, which was probably owing to the distance of their country from the scene of action. The Durocornovium of Antoninus, and the Corinium of Ptolemy, are believed by antiquaries to have been the same place, the capital of the Dobuni, and situated at Cirencester, in Gloucestershire, where there are many marks of a Roman station. Clevum or Glevum, in the thirteenth iter of Antoninus, stood where the city of Gloucester now stands; and Abone, in the fourteenth iter, was probably situated at Avinton on the Severn. The country of the Dobuni was comprehended in the Roman province Britannia Prima.

DOCETÆ, from δοκειν *to appear*, in ecclesiastical history, the followers of Julius Cassianus, one of the Valentinian sect, towards the close of the second century, who revived a notion that had been adopted by a branch of the Gnostics, against whom St. John, Ignatius, and Polycarp, had asserted the truth of the Incarnation. They believed and taught, as their name imports, that the actions and sufferings of Jesus Christ were not in reality, but only in appearance.

DOCIMASIA, in Greek antiquity, a probation of the magistrates and persons employed in public business at Athens. It was performed publicly in the forum, where they were obliged to give an account of themselves and their past lives before certain judges. Among several questions proposed to them, we find the following: Whether they had been dutiful to their parents, had served in the wars, and had a competent estate?

DOCIMASTIC ART, a name given to the art of essaying by operations in small, the nature and quantity of metallic or other matters which may be obtained from mineral or other compound bodies. See REFINING and METALLURGY.

DOCIMENUM MARMOR, a name given by the ancients to a species of marble of a bright and clear white, much used in large and sumptuous buildings, such as temples and the like. It had its name from *Docimenos*, a city of Phrygia, afterwards called *Synaia*; near which it was dug, and from whence it was sent to Rome. It was accounted little inferior to the Parian in colour, but not capable of so elegant a polish; whence it was less used by the statuaries, or in other smaller works. The emperor Adrian is said to have used this marble in building the temple of Jupiter; and many other of the great works of the Romans are formed of it.

DOCK, in botany. See RUMEX.

DOCK, in the manege, is used for a large case of leather, as long as the dock of a horse's tail, which serves it for a cover. The French call the dock *trousequeue*. It is made fast by straps to the crupper, and has leathern thongs that pass between his thighs, and along his flanks to the saddle-straps, in order to keep the tail tight, and to hinder it from whisking about.

DOCK, in maritime affairs, a sort of broad and deep trench, formed on the side of a harbour, or on the banks of a river; and commodiously fitted either to build ships in, or receive them to be repaired. These sorts of docks have generally strong flood-gates to prevent the flux of the tide from entering the dock while the ship is under repair.—There are likewise docks of another kind, called *wet docks*, where a ship can only be cleaned during the recess of the tide, or in the interval between the time when the tide leaves her a-ground and the period when it again reaches her by the return of the flood. The largest and most commodious docks in this country, or perhaps in the world, are those constructed of late years at Liverpool.

DOCK-*Yards*, certain magazines containing all sorts of naval stores and timber for ship-building. In England, the royal dock-yards are at Chatham, Portsmouth, Plymouth, Deptford, Woolwich, and Sheerness. The ships and vessels of war which belong to the nation, are generally moored at these ports during the time of peace; and such as want repairing are taken into the docks, examined, and refitted for service. The principal dock-yards are governed by a commissioner, resident at the port; who superintends all the musters of the officers, artificers, and labourers, employed in the dock-yard and ordinary. He also controuls the payments therein; examines the accounts; contracts, and draws bills on the navy-office to supply the deficiency of stores; and, finally, regulates whatever belongs to the dock-yard, maintaining due order in the respective offices. These yards are generally supplied from the northern states with hemp, pitch, tar, rosin, canvas, oak-plank, and several other articles. Masts, particularly those of the largest size, are usually imported from New-England.

DOCTOR, a person who has passed all the degrees of a faculty, and is impowered to teach or practise the same: thus we say, doctor of divinity, doctor of physic, doctor of laws, &c. The establishment of the *doctorate*, as now in use among us, is ordinarily attributed to Irnerius, who himself drew up the formulary. The first ceremony of this kind was performed at Bologna, in the person of Bulgarus, who began to profess the Roman law, and on that occasion was solemnly promoted to the *doctorate*, *i. e.* installed *juris utriusque doctor*. But the custom was soon transferred from the faculty of law to that of theology; the first instance whereof was given in the university of Paris, where Peter Lombard and Gilbert de la Portree, the two chief divines of those days, were created doctors in theology, *sacræ theologiæ doctores*. Spelman takes the title of doctor not to have commenced till after the publication of Lombard's Sentences, about the year 1140; and affirms, that such as explained that work to their scholars were the first that had the appellation of doctors. Others go much higher, and hold Bede to have been the first doctor at Cambridge, and John de Beverley at Oxford, which latter died in the year 721. But Spelman will not allow doctor to have been the name of any title or degree in England till the reign of king John, about the year 1207.

To paſs doctor in divinity at *Oxford*, the candidate muſt have been four years bachelor of divinity. For doctor of laws, he muſt have been ſeven years in the univerſity to commence bachelor of law; five years after which he may be admitted doctor. Otherwiſe, in three years after taking the degree of maſter of arts, he may take the degree of bachelor in law; and in four years more, that of LL.D. which ſame method and time are likewiſe required to paſs the degree of doctor in phyſic.

At *Cambridge*, to take the degree of doctor in divinity, it is requiſite for the candidate to have been ſeven years bachelor of divinity. Though in ſeveral of the colleges the taking of the bachelor of divinity's degree is diſpenſed with, and they may go out *per ſaltum*. To commence doctor in laws, the candidate muſt have been five years bachelor of law, or ſeven years maſter of arts. To paſs doctor in phyſic, he muſt have been bachelor in phyſic five years, or ſeven years maſter of arts. A doctor of the civil law may exerciſe eccleſiaſtical juriſdiction, though a layman, ſtat. 37 Hen. VIII. cap. 17. ſect. 4.

Doctor *of the Law*, a title of honour among the Jews. The inveſtiture, if we may ſo ſay, of this order was performed by putting a key and table-book in the hands; which is what ſome authors imagine our Saviour had in view, Luke xi. 52. when, ſpeaking of the doctors of the law, he ſays, "Wo unto you doctors of the law, for you have taken away the key of knowledge: you entered not in yourſelves, and them that were entering you hindered."

Doctor *of the Church*, a title given to certain of the fathers whoſe doctrines and opinions have been the moſt generally followed and authoriſed. We uſually reckon four doctors of the Greek church, and three of the Latin. The firſt are St. Athanaſius, St. Baſil, St. Gregory Nazianzen, and St. Chryſoſtom. The latter are St. Jerom, St. Auguſtine, and Gregory the Great. In the Roman breviary there is a particular office for the doctors. It only differs from that of the confeſſors, by the anthem of the Magnificat, and the leſſons.

Doctor, is alſo an appellation affixed to ſeveral ſpecific epithets, expreſſing the merit of ſome of the ſchoolmen: thus, Alexander Hales is called the irrefragable doctor; Thomas Aquinas, the angelic doctor; St. Bonaventure, the ſeraphic doctor; John Duns Scotus, the ſubtile doctor; Raimond Lully, the illuminated doctor; Roger Bacon, the admirable doctor, &c.

Doctor, Διδασκαλος, in the Greek church, is a particular officer, appointed to interpret part of the ſcriptures. He who interprets the Goſpels, is called *doctor of the Goſpels*; he who interprets St. Paul's Epiſtles, *doctor of the Apoſtle*: he who interprets the Pſalms, *doctor of the Pſalter*.

Doctors-*Commons*. See College *of Civilians*.

DOCUMENT, in law, ſome written monument produced in proof of any thing aſſerted.

DODARTIA, in botany; a genus of the angioſpermia order, belonging to the didynamia claſs of plants; and in the natural method ranking under the 40th order, *Perſonatæ*. The calyx is quinquedentated; the under lip of the corolla twice as long as the upper; the capſule bilocular and globoſe.

DODD (Dr. William), an unfortunate Engliſh divine, eldeſt ſon of the Rev. William Dodd, many years vicar of Bourne in Lincolnſhire, was born May 29, 1729. He was ſent, at the age of 16, to the univerſity of Cambridge; and admitted, in the year 1745, a ſizar of Clare-Hall. In 1749-50 he took the degree of B.A. with great honour, being upon that occaſion in the liſt of wranglers. Leaving the univerſity, he imprudently married a Miſs Mary Perkins in 1751, was ordained a deacon the ſame year, prieſt in 1753, and ſoon became a celebrated and popular preacher. His firſt preferment was the lectureſhip of Weſt Ham. In 1754 he was alſo choſen lecturer of St. Olave's, Hart-Street; and in 1757 took the degree of M. A. at Cambridge. On the eſtabliſhment of the Magdalen Hoſpital in 1758, he was a ſtrenuous ſupporter of that charity, and ſoon after became preacher at the chapel of it. By the patronage of Biſhop Squire, he in 1763 obtained a prebend of Brecon, and, by the intereſt of ſome city-friends, procured himſelf to be appointed one of the king's chaplains; ſoon after which, he had the education of the preſent earl of Cheſterfield committed to his care. In 1766 he went to Cambridge, and took the degree of LL. D. At this period, the eſtimation in which he was held by the world was ſufficient to give him expectations of preferment, and hopes of riches and honours; and theſe he might probably have acquired, had he poſſeſſed a common portion of prudence and diſcretion. But, impatient of his ſituation, and eager for advancement, he raſhly fell upon means which in the end were the occaſion of his ruin. On the living of St. George, Hanover-Square, becoming vacant, he wrote an anonymous letter to the lord chancellor's lady, offering 3000 guineas if by her aſſiſtance he was promoted to it. This being traced to him, complaint was immediately made to the king, and Dr. Dodd was diſmiſſed with diſgrace from his office of chaplain. From this period he lived neglected, if not deſpiſed; and his extravagance ſtill continuing, he became involved in difficulties, which tempted him to forge a bond from his late pupil lord Cheſterfield, Feb. 4. 1777, for 4200l., which he actually received: but being detected, he was tried at the Old Bailey, found guilty, and received ſentence of death; and, in ſpite of every application for mercy, was executed at Tyburn, June 27, 1777. Dr. Dodd was a voluminous writer, and poſſeſſed conſiderable abilities, with little judgment and much vanity. An accurate liſt of his various writings is prefixed to his "Thoughts in Priſon," ed. 1781.

DODDER, in botany. See Cuscuta.

DODDRIDGE (Philip), D. D. an eminent preſbyterian miniſter, was the ſon of Daniel Doddridge an oil-man in London, where he was born on the 26th of June 1702; and having completed the ſtudy of the claſſics in ſeveral ſchools, was, in 1719, placed under the tuition of the reverend Mr. John Jennings, who kept an academy at Kilworth in Leiceſterſhire. He was firſt ſettled as a miniſter at Kilworth, where he preached to a ſmall congregation in an obſcure village: but, on Mr. Jennings's death, ſucceeded to the care of his academy; and ſoon after was choſen miniſter of a large congregation of Diſſenters at Northampton, whither he removed his academy, and where the number of his pupils increaſed. He inſtructed his pupils with the freedom and tenderneſs of a father; and never expected nor deſired that they ſhould blindly follow his ſentiments, but encouraged them to judge for themſelves. He checked any appearance of bigotry and uncharitableneſs, and endeavoured to cure them by ſhowing what might be ſaid in defence of thoſe principles they diſliked. He died at Liſbon, whither he went for the recovery of his health; and his remains were interred in the burying-ground belonging to the Britiſh factory there, and a handſome monument was erected to his memory in the meeting-houſe at Northampton, at the expence of the congregation, on which is an epitaph written by Gilbert Weſt, Eſq. He wrote, 1. Free Thoughts on the moſt probable Means of reviving the Diſſenting Intereſt. 2. The Life of Colonel James Gardiner. 3. Sermons on the Education of Children. 4. The Riſe and Progreſs of Religion in the Soul. 5. The Family Expoſitor, in 6 vols 4to, &c. And ſince the author's death, a volume of his Hymns have been publiſhed, and his Theological Lectures. Several of his works have been tranſlated into Dutch, German, and French.

DODECAGON, in geometry, a regular polygon conſiſting of twelve equal ſides and angles.

DODECAHEDRON, in geometry, one of the platonic bodies, or regular ſolids, contained under twelve equal and regular pentagons.

DODECANDRIA, from δωδεκα *twelve*, and ανηρ *a man*, the name of the 11th claſs in Linnæus's ſexual ſyſtem, conſiſting of plants with hermaphrodite flowers, that, according to the title, have twelve ſtamina or male organs. This claſs, however, is not limited with reſpect to the number of ſtamina. Many genera have ſixteen, eighteen, and even nineteen ſtamina; the eſſential character ſeems to be, that, in the claſs in queſtion, the ſtamina, however numerous, are inſerted into the receptacle: whereas in the next claſs, icoſandria, which is as little determined in point of number as the preſent, they are attached to the inſide of the calyx or flower-cup. The orders in this claſs, which are ſix, are founded upon the number of the ſtyles, or female organs. Aſarabacca, mangoſtan, ſtorax, purple looſeſtrife, wild Syrian rue, and purſlane, have only one ſtyle; agrimony and heliocarpus have two; burning thorny plant, and baſtard rocket, three; *glinus*, five; *illicium*, eight; and houſeleek, twelve.

DODECAS, in botany, a genus of the trigynia order, belonging to the dodecandria claſs of plants. The calyx is half quadrifid, having the corolla above; the corolla quinquefid: the capſule unilocular, conjoined with the calyx.

DODECATHEON, in botany, a genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 21ſt order, *Preciæ*. The corolla is verticillated and reflexed; the ſtamina placed in the tube; the capſule unilocular and oblong.

DODO, in ornithology. See Didus.

DODONA, a town of Theſprotia in Epirus, or (according to others) in Theſſaly. There was in its neighbourhood a celebrated oracle of Jupiter. The town and temple of the god were firſt built by Deucalion, after the univerſal deluge. It was ſuppoſed to be the moſt ancient oracle of all Greece; and, according to the traditions of the Egyptians mentioned by Herodotus, it was founded by a dove. The extenſive grove which ſurrounded Jupiter's temple was endowed with the gift of prophecy; and oracles were frequently delivered by the ſacred oaks and the doves which inhabited the place. This fabulous tradition of the oracular power of the doves is explained by Herodotus, who obſerves that ſome Phenicians carried away two prieſteſſes from Egypt, one of whom went to fix her reſidence at Dodona, where the oracle was eſtabliſhed. The oracles, moſt probably, were delivered by the prieſts, who artfully concealed themſelves behind the oaks, and gave occaſion to the ſuperſtitious multitude to believe, that the trees were endowed with the power of prophecy. The oracles of Dodona were, however, generally delivered by women.

DODONÆA, in botany, a genus of the monogynia order belonging to the octandria claſs of plants. The calyx is tetraphyllous; there is no corolla; the capſule trilocular and inflated; the ſeeds twofold.

DODONIAN, *Dodonæus*, in antiquity, an epithet given to Jupiter, becauſe he was worſhipped in a temple built in the foreſt of Dodona, where was the moſt famous, and, it is ſaid, the moſt ancient, oracle of all Greece. See Dodona.

DODONIDES, the prieſteſſes who gave oracles in the temple of Jupiter in Dodona. According to ſome traditions the temple was originally inhabited by ſeven daughters of Atlas, who nurſed Bacchus. Their names were Ambroſia, Eudora, Paſithoe, Pytho, Plexaure, Coronis, Tythe or Tyche. In the later ages the oracles were always delivered by three old women; which cuſtom was firſt eſtabliſhed when Jupiter enjoyed the company of Dione, whom he permitted to receive divine honours in his temple at Dodona. The Bœotians were the only people of Greece who received their oracles at Dodona from men, for reaſons which Strabo, l. 9. fully explains.

DODRANS, in antiquity, three-fourths of the as. See the article As.

DODSLEY (Robert), an eminent bookſeller, and ingenious writer, born at Mansfield in Nottinghamſhire in the year 1703. He was not indebted to education for his literary fame, being originally a livery ſervant; but his natural genius, and early paſſion for reading, ſoon elevated him to a ſuperior ſtation. He wrote an elegant little ſatirical farce called *The Toy-ſhop*, which was acted with applauſe in 1735, and which recommended him to the patronage of Mr. Pope. The following year he produced the *King and Miller of Mansfield*. The profits of theſe two farces enabled him to commence bookſeller, and his own merit procured him eminence in that profeſſion. He wrote ſome other dramatic pieces, and publiſhed a collection of his works in one vol. 8vo, under the modeſt title of *Trifles*; which was followed by *Public Virtue*, a poem in 4to. Beſide what he wrote himſelf, the public were obliged to him for exerting his judgment in the way of his buſineſs; he having collected ſeveral volumes of well choſen *Miſcellaneous Poems* and *Fugitive Pieces*, whoſe brevity would elſe have endangered their being totally loſt to poſterity. He died in 1764.

DODWELL (Henry), a very learned controverſial writer, born at Dublin in 1641, but of Engliſh extraction. He wrote an incredible number of tracts: but his ſervices were ſo little acknowledged, that biſhop Burnet and others accuſe him of doing more hurt than good to the cauſe of Chriſtianity, by his indiſcreet love of paradoxes and novelties, and thus expoſing himſelf to the ſcoffs of unbelievers. His pamphlet on the immortality of the ſoul gave riſe to the well known controverſy between Mr. Collins and Dr. Clark on that ſubject. He died in 1711.

DOESBURG, a town of the united provinces, in the county of Zutphen and province of Guelderland. It is ſmall, but well peopled, and very ſtrong both by art and nature, having the river Yſſel on one ſide, and a moraſs on the other, and is only to be approached by a narrow neck of land. E. long. 5. 55. N. lat. 52. 3.

DOG, in zoology, a well known animal, remarkable for its natural docility, fidelity, and affection for its maſter; which qualities mankind are careful to improve for their own advantage. Theſe uſeful creatures guard our houſes, gardens, and cattle, with ſpirit and vigilance. By their help we are enabled to take not only beaſts, but birds; and to purſue game both over land and through the waters. In ſome northern countries, they ſerve to draw ſledges, and are alſo employed to carry burdens. In ſeveral parts of Africa, China, and by the Weſt Indian negroes, dogs are eaten, and accounted excellent food. Nay, we have the teſtimony of Mr. Forſter, that dog's fleſh, in taſte, exactly reſembles mutton. Dogs were alſo uſed as food by the Romans, and long before them by the Greeks, as we learn from ſeveral treatiſes of Hippocrates. In the preſent times, their ſkins, and even their hair, are found of conſiderable uſe, and form an article of commerce. With regard to the qualities of dogs, thoſe bred in the iſland of Britain are juſtly reckoned ſuperior to the dogs bred in any other country. The ſwiftneſs of the greyhound is amazing: as are alſo the ſteadineſs and perſeverance of other hounds and beagles; the boldneſs of terriers in unearthing foxes, &c.; the ſagacity of pointers and ſetting dogs, who are taught a language by ſigns as intelligible to ſportſmen as ſpeech; and the invincible ſpirit of a bull-dog, which can be quelled only by death.—All the nations in Europe not only do juſtice to the ſuperior qualities of the Britiſh dogs, but adopt our terms and names, and conſider them as valuable preſents.—It is remarkable, however, that almoſt every kind of Britiſh dog degenerates in foreign coun-

tries; nor is it poffible to prevent this degeneracy by any art whatever.

Dogs are liable to many difeafes; the moft dreadful of which, not only as it affects the animal himfelf, but as it endangers the fafety of man and other animals, is that which we ufually call *canine* madnefs, though the difeafe is liable to be produced in fome other quadrupeds as well as the dog. The fymptoms of approaching madnefs are many, and eafily difcerned. When a dog fecludes himfelf contrary to his former ufe, becomes melancholy or droops his head, forbears eating, and as he runs fnatches at every thing; if he often looks upwards, and his ftern at his fetting on be a little erect, and the reft hanging down; if his eyes be red, his breath ftrong, his voice hoarfe, and he drivels and foams at the mouth; we may be affured he has this diftemper. The bite of the animal in this ftate is certainly fatal, unlefs the *piece bitten* be *fairly* and *entirely cut out*. Experience has repeatedly fhewn, that no medicine, wafh, or other remedy, though many have been (wickedly, we think) recommended as infallible, ought to be trufted to in *any inftance*.

As to the practice of *worming* dogs as a preventative of madnefs, it is ridiculous. For the natural hiftory of the Dog, fee Canis.

Dog-*Days*. See Canicula.

Dog-*Fifh*, in ichthyology. See Squalus.

Dogs-*Bane*. See Apocynum.

Dog-*Wood Tree*. See Piscidia.

DOGE, the chief magiftrate in the republics of Venice and Genoa. The word properly fignifies *duke*, being formed from the Latin *dux*; as *dogate*, and *dogado*, from *ducatus* "duchy." The dogate, or office and dignity of doge, is elective: at Venice, the doge is elected for life; at Genoa, only for two years: he is addreffed under the title of *Serenity*, which among the Venetians is fuperior to that of highnefs.

The doge of Venice, however, is no more than the fhadow of a prince; all the authority being referved to the republic. Anciently indeed the doges were fovereigns; but at prefent all the prerogatives annexed to the quality of doge, are thefe: He gives audience to ambaffadors; but does not give them any anfwer from himfelf, in matters of any importance; only he is allowed to anfwer according to his own pleafure, to the compliments they make to the figniory; fuch anfwers being of no confequence. The doge, as being firft magiftrate, prefides in all the councils; and the credentials which the fenate furnifhes its minifters in foreign courts, are written in his name. He does not fign them, however; but a fecretary of ftate figns them, and feals them with the arms of the republic. The ambaffadors direct their difpatches to the doge; and yet he muft not open them but in prefence of the counfellors. The money is ftruck in the doge's name, but not with his ftamp or arms. All the magiftrates rife, and falute the doge when he comes into council; and the doge rifes to none but foreign ambaffadors. The doge nominates to all the benefices in the church of St. Mark; he is protector of the monaftery delle Virgine; and beftows certain petty offices of ufhers of the houfehold, called *Commanders of the Palace*. His family is not under jurifdiction of the mafter of the ceremonies; and his children may have ftaff-officers, and gondoliers in livery. His grandeur, at the fame time, is tempered with a variety of circumftances which render it burdenfome.

The children and brothers of the doge are excluded from all the chief offices of ftate. They cannot receive any benefice from the court of Rome; but may accept of the cardinalate, that being no benefice, nor including any jurifdiction. The doge muft not diveft himfelf of his dignity at pleafure; and after his death, his conduct is examined by three inquifitors and five correctors, who fift it with great feverity.

DOGGER, a Dutch fifhing veffel navigated in the German Ocean. It is generally employed in the herring fifhery; being equipped with two mafts, viz. a main maft and a mizenmaft, and fomewhat refembling a ketch.

DOGGERS, in the Englifh alum works, a name given by the workmen to a fort of ftone found in the fame mines with the true alum rock, and containing fome alum, though not near fo much as the right kind. The county of York, which abounds greatly with the true alum rock, affords alfo a very confiderable quantity of thefe doggers; and in fome places they approach fo much to the nature of the true rock, that they are wrought to advantage.

DOGMA, a principle, maxim, tenet, or fettled opinion, particularly with regard to matters of faith and philofophy.

DOGMATICAL, fomething belonging to a doctrine or opinion. A dogmatical philofopher is one who afferts things pofitively; in oppofition to a fceptic, who doubts of every thing.

DOGMATISTS, a fect of ancient phyficians, of which Hippocrates was the firft founder. They are alfo called *logici*, "logicians," from their ufing the rules of logic in fubjects of their profeffion. They laid down definitions and divifions; reducing difeafes to certain genera, and thofe genera to fpecies, and furnifhing remedies for them all; fuppofing principles, drawing conclufions, and applying thofe principles and conclufions to particular difeafes under confideration: in which fenfe, the dogmatifts ftand contradiftinguifhed from empirics and methodifts. They reject all medicinal virtues that they think not reducible to manifeft qualities: but Galen has long ago obferved of fuch men, that they muft either deny plain matter of fact, or affign but very poor reafons and caufes for many effects they pretend to explain.

DOLCE (Carlo, or Carlino), a celebrated hiftory and portrait painter, was born at Florence in 1616, and was the difciple of Vignali. This great mafter was particularly fond of reprefenting pious fubjects, though he fometimes painted portraits; and his works are eafily diftinguifhed by the peculiar delicacy with which he perfected all his compofitions, by a pleafing tint of colour, and by a judicious management of the chiaro-fcuro. His performance was remarkably flow; and it is reported that his brain was fatally affected by feeing Luca Jordana difpatch more bufinefs in four or five hours than he could have done in as many months. He died in 1686.

DOLE, in the Saxon and Britifh tongue, fignified a part or portion, moft commonly of a meadow, where feveral had fhares. It alfo ftill fignifies a diftribution or dealing of alms, or a liberal gift made by a great man to the people.

DOLICHOS, in botany, a genus of the decandria order, belonging to the diadelphia clafs of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The bafis of the vexillum has two callous knobs, oblong, parallel, and compreffing the alæ below. There are 25 fpecies, the moft remarkable of which are: 1. The *lablab*, with a winding ftalk, is a native of warm climates, where it is frequently cultivated for the table. Mr. Haffelquift informs us, that it is cultivated in the Egyptian gardens, but is not a native of that country. The Egyptians make pleafant arbours with it in their houfes and gardens, by fupporting the ftem and leading it where they think proper. They not only fupport it with fticks and wood, but tie it with cords, by which means the leaves form an excellent covering, and afford an agreeable fhade in fultry weather. 2. The *foja*, a native of Japan, where it is termed *daidfu*; and, from its excellence, *mame*; that is, "the legumen or pod," by way of eminence. It grows with an erect, flender, and hairy ftalk, to the height of about four feet. The leaves are like thofe of the garden kidney-bean. The flowers are of a blueifh white, and produced from the bofom of the leaves, and fucceeded by briftly hanging pods refembling thofe of the yellow lupine,

which commonly contain two, fometimes three, large white feeds. There is a variety of this kind, with a fmall black fruit, which was once employed in medicine. Kempfer affirms, that the feeds of this give relief in the afthma. This legumen is doubly ufeful in the Japanefe kitchens. It ferves for the preparation of a fubftance named *mifo*, that is ufed as butter; and likewife a pickle celebrated among them, and frequent alfo at our own tables, under the name of *fooju* or *foy*. To make the firft, they take a meafure of the beans produced by the plant: after boiling them to a proper degree of foftnefs, they beat them into a foftifh pafte; incorporating with it a large quantity of common falt. They then add a certain preparation of rice named *koos*; and having formed the whole into a mafs, remove it into a wooden veffel, and in about two months it is fit for ufe. The koos gives it a grateful tafte; and the preparing of it, like the polenta of the Germans, requires fome experience. To make fooju or foy, they take equal quantities of the fame beans boiled, and of muggi, that is, barley or wheat roughly ground; and of common falt. Having properly mixed the beans with the pounded corn, they keep it covered in a warm place, in order to ferment; then putting the mafs into a pot, they cover it with the falt, pouring over the whole two meafures and a half of water. This they frequently ftir for two or three months, at the end of which time, they filtrate and exprefs the mafs, and preferve the liquor in wooden veffels. The older it is, the better and the clearer: and if made of wheat, it is the blacker. 3. The *pruriens*, or cow-itch, is alfo a native of warm climates. It has a fibrous root, and an herbaceous climbing ftalk, which is naked, dividing into a great number of branches; and rifes to a great height when properly fupported. The leaves are alternate and trilobate, rifing from the ftem and branches about 12 inches diftant from each other. The footftalk is cylindrical, from 6 to 14 inches long. From the axilla of the leaf defcends a pendulous folitary fpike, from 6 to 14 inches long, covered with long blood-coloured papilionaceous flowers, rifing by threes in a double alternate manner from fmall flefhy protuberances, each of which is a fhort pedunculus of three flowers. Thefe are fucceeded by leguminous, coriaceous pods, four or five inches long, crooked like an Italic *f*; denfely covered with fharp hairs, which penetrate the fkin, and caufe great itching. This will grow in any foil in thofe countries where it is a native: but it is generally eradicated from all cultivated grounds; becaufe the hairs from the pods fly with the winds, and torment every animal they happen to touch. If it was not for this mifchievous quality, the beauty of its flowers would intitle it to a place in the beft gardens. It flowers in the cool months, from September to March, according to the fituation.—The fpiculæ, or fharp hairs, of this plant, have been long ufed in South America in cafes of worms; and have of late been frequently, and, as fome writers have faid, fuccefsfully employed in Britain for the like purpofe. The fpiculæ of one pod mixed with fyrup or melaffes, and taken in the morning fafting, is a dofe for an adult.

DOLLAR, or Daller, a filver coin, nearly of the value of the Spanifh piece of eight or French crown. Dollars are coined in different parts of Germany and Holland; and have their diminutions, as femi-dollars, quarter dollars, &c. See Money-*Table*. They are not all of the fame finenefs nor weight. The Dutch dollars are the moft frequent. In the Levant they are called *afla*ni, from the impreffion of a lion which they bear.

DOLPHIN, in ichthyology. See Delphinus.

Dolphin *of the Maft*, a peculiar kind of wreath, formed of plaited cordage, to be faftened occafionally round the mafts, as a fupport to the puddening, whofe ufe is to fuftain the weight of the fore and main yards in cafe the rigging or chains by which thofe yards are fufpended fhould be fhot away in the time of battle; a circumftance which might render their fails ufelefs at a feafon when their affiftance is extremely neceffary. See the article Puddening.

DOM, or Don, a title of honour invented and chiefly ufed by the Spaniards, fignifying *fir* or *lord*. This title, it feems, was firft given to Pelayo, in the beginning of the eighth century. In Portugal no perfon can affume the title of *don* without the permiffion of the king, fince it is looked upon as a mark of honour and nobility. In France it was fometimes ufed among the religious. It is an abridgment of *domnus*, from *dominus*.

Dom *and Som*, in old charters, fignifies full property and jurifdiction.

DOMAIN, the inheritance, eftate, or poffeffion of any one. See Demesne.

DOMAT (John), a celebrated French lawyer, born in 1625, who obferving the confufed ftate of the laws, digefted them in 4 vols. 4to, under the title of "The Civil Laws in their natural order;" for which undertaking Louis XIV. fettled on him a penfion of 2000 livres. Domat was intimate with the famous Pafcal, who left him his private papers at his death: he himfelf died in 1696.

DOME, in architecture, a fpherical roof, or a roof of a fpherical form, raifed over the middle of a building, as a church, hall, pavilion, veftibule, ftair-cafe, &c. by way of crowning. The word dome is formed from the barbarous Latin, *doma*, which fignified a roof, or open porch; as is obferved by Papias. It is frequent in the corrupt Latin authors, who borrowed it from the Greeks, among whom *trullus*, or *trullum*, is a common name for any round building; fuch as the palace of Conftantinople, wherein was held the council there called *in trullo*. Domes are the fame with what the Italians call *cuppolas*; and we frequently *cupolas*: the Latins, according to Vitruvius, *tholi*. They are ufually made round; though we have inftances of fquare ones; as thofe of the Louvre; and others that are polygons, as that of the Jefuits church in the Rue St. Antoine at Paris. They have ufually columns ranged around their outfides, both by way of ornament, and to fupport the vault. In plate 26 of vol. i. we have given the plan and elevation of a circular dome conftructed *without centering*.

The firft courfe confifts of the ftones marked 1, 1, of different fizes (the large ones exactly twice the height of the fmall ones), placed alternately, and forming intervals to receive the ftones marked 2, which rife half their height above the large ones of the firft courfe, and leave alternate intervals as before for thofe marked 3: the other courfes are continued in the fame manner, according to the order of the figures, to the top. It is evident from the converging or wedge-like form of the intervals, that the ftones they receive can only be inferted from the outfide, and cannot fall through; therefore the whole dome may be built without centering or temporary fupport. To break the upright joints, the ftones may be cut of the form as at A, and thofe marked 16, 17, &c. near the key-ftone, may be enlarged, as at B.

Dome, in chemiftry, the upper part of a furnace, particularly that of a portable kind. It has the figure of a hollow hemifphere or fmall dome. Its ufe is to form a fpace in the upper part of the furnace, the air of which is continually expelled by the fire: hence the current of air is confiderably increafed, being obliged to enter by the afh-hole, and to pafs through the fire, to fupply the place of the air driven from the dome. The form of this piece renders it proper to reflect or reverberate a part of the flame upon the fubftances in the furnace, which has occafioned this kind of furnace to be called a *reverberating* one. See Furnace.

Dome, or *Doom*, ſignifies judgment, ſentence, or decree. The homagers oath in the black book of Hereford ends thus: "So help me God at his holy *dome*, and by my trowthe."

DOMENICHINO, a famous Italian painter, born of a good family at Bologna in 1581. He was at firſt a diſciple of Calvert the Fleming, but ſoon quitted his ſchool for that of the Caraccis. He always applied himſelf to his work with much ſtudy and thoughtfulneſs; and never offered to touch his pencil but when he found a proper kind of enthuſiaſm upon him. His great ſkill in architecture alſo procured him the appointment of chief architect of the apoſtolical palace from Pope Gregory XV.; nor was he without a theoretical knowledge in muſic. He died in 1641.

DOMESDAY, or doomsday, Book, a moſt ancient record, made in the time of William I. furnamed the *Conqueror*, and containing a ſurvey of all the lands of England. It conſiſts of two volumes, a greater and a leſs. The firſt is a large folio, written on 382 double pages of vellum, in a ſmall but plain character; each page having a double column. Some of the capital letters and principal paſſages are touched with red ink; and ſome have ſtrokes of red ink run acroſs them, as if ſcratched out. This volume contains the deſcription of 31 counties. The other volume is in quarto, written upon 450 double pages of vellum, but in a ſingle column, and in a large but very fair character. It contains the counties of Eſſex, Norfolk, Suffolk, part of the county of Rutland included in that of Northampton, and part of Lancaſhire in the counties of York and Cheſter.

This work, according to the red book in the exchequer, was begun by order of William the Conqueror, with the advice of his parliament, in the year of our Lord 1080, and completed in the year 1086. The reaſon given for taking this ſurvey, as aſſigned by ſeveral ancient records and hiſtorians, was, that every man ſhould be ſatisfied with his own right, and not uſurp with impunity what belonged to another. But, beſides this, it is ſaid by others, that now all thoſe who poſſeſſed landed eſtates became vaſſals to the king, and paid him ſo much money by way of fee or homage in proportion to the lands they held. This appears very probable, as there was at that time extant a general ſurvey of the whole kingdom, made by order of king Alfred.

For the execution of the ſurvey recorded in domeſday book, commiſſioners were ſent into every county and ſhire; and juries ſummoned in each hundred, out of all orders of freemen, from barons down to the loweſt farmers. Theſe commiſſioners were to be informed by the inhabitants, upon oath, of the name of each manor, and that of its owner; alſo by whom it was held in the time of Edward the Confeſſor; the number of hides; the quantity of wood, of paſture, and of meadow-land; how many ploughs were in the demeſne, and how many in the tenanted part of it; how many mills, how many fiſh-ponds or fiſheries belonged to it; with the value of the whole together in the time of king Edward, as well as when granted by king William, and at the time of this ſurvey; alſo whether it was capable of improvement, or of being advanced in its value: they were likewiſe directed to return the tenants of every degree, the quantity of lands then and formerly held by each of them, what was the number of villains or ſlaves, and alſo the number and kinds of their cattle and live ſtock. Theſe inquiſitions being firſt methodized in the county, were afterwards ſent up to the king's exchequer.

This ſurvey, at the time it was made, gave great offence to the people; and occaſioned a jealouſy that it was intended for ſome new impoſition. But notwithſtanding all the precaution taken by the conqueror to have this ſurvey faithfully and impartially executed, it appears from indiſputable authority, that a falſe return was given in by ſome of the commiſſioners; and that, as it is ſaid, out of a pious motive. This was particularly the caſe with the abbey of Croyland in Lincolnſhire, the poſſeſſions of which were greatly under-rated, both with regard to quantity and value. Perhaps more of theſe pious frauds were diſcovered, as it is ſaid Ralph Flambard, miniſter to William Rufus, propoſed the making a freſh and more vigorous inquiſition; but this was never executed.

Notwithſtanding this proof of its falſehood in ſome inſtances, which muſt throw a ſuſpicion on all others, the authority of domeſday-book was never permitted to be called in queſtion; and always, when it has been neceſſary to diſtinguiſh whether lands were held in ancient demeſne, or in any other manner, recourſe was had to domeſday-book, and to that only, to determine the doubt. From this definitive authority, from which, as from the ſentence pronounced at *domeſday*, or the day of judgment, there could be no appeal, the name of the book is ſaid to have been derived. But Stowe aſſigns another reaſon for this appellation; namely, that domeſday-book is a corruption of *domus Dei book*; a title given it becauſe heretofore depoſited in the king's treaſury, in a place of the church of Weſtminſter or Wincheſter, called *domus Dei*. From the great care formerly taken for the preſervation of this ſurvey, we may learn the degree of eſtimation in which it was held. The dialogue de Scaccariis ſays, "*Liber ille* (domeſday) *ſigilli regis comes eſt individuus in theſauro.*" Until lately it has been kept under three different locks and keys; one in the cuſtody of the treaſurer, and the others in that of the two chamberlains of the exchequer. It is now depoſited in the chapter-houſe at Weſtminſter, where it may be conſulted on paying to the proper officers a fee of 6s. 8d. for a ſearch, and four-pence per line for a tranſcript.

Beſides the two volumes above mentioned, there is alſo a third made by order of the ſame king; and which differs from the others in form more than in matter. There is alſo a fourth called *domeſday*, which is kept in the exchequer; which, though a very large volume, is only an abridgment of the others. In the remembrancer's office in the exchequer, is kept a fifth book, likewiſe called *domeſday*, which is the ſame with the fourth book already mentioned. King Alfred had a roll which he called *domeſday*; and the domeſday-book made by William the Conqueror referred to the time of Edward the Confeſſor, as that of king Alfred did to the time of Ethelred. The fourth book of domeſday having many pictures and gilt letters in the beginning relating to the time of king Edward the Confeſſor, ſome were led into a falſe opinion that domeſday-book was compoſed in the reign of king Edward.

DOMESTIC, any man who acts under another, ſerving to compoſe his family; in which he lives, or is ſuppoſed to live, as a chaplain, ſecretary, &c. Sometimes domeſtic is applied to the wife and children; but very ſeldom to ſervants, ſuch as footmen, porters, &c.

Domestic, as an adjective, is ſometimes oppoſed to *foreign*. Thus "*domeſtic* occurrences" ſignify thoſe events which happen in our own country, in contradiſtinction to thoſe of which we receive intelligence from abroad. In its more uſual acceptation, the term implies ſomething peculiar to *home* or *houſehold*. Thus we ſpeak of *domeſtic* pleaſures: meaning the pleaſures enjoyed in the boſom of our families; in oppoſition to thoſe found in the buſtle of public life, or deluſively ſought in the haunts of diſſipation. The contempt in which domeſtic pleaſures have in modern times been held, is a mark of profligacy; and alſo a proof of a prevailing ignorance of real enjoyment. It argues a defect in taſte and judgment as well as in morals; for the general voice of the experienced has in all ages declared, that the trueſt happineſs is to be found at home.

DOMIFYING, in aſtrology, the dividing or diſtributing

the heavens into 12 houſes, in order to erect a theme, or horoſcope, by means of ſix great circles, called *circles of poſition*. There are various ways of domifying: that of Regiomontanus, which is the moſt common, makes the circles of poſition paſs through the interſections of the meridian and the horizon: others make them paſs through the poles of the zodiac.

DOMINANT, from the Latin word *dominari* "to rule or govern," among muſicians, is uſed either as an adjective or ſubſtantive; but theſe different acceptations are far from being indiſcriminate. In both ſenſes it is explained by Rouſſeau as follows: The *dominant* or ſenſible chord is that which is practiſed upon the dominant of the tone, and which introduces a perfect cadence. Every perfect major chord becomes a *dominant* chord, as ſoon as the ſeventh minor is added to it. *Dominant* (ſubſt.). Of the three notes eſſential to the tone, it is that which is a fifth from the tonick. The tonick and the *dominant* fix the tone; in it they are each of them the fundamental ſound of a particular chord; whereas the mediant, which conſtitutes the mode, has no chord peculiar to itſelf, and only makes a part of the chord of the tonick. Mr. Rameau gives the name of *dominant* in general to every note which carries a chord of the ſeventh, and diſtinguiſhes that which carries the ſenſible chord by the name of a *tonick dominant*; but, on account of the length of the word, this addition to the name has not been adopted by muſicians: they continue ſimply to call that note a *dominant* which is a fifth from the tonick; and they do not call the other notes which carry a chord of the ſeventh *dominants*, but *fundamentals*; which is ſufficient to render their meaning plain, and prevents confuſion. A *dominant*, in that ſpecies of church-muſic which is called *plain-chant*, is that note which is moſt frequently repeated or beaten, in whatever degree it may be from the tonick. In this ſpecies of muſic there are *dominants* and *tonicks*, but no mediant.

DOMINATION, or Dominion, in theology, the fourth order of angels or bleſſed ſpirits in the hierarchy, reckoning from the ſeraphim.

DOMINGO, or St. Domingo, the capital of the iſland of Hiſpaniola in the Weſt Indies, is ſeated in that part belonging to the Spaniards on the ſouth ſide of the iſland, and has a commodious harbour. The town is built in the Spaniſh manner, with a great ſquare in the middle of it; about which are the cathedral and other public buildings. From this ſquare run the principal ſtreets, in a direct line, they being croſſed by others at right angles, ſo that the form of the town is almoſt ſquare. The country on the north and eaſt ſide is pleaſant and fruitful; and there is a large navigable river on the weſt, with the ocean on the ſouth. It is the ſee of an archbiſhop, an ancient royal audience, and the ſeat of the governor. It has ſeveral fine churches and monaſteries; and is ſo well fortified, that a fleet and army ſent by Oliver Cromwell in 1654 could not take it. The inhabitants are Spaniards, Negroes, Mulattoes, Meſtices, and Albatraces; of whom about a ſixth part may be Spaniards. It had formerly about 2000 houſes, but it has much declined of late years. The Spaniſh part of the iſland has lately been ceded by treaty to the French republic. The river on which St. Domingo is ſeated is called *Ozama*. W. long. 69. 30. N. lat. 18. 25.

DOMINIC (de Guzman), founder of the Dominican order of monks, was born at Calaroga in Old Caſtile, 1170. He preached with great fury againſt the Albigenſes, when Pop Innocent III. made a croiſade againſt that unhappy people and was inquiſitor in Languedoc, where he founded his order, and got it confirmed by the Lateran council in 1215. He died at Bologna in 1221, and was afterwards canonized. The dominican order has produced many illuſtrious men. See Dominicans.

DOMINICA, an iſland in the Weſt Indies, one of thoſe formerly called The Neutral Iſlands, but ceded to Great Britain by the peace of Paris in 1763. It lies in 15. 18. N. lat. and 61. 23. W. long. about half-way between Guadaloupe and Martinico, and is near 28 miles in length, and 13 in breadth. The ſoil is thin, and better adapted to the rearing of coffee than ſugar; but the ſides of the hills bear the fineſt trees in the Weſt Indies, and the iſland is well ſupplied with rivulets of water.

Dominica, one of the iſlands of the South Pacific Ocean, called the Marqueſas. Long. 139. 2. W. Lat. 9. 41. S.

DOMINICAL letter. See Chronology.

Dominical, in church-hiſtory. The council of Auxerre, held in 578, decrees, that women communicate with their dominical. Some authors contend, that this dominical was a linen cloth, wherein they received the ſpecies; as not being allowed to receive them in the bare hand. Others will have it a kind of veil, wherewith they covered the head. The moſt probable account is, that it was a ſort of linen cloth or handkerchief wherein they received and preſerved the euchariſt in times of perſecution, to be taken on occaſion at home. This appears to have been the caſe by the practice of the firſt Chriſtians, and by Tertullian's book *Ad Uxorem*.

DOMINICANS, an order of religious, called in ſome places *Jacobins*; and in others, *Predicants*, or *Preaching Friars*. The Dominicans take their name from their founder Dominic de Guzman, a Spaniſh gentleman, born in 1170, at Calaroga in Old Caſtile. He was firſt canon and archdeacon of Oſma; and afterwards preached with great zeal and vehemence againſt the Albigenſes in Languedoc, where he laid the foundation of his order. The firſt convent was founded at Tholouſe by the biſhop and Simon de Montfort. Two years afterwards they had another at Paris; and ſome time after, a third in the rue St. Jacques, whence the denomination of *Jacobins*. Juſt before his death, Dominic ſent Gilbert de Freſney, with twelve of the brethren, into England, where they founded their firſt monaſtery at Oxford in the year 1221, and ſoon after another at London. In the year 1276 the mayor and aldermen of the city of London gave them two whole ſtreets by the river Thames, where they erected a very commodious convent, whence that ſpot is ſtill called *Black Friars*, a name by which the Dominicans were then diſtinguiſhed. St. Dominic, at firſt, only took the habit of the regular canons; that is, a black caſſock and rochet: but this he quitted in 1219, for that which they now wear, which, it is pretended, was ſhown by the bleſſed Virgin herſelf to the beatified Renaud d'Orleans.

This order is diffuſed throughout the whole known world. It has forty-five provinces under the general, who reſides at Rome; and twelve particular congregations or reforms, governed by vicars general. They reckon three popes of this order, above ſixty cardinals, ſeveral patriarchs, a hundred and fifty archbiſhops, and about eight hundred biſhops; beſide maſters of the ſacred palace, whoſe office has been conſtantly diſcharged by a religious of this order, ever ſince St. Dominic, who held it under Honorius III. in 1218. Of all the monaſtic orders, none enjoyed a higher degree of power and authority than the Dominican friars, whoſe credit was great, and their influence univerſal. But the meaſures they uſed in order to maintain and extend their authority were ſo perfidious and cruel, that their influence began to decline towards the beginning of the ſixteenth century. The tragic ſtory of Jetzer, conducted at Bern in 1509, for determining an uninteresting diſpute between them and the Franciſcans, relating to the *immaculate conception*, will reflect indelible infamy on this order: ſee an account of it in Burnet's Travels through France, Italy, &c. They were indeed perpetually employed in ſtigmatizing as heretics numbers of learned and pious men; in encroaching upon the rights and property of others to augment their poſ-

feffions; and in laying the moft iniquitous fnares and ftratagems for the deftruction of their adverfaries. They were the principal counfellors, by whofe inftigation and advice Leo X. was determined to the public condemnation of Luther. The papal fee never had more active and ufeful abettors than this order, and that of the Jefuits. The dogmata of the Dominicans are ufually oppofite to thofe of the Francifcans.

There are alfo nuns or fifters of this order, called in fome places *Preaching Sifters*. Thefe are even more ancient than the friars; St. Dominic having founded a fociety of religious maids at Prouilles fome years before the inftitution of his order of men; viz. in 1206. There is alfo a third order of Dominicans, both for men and women.

DOMINION, DOMINIUM, in the civil law, fignifies the power to ufe or difpofe of a thing as we pleafe.

DOMINION, or *Domination*. See DOMINATION.

DOMINIS (Mark Anthony de), archbifhop of Spalatro in Dalmatia at the clofe of the 15th and beginning of the 16th centuries, was a man whofe ficklenefs in religion proved his ruin. His preferment, inftead of attaching him to the church of Rome, rendered him difaffected to it, and being imprifoned by Pope Urban VIII. died in 1625. He was the author of the firft philofophical explanation of the rainbow, which before his time was accounted a prodigy.

DOMINUS, in ancient times, a title prefixed to a name, ufually to denote that the perfon was either a knight or a clergyman. See VICE-*Dominus*. The title was fometimes alfo given to a gentleman not dubbed; efpecially if he were lord of a manor. See DOM, GENTLEMAN, and SIRE. In Holland, the title *dominus* is ftill retained, to diftinguifh a minifter of the reformed church.

DON, one of the principal rivers in Europe, which feparates it from Afia. It iffues from the fmall lake of St. John, near Tula, in the government of Mofcow, and flowing through part of the province of Voronetz, a fmall portion of the Ukraina-Slobodfkaia, and the whole province of Afoph, divides, near Tcherkaile, into three ftreams, which fall into the fea of Afoph. This river has fo many windings, is fo fhallow in many parts, and has fuch numerous fhoals, as to be fcarcely navigable, except in the fpring, on the melting of the fnows; and its mouth alfo is fo choked up, that flat-bottom boats only, except in the fame feafon, can pafs into the fea of Afoph.

DON, a Spanifh title of diftinction. See DOM.

DON, a river in Scotland. See ABERDEEN.

DONARIA, among the ancients, in its primary fignification, was taken for the places where the oblations offered to the gods were kept; but afterwards was ufed to denote the offerings themfelves; and fometimes, though improperly, the temples.

DONATIA, in botany; a genus of the trigynia order, belonging to the triandria clafs of plants. The calyx is a triphyllous perianthium, with fhort fubulated leaves ftanding at a diftance from one another. The corolla has from eight to ten petals of an oblong linear fhape, twice as long as the calyx. The ftamina are three fubulated filaments the length of the calyx; the antheræ roundifh, didymous, and two-lobed at the bafe.

DONATION, DONATIO, an act or contract whereby a man transfers to another either the property or the ufe of the whole or a part of his effects as a free gift. A donation, to be valid and complete, fuppofes a capacity both in the donor and the donee; and requires confent, acceptance, and delivery.

DONATION *Mortis Caufa*, in law, a difpofition of property made by a perfon in his laft ficknefs, who apprehending his diffolution near, delivers, or caufes to be delivered to another, the poffeffion of any perfonal goods, to keep in cafe of his deceafe. If the donor dies, this gift needs not the confent of his executor; but it fhall not prevail againft creditors; and it is accompanied with this implied truft, that, if the donor lives, the property fhall revert to himfelf, being only given in profpect of death, or *mortis caufa*. This method of donation feems to have been conveyed to us from the civil lawyers, who borrowed it from the Greeks.

DONATISTS, ancient fchifmatics in Africa, fo denominated from their leader Donatus. They had their origin in the year 311, when, in the room of Menfurius, who died in that year on his return to Rome, Cæcilian was elected bifhop of Carthage, and confecrated without the concurrence of the Numidian bifhops, by thofe of Africa alone; whom the people refufed to acknowledge, and to whom they oppofed Majorinus; who, accordingly, was ordained by Donatus bifhop of Cafæ Nigræ. They were repeatedly condemned, and many of them punifhed with great feverity. They were diftinguifhed by other appellations; as *Circumcelliones*, *Montenfes*, or *Mountaineers*, *Campites*, *Rupites*, &c. The errors of the Donatifts, befide their fchifm, were, 1. That baptifm conferred out of the church, that is, out of their fect, was null; and accordingly they re-baptifed thofe who joined their party from other churches, and re-ordained their minifters. 2. That theirs was the only true, pure, and holy church; all the reft of the churches they held as proftitute and fallen. Donatus feems likewife to have given into the doctrine of the Arians, with whom he was clofely allied; and, accordingly, St. Epiphanius, Theodoret, and fome others, accufed the Donatifts of Arianifm; and it is probable that the charge was well founded, becaufe they were patronized by the Vandals, who were of thefe fentiments. But St. Auguftine, Ep. 185, to count Bonniface, & Hær. 69. affirms, that the Donatifts, in this point, kept clear of the errors of their leader.

DONATIVE, DONATIVUM, a prefent made by any perfon; called alfo *gratuity*. The Romans made large donatives to their foldiers. Julia Pia, wife of the emperor Severus, is called on certain medals *mater caftrorum*, becaufe of the care fhe took of the foldiery, by interpofing for the augmentation of their donatives, &c. *Donative* was properly a gift made to the foldiery; as congiarium was that made to the people. Salmafius, in his notes to Lampridius, on his Life of Heliogabalus, mentioning a donative that emperor gave of three pieces of gold *per* head, obferves, that this was the common and legitimate rate of a donative. Cafaubon, in his notes on the Life of Pertinax by Capitolinus, obferves, that Pertinax made a promife of 3000 denarii to each foldier; which amounts to upwards of 97 pounds fterling. The fame author writes, that the legal donative was 20,000 denarii; and that it was not cuftomary to give lefs, efpecially to the prætorian foldiers; that the centurions had double, and the tribunes, &c. more in proportion.

DONATIVE, in the canon law, a benefice given, and collated to a perfon, by the founder or patron; without either prefentation, inftitution, or induction by the ordinary. If chapels founded by laymen be not approved by the diocefan, and, as it is called, *fpiritualized*, they are not accounted proper benefices, neither can they be conferred by the bifhop, but remain to the pious difpofition of the founders; fo that the founders, and their heirs, may give fuch chapels without the bifhop. Gwin obferves, that the king might of ancient time found a free chapel, and exempt it from the jurifdiction of the diocefan; fo may he, by letters patent, give liberty to a common perfon to found fuch a chapel, and make it donative, not prefentable; and the chaplain, or beneficiary, fhall be deprivable

by the founder or his heir, and not by the biſhop. And this ſeems to be the original of donatives in England. Donatives are within the ſtatute againſt ſimony; and if they have cure of ſouls, within that againſt pluralities. If the patron of a donative doth not nominate a clerk, there can be no lapſe thereof, unleſs it be ſpecially provided for in the foundation; but the biſhop may compel him to do it by ſpiritual cenſures. But if it be augmented by queen Anne's bounty, it will lapſe like other preſentative livings. 1 Geo. I. ſtat. 2. cap. 10. The ordinary cannot viſit a donative, and therefore it is free from proeuration, and the incumbent is exempted from attendance at viſitations. All biſhoprics in ancient time were donative by the king. Again, where a biſhop has the gift of a benefice, it is properly called a *donative*, becauſe he cannot preſent to himſelf.

DONATUS, a ſchiſmatic biſhop of Carthage, founder of the ſect of DONATISTS. His followers ſwore by him, and honoured him like a god. He died about the year 368.

DONATUS (Ælius), a famous grammarian, lived at Rome in 354. He was one of St. Jerome's maſters; and compoſed commentaries on Terence and Virgil, which are eſteemed.

DONAWERT, a ſtrong town of Germany, on the frontiers of Suabia, and ſubject to the duke of Bavaria. It is ſeated on the N. ſide of the Danube, over which was a bridge that was burnt by the French in 1743. It is 25 miles N. of Augſburg. Long. 11. 5. E. Lat. 48. 52. N.

DONAX, a genus of inſects belonging to the order of vermes teſtacea. It is an animal of the oyſter kind; and the ſhell has two valves, with a very obtuſe margin in the fore-part. There are 10 ſpecies, principally diſtinguiſhed by the figure of their ſhells. See Plate 2.

DONCASTER, a market-town of Yorkſhire, 30 miles ſouth of York; once noted for knitting worſted ſtockings. W. long. 1. 0. N. lat. 53. 30.

DONNE (Dr. John), an excellent poet and divine of the 17th century. His parents were of the Romiſh religion, and uſed their utmoſt efforts to keep him firm to it; but his early examination of the controverſy between the church of Rome and the Proteſtants, at laſt determined him to chooſe the latter. He travelled into Italy and Spain; where he made many uſeful obſervations, and learned their languages to perfection. Soon after his return to England, Sir Thomas Egerton, keeper of the great ſeal, appointed him his ſecretary; in which poſt he continued five years. He marrying privately Anne the daughter of Sir George Moore then chancellor of the garter, and niece to the lord keeper's lady, was diſmiſſed from his place, and thrown into priſon. But he was reconciled to Sir George by the good offices of Sir Francis Wolley. In 1612 he accompanied Sir Robert Drury to Paris. During this time many of the nobility ſolicited the king for ſome ſecular employment for him. But his majeſty, who took pleaſure in his converſation, had engaged him in writing his *Pſeudo Martyr*, printed at London in 1610; and was ſo highly pleaſed with that work, that in 1614 he prevailed with him to enter into holy orders; appointed him one of his chaplains, and procured him the degree of Doctor of Divinity from the univerſity of Oxford. In 1619 he attended the earl of Doncaſter in his embaſſy into Germany. In 1621 he was made dean of St. Paul's; and the vicarage of St. Dunſtan in the weſt, in London, ſoon after fell to him; the advowſon of it having been given to him long before by Richard earl of Dorſet. By theſe and other preferments he was enabled to be charitable to the poor, kind to his friends, and to make good proviſion for his children. He wrote, beſides the above, 1. Devotions upon emergent occaſions. 2. The Ancient Hiſtory of the Septuagint, tranſlated from the Greek of Ariſteus, quarto. 3. Three volumes of ſermons, folio. 4. A conſiderable number of poems; and other works. He died in 1631; and was interred in St. Paul's cathedral, where a monument was erected to his memory. His writings ſhow him to be a man of incomparable wit and learning; but his greateſt excellence was ſatire. He had a prodigious richneſs of fancy, but his thoughts were much debaſed by his verſification. He was, however, highly eſteemed by all the great men of that age.

DONOR, in law, the perſon who gives lands or tenements to another in tail, &c. as he to whom ſuch lands, &c. are given, is the *donee*.

DOOMSDAY BOOK. See DOMESDAY *Book*.

DOOR, in architecture. See ARCHITECTURE, p. 292.

DOR, the Engliſh name of the common black beetle. Some apply it alſo to the duſty beetle, that flies about hedges in the evening. See SCARABÆUS.

DORADO, in aſtronomy, a ſouthern conſtellation, not viſible in our latitude; it is alſo called *xiphias*. The ſtars of this conſtellation, in Sharp's Catalogue, are ſix.

DORCHESTER, the capital of Dorſetſhire, ſituated on the river Froom, ſix miles north of Weymouth. W. long. 2. 35. N. lat. 50. 40. It gave the title of marquis to the noble family of Pierpoint, duke of Kingſton; and ſends two members to parliament.

DOREE, or JOHN DOREE, in ichthyology. See ZEUS.

DORIA (Andrew), a gallant Genoeſe ſea-officer, born in 1466. He entered into the ſervice of Francis I. of France; but preſerved that ſpirit of independence ſo natural to a ſailor and a republican. When the French attempted to render Savona, long the object of jealouſy to Genoa, its rival in trade, Doria remonſtrated againſt the meaſure in a high tone; which bold action, repreſented by the malice of his courtiers in the moſt odious light, irritated Francis to that degree, that he ordered his admiral Barbeſieux to ſail to Genoa, then in the hands of the French troops, to arreſt Doria, and to ſeize his gallies. This raſh order Doria got timely hints of; retired with all his gallies to a place of ſafety; and, while his reſentment was thus raiſed, he cloſed with the offers of the emperor Charles V. returned his commiſſion with the collar of St. Michael to Francis, and hoiſted the Imperial colours. To deliver his country, weary alike of the French and Imperial yoke, from the dominion of foreigners, was now Doria's higheſt ambition; and the favourable moment offered. Genoa was afflicted with the peſtilence, the French garriſon was greatly reduced and ill-paid, and the inhabitants were ſufficiently diſpoſed to ſecond his views. He ſailed to the harbour with 13 gallies, landed 500 men, and made himſelf maſter of the gates and the palace with very little reſiſtanee. The French governor with his feeble garriſon retired to the citadel, but was quickly forced to capitulate; when the people ran together, and levelled the citadel with the ground. It was now in Doria's power to have rendered himſelf the ſovereign of his country; but, with a magnanimity of which there are few examples, he aſſembled the people in the court before the palace, diſclaimed all pre-eminence, and recommended to them to ſettle that form of government they choſe to eſtabliſh. The people, animated by his ſpirit, forgot their factions, and fixed that form of government which has ſubſiſted ever ſince with little variation. This event happened in 1528. Doria lived to a great age, reſpected and beloved as a private citizen; and is ſtill celebrated in Genoa by the moſt honourable of all appellations, "The father of his country, and the reſtorer of its liberty."

DORIC, in general, any thing belonging to the Dorians, an ancient people of Greece, inhabiting the country near mount Parnaſſus. See DORIS.

DORIC, in architecture, is the ſecond of the five orders; being that between the Tuſcan and Ionic. It is uſually placed

upon the Attic baſe, though originally it had no baſe. See ARCHITECTURE, p. 277.

DORIC *Cymatium.* See CYMA.

DORIC *Dialect*, one of the five dialects which obtained among the Greeks. It was firſt uſed by the Lacedemonians, and particularly thoſe of Argos; thence it paſſed into Epirus, Libya, Sicily, the iſlands of Rhodes and Crete. In this dialect, Archimedes and Theocritus wrote, who were both of Syracuſe; as likewiſe Pindar, and ſeveral others. In ſtrictneſs, however, we ſhould rather define Doric, the manner of ſpeaking peculiar to the Dorians, after their receſs near Parnaſſus and Aſopus; and which afterwards came to obtain among the Lacedemonians, &c. Some even diſtinguiſh between the Lacedemonian and Doric; but, in reality, they were the ſame; ſetting aſide a few particularities in the language of the Lacedemonians; as is ſhown by Rulandus, in his excellent treatiſe *De Lingua Græca ejuſque Dialectis*, lib. v. Moſt of the medals of the cities of Græcia Magna, and Sicily, favour of the Doric dialect in their inſcriptions: witneſs, ΑΜΒΡΑΚΙΩΤΑΝ, ΑΠΟΛΛΩΝΙΑΤΑΝ, ΑΧΕΡΟΝΤΑΝ, ΑΧΥΡΙΤΑΝ, ΗΡΑΧΛΕΩΤΑΝ, ΤΡΑΧΙΝΙΩΝ, ΘΕΡΜΙΤΑΝ, ΚΑΥΛΟΝΙΑΤΑΝ, ΚΟΠΙΑΤΑΝ, ΤΑΥΡΟΜΕΝΙΤΑΝ, &c. which ſhows the countries wherein the Doric dialect was uſed.

The general rules of this dialect are detailed by the Port-royaliſts; but they are much better explained in the fourth book of Rulandus; where he even notes the minuter differences of the dialects of Sicily, Crete, Tarentum, Rhodes, Lacedæmon, Laconia, Macedonia, and Theſſaly. The *a* abounds every where in the Doric; but this dialect bears ſo near a conformity with the Æolic, that many reckon them but one.

DORIC *Mode*, in muſic, the firſt of the authentic modes of the ancients. Its character is to be ſevere, tempered with gravity and joy; and is proper upon religious occaſions, as alſo to be uſed in war. It begins *D*, *la*, *ſol*, *re*. Plato admires the muſic of the Doric mode, and judges it proper to preſerve good manners as being maſculine; and on this account allows it in his commonwealth. The ancients had likewiſe their ſubdoric or hypodoric mode, which was one of the plagal modes. Its character was to be very grave and ſolemn: it began with *re*, a fourth lower than the Doric.

DORING, or DARING, among ſportſmen, a term uſed to expreſs a method of taking larks, by means of a clap-net and a looking-glaſs. For this ſport there muſt be provided four ſticks very ſtraight and light, about the bigneſs of a pike; two of theſe are to be four feet nine inches long, and all notched at the edges or the ends. At one end of each of theſe ſticks there is to be faſtened another of about a foot long on one ſide; and on the other ſide a ſmall wooden peg about three inches long. Then four or more ſticks are to be prepared, each of one foot length; and each of theſe muſt have a cord of nine feet long faſtened to it at the end. Every one ſhould have a buckle for the commodious faſtening on to the reſpective ſticks when the net is to be ſpread. A cord muſt alſo be provided, which muſt have two branches. The one muſt be nine feet and a half, and the other ten feet long, with a buckle at the end of each; the reſt, or body of the cord, muſt be 24 yards long. All theſe cords, as well the long ones as thoſe about the ſticks, muſt be well twiſted and of the bigneſs of one's little finger. The next thing to be provided is a ſtaff of four feet long, pointed at one end, and with a ball of wood at the other, for the carrying theſe conveniences in a ſack or wallet. There ſhould alſo be carried, on this occaſion, a ſpade to level the ground where there may be any little irregularities; and two ſmall rods, each 18 inches long, and having a ſmall rod fixed with a pack-thread at the larger end of the other. To theſe are to be tied ſome pack-thread loops, which are to faſten in the legs of ſome larks; and there are to be reels to theſe, that the birds may fly a little way up and down. When all this is done, the looking glaſs is to be prepared in the following manner. Take a piece of wood about an inch and an half thick, and cut it in form of a bow, ſo that there may be about nine inches ſpace between the two ends; and let it have its full thickneſs at the bottom, that it may receive into it a falſe piece, in the five corners of which there are to be fixed five pieces of looking-glaſs. Theſe are ſo placed that they may dart their light upwards; and the whole machine is to be ſupported on a moveable pin, with the end of a long line fixed to it, and made in the manner of the children's play-thing of an apple and a plum-ſtone; ſo that the other end of the cord being carried through a hedge, the barely pulling it may ſet the whole machine with the glaſſes a-turning. This and the other contrivances are to be placed in the middle between the two nets. The larks fixed to the place, and termed *calls*, and the glittering of the looking-glaſſes as they twirl round in the ſun, invite the other larks down; and the cord that communicates with the nets, and goes through the hedge, gives the perſon behind an opportunity of pulling up the nets, ſo as to meet over the whole, and take every thing that is between them. The places where this ſort of ſporting ſucceeds beſt are open fields remote from any trees and hedges except one by way of ſhelter for the ſportſman: and the wind ſhould always be either in the front or back; for if it blows ſideways, it prevents the playing of the net.

DORIS, a country of Greece, between Phocis, Theſſaly, and Acarnania. It received its name from Dorus the ſon of Deucalion, who made a ſettlement there. It was called *Tetrapolis* from the four cities which it contained. The Dorians ſent many colonies into different places, which bore the ſame name as their native country.

DORIS, a genus of inſects, belonging to the order of vermes teſtacea. The body is oblong, flat beneath; creeping: mouth placed below: vent behind ſurrounded with a fringe: two feelers, retractile. There are ſeveral ſpecies.—The argo, or lemon doris, has an oval body, convex, marked with numerous punctures, of a lemon colour, the vent beſet with elegant ramifications. It inhabits different parts of our ſeas, and is popularly called the *ſea-lemon*. See Plate 2.

DORMANT, in heraldry, is uſed for the poſture of a lion, or any other beaſt, lying along in a ſleeping attitude with the head on the fore-paws; by which it is diſtinguiſhed from *couchant*, where though the beaſt is lying, yet he holds up his head.

DORMER, in architecture, ſignifies a window made in the roof of an houſe, or above the entablature, being raiſed upon the rafters.

DORMITORY, a gallery in convents or religious houſes, divided into ſeveral cells, in which the religious ſleep or lodge.

DORMOUSE, in zoology. See MUS and SCIURUS.

DORONICUM, LEOPARD'S BANE; a genus of the polygamia ſuperflua order, belonging to the ſyngeneſia claſs of plants; and in the natural method ranking under the 49th order, *Compoſitæ*. The receptacle is naked, the pappus ſimple; the ſcales of the calyx in a double row, longer than the diſc. The ſeeds of the radius naked without any pappus. There are three ſpecies; of which the only one worthy of notice is the pardalianches, with obtuſe heart-ſhaped leaves. It grows naturally in Hungary, and on the Helvetian mountains; but is frequently preſerved in the Engliſh gardens. It has thick fleſhy roots, which divide into many knobs or knees, ſending out ſtrong fleſhy fibres which penetrate deep into the ground; from theſe ariſe in the ſpring a cluſter of heart-ſhaped leaves, which are hairy, and ſtand upon footſtalks: between theſe ariſe the flower-ſtalks, which are channelled and hairy, near three feet high, putting out one or two ſmaller ſtalks from the

ſide. Each ſtalk is terminated by one large yellow flower. The plant multiplies very faſt by its ſpreading roots; and the ſeeds, if permitted to ſcatter, will produce plants wherever they happen to fall; ſo that it very ſoon becomes a weed in the places where it is once eſtabliſhed. It loves a moiſt ſoil and ſhady ſituation. The roots were formerly uſed in medicine, but their operation was found ſo violent that they are now entirely laid aſide.

DORSAL, an appellation given to whatever belongs to the back. See DORSUM.

DORSET (Thomas Sackville), Lord Buckhurſt. See SACKVILLE.

DORSET (Charles Sackville), Earl of. See SACKVILLE.

DORSETSHIRE, a county of England, bounded on the N. by Somerſetſhire and Wiltſhire; on the E. by Hampſhire; on the S. by the Engliſh Channel; and on the W. by Devonſhire and Somerſetſhire; extending 50 miles in length from E. to W. and 38 from N. to S. where broadeſt; containing 22 market-towns, and 248 pariſhes. The air is for the moſt part very good and wholeſome. On the hills it is ſomewhat bleak and ſharp, but it is very mild and pleaſant near the coaſt. The ſoil is generally rich and fertile, though in ſome parts very ſandy. The northern part, which is divided by a range of chalk hills from the ſouthern, was anciently overſpread with foreſts, but now affords good paſture for cattle; while the ſouthern part chiefly conſiſts of fine downs, and feeds incredible numbers of ſheep. The chalk hills, which run through every county from the S. E. part of the kingdom thus far, terminate at the farther extremity of this; but on the coaſt, chalk cliffs extend beyond it into Devonſhire, ten miles W. of Lyme. From the Hampſhire border to the neighbourhood of Blandford, a heathy common extends, which cauſes an exception to the general character of fertility which this county merits; but the rich vales to the S. W. make ample amends. The downs and hills are covered with great flocks of ſheep, whoſe fleſh is ſweet and delicate, and wool very fine. Here is plenty of fowls, as poultry of all ſorts, ſwans, woodcocks, pheaſants, partridges, fieldfares, &c. beſide cattle, fiſh, &c. The products are corn, wool, hemp, fine Portland ſtones, and ſome marble. The peninſula of Purbeck furniſhes a particular kind of ſtone called by its name, and tobacco-pipe clay. This county is diſtinguiſhed for its woollen manufactures, and its fine ale and beer. It ſends 20 members to parliament, and its principal rivers are the Stour and Frome.

DORSIFEROUS PLANTS, among botaniſts, ſuch as are of the capillary kind, without ſtalks, and which bear their ſeeds on the back-ſide of their leaves.

DORSTENIA, CONTRAYERVA; a genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 53d order, *Scabridæ*. The receptacle is common, monophyllous, and carnous; the ſeeds lying ſingly in the carnous ſubſtance. There are four ſpecies, all of them low herbaceous plants, growing in the warm countries of America. The root is uſed in medicine. It is full of knots; an inch or two in length, about half an inch thick; externally of a reddiſh brown colour, and pale within; long, tough, ſlender fibres ſhoot out from all ſides of it, which are generally loaded with ſmall round knots. The root has a peculiar kind of aromatic ſmell, and a ſomewhat aſtringent, warm, bitteriſh taſte, with a light and ſweetiſh kind of acrimony when chewed. The fibres have little taſte or ſmell; the tuberous part therefore ſhould only be choſen. Contrayerva is indiſputably a good and uſeful diaphoretic. Its virtues are extracted both by water and rectified ſpirit, and do not ariſe by evaporation with either. The plants cannot be propagated in this country without the greateſt difficulty.

DORSUM, the BACK, in anatomy, comprehends all the poſterior part of the trunk of the body from the neck to the buttocks. See ANATOMY.

DORT, or DORDRECHT, a city of Holland, which holds the firſt rank in the aſſembly of the ſtates. It is ſeated in a ſmall iſland formed by the rivers Meuſe, Merue, Rhine, and Linghe. The Meuſe, on which it ſtands, gives it a good harbour, and ſeparates it from the iſlands of Iſſelmonde and Ablas. It is divided from Beyerland by a canal. The harbour is very commodious for the merchandizes which come down the Rhine and the Meuſe, which keep it in a flouriſhing condition. Its ſtrength conſiſts in being ſurrounded with water. Its walls are old, and defended by round towers. It is very rich, and well built with brick, and had formerly the excluſive right of coining money. It is at preſent the ſtaple town for wines, particularly Rheniſh. It was detached from the main land in 1421, on the 17th of November, by a flood occaſioned by the breaking down of the dyke, which overwhelmed 70 villages, and about 100,000 perſons. However, by time and the induſtry of the inhabitants, a great part of the land is recovered. It has two principal canals, namely, the New and Old Haven, by which heavy-loaded veſſels may enter into the city. Over the Old Haven is a large bridge well built with brick. E. long. 4. 36. N. lat. 51. 39.

Synod of DORT, a national ſynod, ſummoned by authority of the States General, the provinces of Holland, Utrecht, and Overyſſel excepted, and held at Dort in 1618. The moſt eminent divines of the United Provinces, and deputies from the churches of England, Scotland, Switzerland, Bremen, Heſſia, and the Palatinate, aſſembled on this occaſion in order to decide the controverſy between the Gomariſts or Calviniſts and Arminians; the latter of whom were declared corrupters of the true religion. But the authority of this ſynod was far from being univerſally acknowledged either in Holland or in England. The liberty of private judgment with reſpect to the doctrines of predeſtination and grace, which the ſpirit that prevailed among the divines of Dort ſeemed ſo much adapted to diſcourage and ſuppreſs, acquired new vigour in conſequence of the arbitrary proceedings of this aſſembly.

DORTMUND, a rich, populous, and imperial city of Germany, in the circle of Weſtphalia. It is pretty large, but not well built. Formerly it was one of the Hanſe towns. Its territory alſo was formerly a county, and had lords of its own: but ſince 1504 it has been poſſeſſed entirely by the city.

DORYPHORI, from δορυ *ſpear*, and φερω *I bear*, an appellation given to the life-guard-men of the Roman emperors. They were held in ſuch high eſtimation, as frequently to have the command of armies conferred on them. It was uſual alſo for chief commanders to have their doryphori or life-guard to attend them.

DOSE, in pharmacy, &c. the quantity of a medicine to be taken at one time. The word is formed from the Greek δοσις, which ſignifies *gift*, or a thing given; from διδωμι *do*, "I give."

DOSITHEANS, DOSITHEI, an ancient ſect among the Samaritans in the firſt century of the Chriſtian era. Mention is made in Origen, Epiphanius, Jerom, and divers other Greek and Latin fathers, of one Doſitheus, the chief of a faction among the Samaritans; but the learned are not at all agreed as to the time wherein he lived. St. Jerom, in his dialogue againſt the Luciferians, places him before our Saviour; wherein he is followed by Druſius, who in his anſwer to Serrarius places him about the time of Sennacherib king of Aſſyria. But Scaliger will have him poſterior to our Saviour's time: and in effect Origen intimates him to have been contemporary with the apoſtles; where he obſerves, that he endeavoured to perſuade the Samaritans that he was the Meſſiah foretold by Moſes. He had many followers; and his ſect was ſtill ſub-

fiding at Alexandria in the time of the patriarch Eulogius, who makes him contemporary with Simon Magus; and accuses him of corrupting the Pentateuch, and of composing several books directly contrary to the law of God. Tertullian states, that he was the first who dared to reject the authority of the prophets by denying their inspiration. But he charges that as a crime peculiar to this sectary; which in reality is common to the whole sect, who have never allowed any but the five books of Moses to be divine.

DOSSER, a sort of basket to be carried on the shoulders of men. It is used in carrying the superfluous earth from one part of a fortification to another where it is wanted. There are likewise small carts and wheel-barrows for the same use.

DOSSIL, in surgery, is lint made into a cylindric form, or resembling the shape of a date or olive-stone. Dossils are sometimes secured by a thread tied round their middle.

DOTTEREL, in ornithology. See CHARADRIUS.

DOU, or DOUW, (Gerhard). See DOUW.

DOUAY, a considerable town of France, in the department of the North and late French Flanders. It has a fine arsenal, a foundery for cannon, and a military school. The fort of Scarpe, within cannon-shot, serves for a citadel. It has three famous colleges; and the great square in the centre of the city, and the principal church, are worthy of notice. It was taken by the French in 1712, after the suspension of arms between Great Britain and France. It is seated on the river Scarpe, whence there is a canal to the Deule, 15 miles N. W. of Cambray. Lon. 3. 10. E. Lat. 50. 22. N.

DOUBLE; two of a sort, one corresponding to the other. Instances of *Double Children*, *Double Cats*, *Double Pears*, &c. repeatedly occur in the *Philosoph. Transact.* and elsewhere. (See MONSTER.) Sir John Floyer, in the same *Transactions*, giving an account of a *double turkey*, furnishes some reflections on the production of *double animals* in general. There are two causes of duplicity in embryos. 1. The conjoining or connection of two perfect animals; and, 2. An extraordinary division and ramification of the original vessels, &c.

DOUBLE *Employment*, in music, a name given by M. Rameau to the two different ways in which the chord of the sub-dominant may be regarded and treated, viz. as the fundamental chord of the sixth superadded, or as the chord of the great sixth, inverted from a fundamental chord of the seventh. In reality, the chords carry exactly the same notes, are figured in the same manner, are employed upon the same chord of the tone, in such a manner that frequently we cannot discern which of the two chords the author employs, but by the assistance of the subsequent chord, which resolves it, and which is different in these different cases. To make this distinction, we must consider the diatonic progress of the two notes which form the fifth and the sixth, and which, constituting between them the interval of a second, must one or the other constitute the dissonance of the chord. Now, this progress is determined by the motion of the bass. Of these two notes, then, if the superior be the dissonance, it will rise by one gradation into the subsequent chord, the lower note will keep its place, and the higher note will be a superadded sixth. If the lower be the dissonance, it will descend into the subsequent chord, the higher will remain in its place, and the chord will be that of the great sixth. See the two cases of the *double employment* in Rousseau's Musical Dictionary, Plate D, fig. 12. With respect to the composer, the use which he may make of the double-employment, is to consider the chord in its different points of view, that from thence he may know how to make his entrance to it, and his exit from it; so that having arrived, for instance, at the chord of the superadded sixth, he may resolve it as a chord of the great sixth, and reciprocally.

DOUBLE *Fichy*, or *Fiché*, in heraldry, the denomination of a cross, when the extremity has two points; in contradistinction to fiché, where the extremity is sharpened away to one point.

DOUBLE *Octave*, in music, an interval composed of fifteen notes in diatonic progression; and which, for that reason, is called a *fifteenth*. "It is (says Rousseau) an interval composed of two octaves, called by the Greeks *disdiapason*." It deserves, however, to be remarked, that in intervals less distant and compounded, as in the *third*, the *fifth*, the *simple octave*, &c. the lowest and highest extremes are included in the number from whence the interval takes its name. But, in the *double octave*, when termed a fifteenth, the simple number of which it is composed gives the name. This is by no means analogical, and may occasion some confusion. We should rather choose, therefore, to run any hazard which might occur from uniformly including all the terms of which the component intervals consist, and call the *double* octave a sixteenth, according to the general analogy. See INTERVAL.

DOUBLET, among lapidaries, implies a counterfeit stone composed of two pieces of crystal, and sometimes glass softened, together with proper colours between them; so that they make the same appearance to the eye as if the whole substance of the crystal had been tinged with these colours. The impracticability of imparting tinges to the body of crystals, while in their proper and natural state, and the softness of glass, which renders ornaments made of it greatly inferior in wear to crystal, gave inducements to the introduction of colouring the surface of crystal wrought in a proper form, in such a manner that the surfaces of two pieces so coloured being laid together, the effect might appear the same as if the whole substance of the crystal had been coloured. The crystals, and sometimes white transparent glass so treated, were called *doublets*; and at one time prevailed greatly in use, on account of the advantages, with respect to wear, such doublets had, when made of crystal, over glass, and the brightness of the colours which could with certainty be given to counterfeit stones this way, when coloured glass could not be procured, or at least not without a much greater expence. Doublets have not indeed the property which the others have, of bearing to be set transparent, as is frequently required in drops of ear-rings and other ornaments: but when mounted in rings, or used in such a manner that the sides of the pieces, where the joint is made, cannot be inspected, they have, when formed of crystal, the title to a preference to the coloured glass; and the art of managing them is therefore, in some degree, of the same importance with that of preparing glass for the counterfeiting gems; and is therefore properly an appendage to it, as being entirely subservient to the same intention. There is, however, an easy method of distinguishing doublets, which is only to behold them betwixt the eye and light, in such a position that the light may pass through the upper part and corners of the stone; when it will easily be perceived that there is no colour in the body of the stone.

DOUBLETS, a game on dice within tables; the men, which are only 15, being placed thus: Upon the sice, cinque, and quatre points, there stand three men a-piece; and upon the trey, duce, and ace, only two. He that throws highest has the benefit of throwing first, and what he throws he lays down, and so does the other: what the one throws, and has not, the other lays down for him, but on his own account; and thus they do till all the men are down, and then they bear. He that is down first, bears first; and will doubtless win the game, if the other throws not doublets to overtake him: which he is sure to do, since he advances or bears as many as the doublets make, viz. eight for two fours.

DOUBLING, in the military art, is the putting two ranks or files of soldiers into one. Thus, when the word of com-

mand is, *double your ranks*, the second, fourth, and fixth ranks march into the firft, third, and fifth, fo that the fix ranks are reduced to three, and the intervals between the ranks become double what they were before.

Doubling, among hunters, who fay that a hare doubles when fhe keeps in plain fields, and winds about to deceive the hounds.

Doubling, in the manege, a term ufed of a horfe, who is faid to double his reins, when he leaps feveral times together, to throw his rider: thus we fay, *the ramingue doubles his reins, and makes pontlevis*.

Doubling, in navigation, the act of failing round or paffing beyond a cape or promontory, fo as that the cape or point of land feparates the fhip from her former fituation, or lies between her and any diftant obferver.

Doubling-*Upon*, in naval tactics, the act of inclofing any part of a hoftile fleet between two fires, or of cannonading it on both fides. It is ufually performed by the van or rear of that fleet which is fuperior in number, taking the advantage of the wind, or of its fituation and circumftances, and tacking or veering round the van or rear of the enemy, who will thereby be expofed to great danger, and can fcarcely avoid being thrown into a general confufion.

DOUBLON, or Dubloon, a Spanifh and Portuguefe coin, being the double of a Pistole.

DOUBTING, the act of with-holding our affent from any propofition, on fufpicion that we are not thoroughly apprifed of the merits of it, or from not being able peremptorily to decide between the reafons for and againft it. Doubting is diftinguifhed by the fchoolmen into two kinds, *dubitatio fterilis*, and *dubitatio efficax*. The former is that where no determination enfues: in this manner the Sceptics and Academics doubt, who with-hold their affent from every thing. See Sceptics, &c. The latter is followed by judgment, which diftinguifhes truth from falfehood: fuch is the doubting of the Peripatetics and Cartefians. The laft in particular are perpetually inculcating the deceitfulnefs of our fenfes, and tell us that we are to doubt of every one of their reports, till they have been examined and confirmed by reafon. On the other hand, the Epicureans teach, that our fenfes always tell truth; and that, if you go ever fo little from them, you come within the province of doubting. See Cartesians, Epicureans, &c.

Doubting, in rhetoric, a figure whereon the orator appears fome time fluctuating, and undetermined what to do or fay. Tacitus furnifhes us with an inftance of doubting, almoft to a degree of diftraction, in thofe words of Tiberius written to the fenate: *Quid fcribam, P. S. aut quomodo fcribam, aut quid omnino non fcribam hoc tempore, dii me deæque pejus perdant quam perire quotidie fentio, fi fcio.*

DOUCETS, or Doulcets, among fportfmen, denote the tefles of a deer or ftag.

DOUCINE, in architecture, a moulding concave above and convex below, ferving commonly as a cymatium to a delicate corniche. It is likewife called gula.

DOVE, in ornithology. See Columba.

Dove-*Tailing*, in carpentry, is the manner of faftening boards together by letting one piece into another, in the form of the tail of a dove. The dove-tail is the ftrongeft of the affemblages or jointings; becaufe the tenon, or piece of wood which is put into the other, goes widening to the extreme, fo that it cannot be drawn out again, becaufe the extreme or tip is bigger than the hole.

DOVER, a fea-port of Kent, with two markets, on Wednefday and Saturday. It is ftrong both by nature and art, being fituated between high cliffs; and it has an ancient caftle, built on a high hill E. from the town. It was repaired in 1756, and there are barracks in it for 3000 men. The town was once walled round, and had ten gates; but there now remain only three, and thofe much out of repair. It is one of the cinque ports, and a corporation, confifting of a mayor and 12 jurats. It fends two members to parliament, and is the ftation of the packet-boats that, in time of peace, pafs between Dover and Calais, from which it is diftant only 21 miles. It was once of much larger extent, and had feven churches, which are now reduced to two in the town, and one in the caftle. It was formerly a place of the greateft importance, and deemed the key of the ifland. The harbour is made by a gap in the cliffs, which are here of a fublime height, though certainly exaggerated in Shakefpeare's celebrated defcription. Hence, in fine weather, is a profpect of the coaft of France. Dover is 15 miles S. E. of Canterbury, and 72 S. E. of London. Lon. 1. 23. E. Lat. 51. 8. N.

Dover, a town of the county of Kent, and ftate of Delaware, in N. America. It is the feat of the government, and ftands on Jones's Creek, a few miles from the Delaware river. Four ftreets interfect each other at right angles, in the centre of the town, whofe incidences form a fpacious parade, on the E. fide of which is an elegant ftatehoufe of brick. The town has a lively appearance, and drives a confiderable trade with Philadelphia. Wheat is the principal article of export. The landing is about fix miles from the town of Dover. Lon. 75. 30. W. Lat. 39. 10.

Dover *Straits*, the narrow channel between Dover and Calais, which feparates our ifland from the oppofite continent. Britain is fuppofed by many to have been once peninfulated, the prefent ftraits occupying the fite of the ifthmus which joined it to Gaul. Thefe celebrated ftraits are only 21 miles wide in the narroweft part. From the pier at Dover to that at Calais is 24. It is conjectured, that their breadth leffens, and that they are two miles narrower than they were in ancient times. An accurate obferver of fifty years has remarked, that the increafed height of water, from a decreafe of breadth, has been apparent even in that time. The depth of the channel at a medium in higheft fpring tides is about 25 fathoms: the bottom either coarfe fand or rugged fcars, which have for ages unknown refifted the attrition of the currents. From the ftraits, both eaftward and weftward, is a gradual increafe of depth through the channel to 100 fathoms, till foundings are totally loft or unattended to. The fpring-tides in the ftraits rife on an average 24 feet, the neap-tides 15. The tide flows from the German fea, paffes the ftraits, and meets, with a great rippling, the weftern tide from the ocean, between Fairleigh near Haftings and Bologne; a proof that if the feparation of the land was effected by the feas, it muft have been by the overpowering weight of thofe of the north.

DOUGLAS, the principal town of the Ifle of Man, and which has lately increafed both in trade and buildings. The harbour, for fhips of a tolerable burden, is the fafeft in the ifland, and is much mended by a fine mole that has been built. It is feated on the eaftern fide. W. long. 4. 25. N. lat. 54. 7.

DOUW (Gerhard), a celebrated painter, was born at Leyden in 1613, and received his firft inftructions in drawing and defign from Bartholomew Dolendo an engraver, and alfo from Peter Kouwhoorn a painter on glafs; but at the age of fifteen he became a difciple of Rembrandt. In that famous fchool he continued for three years; and then found himfelf qualified to ftudy nature, the moft unerring director. From Rembrandt he learned the true principles of colouring, and obtained a complete knowledge of the chiaro-fcuro; but to that knowledge he added a delicacy of pencil, and a patience in working up his colours to the higheft degree of neatnefs, fuperior to any other mafter. He therefore was more pleafed with thofe pic-

tures of Rembrandt which were painted in his youth than thoſe by which he was diſtinguiſhed in his more advanced age; becauſe the firſt ſeemed finiſhed with more care and attention, the latter with more boldneſs, freedom, and negligence, which was quite oppoſite to the taſte of Douw. But although his manner appears ſo different from that of his maſter, yet it was to Rembrandt alone that he owed all that excellence in colouring by which he triumphed over all the artiſts of his own country.

His pictures uſually are of a ſmall ſize, with figures ſo exquiſitely touched, ſo tranſparent, ſo wonderfully delicate, as to excite aſtoniſhment as well as pleaſure. He deſigned every object after nature, and with an exactneſs ſo ſingular, that each object appears as perfect as nature itſelf, in reſpect to colour, freſhneſs, and force. It is almoſt incredible what vaſt ſums have been given and are given at this day for the pictures of Douw, even in his own country; as alſo in Italy and every polite part of Europe: for he was exceedingly curious in finiſhing them, and patiently aſſiduous beyond example. Of that patience Sandrart gives a ſtrong proof in a circumſtance which he mentions relative to this artiſt. He ſays, that having once, in company with Bemboccio, viſited Gerhard Douw, they could not forbear to admire the prodigious neatneſs of a picture which he was then painting, in which they took particular notice of a broom; and expreſſing their ſurpriſe at the exceſſive neatneſs of the finiſhing that minute object, Douw told them he ſhould ſpend three days more in working on that broom before he ſhould account it entirely complete. In a family picture of Mrs. Spiering, the ſame author ſays, that the lady had ſat five days for the finiſhing one of her hands that leaned on an arm-chair. For that reaſon not many would ſit to him for their portraits; and he therefore indulged himſelf moſtly in works of fancy, in which he could introduce objects of ſtill life, and employ as much time on them as ſuited his own inclination. Sandrart aſſures us, that 100 guelders a-year were paid to Gerhard, on conſideration that he ſhould give his benefactor, Mr. Spiering, the option of every picture he painted, for which he was immediately to receive the utmoſt of his demand. This great maſter died in 1674, aged 61.

Douw appears inconteſtably to be the moſt wonderful in his finiſhing of all the Flemiſh maſters. Every thing that came from his pencil is precious, and his colouring is the true tint of nature; nor do his works appear tortured, nor their vigour leſſened, by his patient pencil; for whatever pains he may have taken, there is no look of labour or ſtiffneſs; and his pictures are remarkable, not only for retaining their original luſtre, but for having the ſame beautiful effect at any diſtance at which they may be viewed. At Turin are ſeveral pictures by Gerhard Douw, wonderfully beautiful; eſpecially one, of a doctor attending a ſick woman, and ſurveying an urinal. The execution of that painting is aſtoniſhingly fine, and although the ſhadows appear a little too dark, the whole has an inexpreſſible effect. In the gallery at Florence there is a night-piece by candle light, which is exquiſitely finiſhed; and in the ſame apartment, a mountebank attended by a number of figures, which it ſeems impoſſible either ſufficiently to commend or to deſcribe.

DOULEIA, Δουλεια, among the Athenians, a kind of puniſhment, by which the criminal was reduced to the condition of a ſlave. It was never inflicted upon any but the ατιμοι, *ſojourners* and *freed ſervants*.

To DOUSE, in ſea language, is to lower ſuddenly, or ſlacken; and it is applied to a ſail in a ſquall of wind, an extended hawſer, &c.

DOWAGER, Dotissa (*q. d.* a widow endowed, or that has a jointure), a title, or addition, applied to the widows of princes, dukes, earls, and perſons of high rank only. *Queen* Dowager, is the widow of the king, and as ſuch enjoys moſt of the privileges belonging to her as queen conſort: but it is not high treaſon to violate her chaſtity or conſpire her death, becauſe the ſucceſſion is not thereby endangered; but no man can marry her without ſpecial licenſe from the king, on pain of forfeiting his lands and goods.

DOWER (*Dotarium*, *Doarium*, or *Dos*), a portion of lands or tenements which a widow enjoys for term of life from her huſband, in caſe ſhe ſurvives him: and which, at her death, deſcends to their children. But ſhe muſt have been the wife of the party at the time of his deceaſe; or not divorced *a vinculo matrimonii:* nor, if ſhe has eloped from her huſband, and lives with an adulterer, ſhall ſhe be entitled to dower, unleſs her huſband be voluntarily reconciled to her. The widows of traitors are alſo barred of their dower by 5 and 6 Ed. VI. cap. 11. but not the widows of felons. An alien cannot be endowed, unleſs ſhe be queen-conſort. And if a woman levies a fine with her huſband, or if a common recovery be had with the huſband and wife of the huſband's lands, ſhe is barred of her dower. A widow, clear of theſe impediments, is by law entitled to be endowed of all lands and tenements, of which her huſband was ſeiſed in fee-ſimple or fee-tail at any time during the coverture; and of which any iſſue ſhe might have had might by poſſibility have been heir. See Jointure.

DOWN, a county of Ireland in the province of Ulſter, bounded on the eaſt and ſouth by St. George's channel; on the weſt by the county of Armagh; and on the north by the county of Antrim. It lies oppoſite to the Iſle of Man, Cumberland, and Weſtmoreland; and the north part of it fronts the Mull of Galloway in Scotland, and is about 44 miles from it. It is about 44 miles in length, and thirty in breadth. It ſends 14 members to parliament, two for the county, and 12 for the following boroughs, Down-Patrick, Newry, Newtown, Killeleagh, Bangor, and Hillſborough. This county is rough and full of hills, and yet the air is temperate and healthy. The ſoil naturally produces wood, unleſs conſtantly kept open and ploughed; and the low grounds degenerate into bogs and moſs, where the drains are neglected. But by the induſtry of the inhabitants it produces good crops of corn, particularly oats; and, where marle is found, barley. This laſt is exported from Killogh to Dublin. The ſtaple commodity of this county is the linen manufacture.

Down, or *Down-Patrick*, a town of Ireland, in the county of Down, is one of the moſt ancient in that kingdom. It is a market-town and a biſhoprick, ſaid to be erected in the 5th century by St. Patrick, but is now united to the ſee of Connor. Within 200 paces of the town, on the aſcent of a hill, are the ruins of an old cathedral, remarkable for the tomb of St. Patrick the founder, in which they ſay the bodies of St. Bridget and St. Columb are alſo laid. The town, which is ſeated on the ſouth corner of Lough Coin, now called the *lake of Strangford*, is adorned with ſeveral handſome public buildings. Among the hills, and in many iſlands, are flights of ſwans and other water-fowl; and the lough abounds with ſalmon, mullets, and other ſea-fiſh. About a mile from this town is St. Patrick's well, which many people frequent to drink at ſome ſeaſons of the year, and others to perform a penance enjoined them by the popiſh prieſts. The linen manufacture is carried on here, as it is in ſeveral places in this country. W. long. 5. 50. N. lat. 54. 23.

Down, the fine feathers from the breaſts of ſeveral birds, particularly of the duck kind.—That of the eider duck (ſee Anas) is the moſt valuable. Theſe birds pluck it from their breaſts and line their neſts with it. We are told that the quantity of down found in one neſt more than filled the crown of an hat, yet weighed no more than three quarters of an ounce. (*Br. Zool.*) Three pounds of this down may be compreſſed

into a ſpace ſcarce bigger than one's fiſt; yet is afterwards ſo dilatable as to fill a quilt five feet ſquare. *Salern. Orn.* p. 416. That found in the neſts is moſt valued, and termed *live down*; it is infinitely more elaſtic than that plucked from the dead bird, which is little eſteemed in Iceland. The beſt ſort is ſold at 45 fiſh per pound when cleanſed, and at 16 when not cleanſed. There are generally exported every year, on the company's account, 1500 or 2000 lb. of both ſorts, excluſive of what is privately exported by foreigners. In 1750 the Iceland company ſold as much in quantity of this article as amounted to 3745 banco dollars, beſides what was ſent directly to Gluckſtadt. *Von Troil.* p. 146.

Down or hair of plants. See Hair.

DOWNHAM, a town of Norfolk, with a market on Saturday. It is ſeated on the Ouſe, and is noted for the prodigious quantity of butter that is brought hither, and ſent to Cambridge up the Ouſe, whence it is conveyed in the Cambridge waggons to London, and generally known there by the name of Cambridge butter. It is 35 miles N. E. of Cambridge, and 86 N. by E. of London. Lon. 0. 20. E. Lat. 52. 40. N.

DOWNS, a bank or elevation of ſand, which the ſea gathers and forms along its ſhores; and which ſerves it as a barrier. The word is formed from the French *dune*, of the Celtic *dun*, a "mountain." Charles de Viſch. in his *Compend. Chronolog. Exord. & Progreſſ. Abbat. Clariſſ. B. Mariæ, de Dunis*, ſays, *Vallem reperit arenarum collibus* (*quos incolæ* Duynen *vocant*) *undique cinctam*.

Downs are particularly uſed for a famous road for ſhips along the eaſtern coaſt of the county of Kent, from Dover to the North Foreland; where both the outward and homeward-bound ſhips frequently make ſome ſtay; and ſquadrons of men of war rendezvous in time of war. It affords excellent anchorage; and is defended by the caſtles of Deal, Dover, and Sandwich.

DOWNTON, a borough of Wilts, with a market on Friday. It is ſeated on the Avon, and is ſix miles S. E. of Saliſbury, and 84 W. S. W. of London. Lon. 1. 36. Lat. 51.0. N.

DOWRY, the money or fortune which the wife brings her huſband in marriage: it is otherwiſe called *maritagium*, marriage-goods, and differs from dower. See Dower.

DOXOLOGY, an hymn uſed in praiſe of the Almighty, diſtinguiſhed by the title of *greater* and *leſſer*. The doxology was uſed at the cloſe of every ſolemn office. The weſtern church repeated it at the end of every pſalm, and the eaſtern church at the end of the laſt pſalm. Many of their prayers were alſo concluded with it, particularly the ſolemn thankſgiving or conſecration prayer at the euchariſt. It was alſo the ordinary concluſion of their ſermons.

DRABA, in botany, a genus of the ſiliculoſa order, belonging to the tetradynamia claſs of plants; and in the natural method ranking under the 39th order, *Siliquoſæ*. The ſilicula is entire, and oval oblong; with the valves a little plane, parallel to the partition: there is no ſtyle. There are ſix ſpecies; of which the only one worthy of notice is the verna, or early whitlow graſs. It hath naked ſtalks, with leaves a little ſerrated. The bloſſoms are white, and at night the flowers hang down. It grows on old walls and dry banks. It is one of the earlieſt flowering plants we have, and is good to eat as a ſalad. Goats, ſheep, and horſes eat it; cows are not fond of it; ſwine refuſe it.

DRABLER, in the ſea-language, a ſmall ſail in a ſhip, which is the ſame to a bonnet that a bonnet is to a courſe, and is only uſed when the courſe and bonnet are too ſhoal to clothe the maſt. See Bonnet and Course.

DRABLING, in angling, is a method of catching barbels. Take a ſtrong line of ſix yards; which, before you faſten it to your rod, muſt be put through a piece of lead, that if the fiſh bite, it may ſlip to and fro, and that the water may ſomething move it on the ground. Bait with a lobe worm well ſecured, and ſo by its motion the barbel will be enticed into the danger without ſuſpicion. The beſt places are in running water near piles, or under wooden bridges, ſupported with oaks floated and ſlimy.

DRABS, in the ſalt-works, a kind of wooden boxes for holding the ſalt when taken out of the boiling pan. The bottoms of them are made ſhelving or inclining forwards, that the briny moiſture of the ſalt may drain off.

DRAC, an imaginary being, much dreaded by the country people in many parts of France. The dracs are ſuppoſed to be malicious or at leaſt trickſome demons; but, which is very rare, if one of them happens to take a fancy to a man or woman, they are ſure to be the better for it. Still they are ſaid to lay gold cups and rings on the ſurface of pits and rivers, as baits to draw women and children in; though their uſual dwelling is ſome old empty houſe, whence they make excurſions in human form, viſible or inviſible as beſt ſuits their purpoſe. The country folks ſhudder at the very name of the drac. Some are poſitive that they have ſeen him; for happy indeed is that village in which there is not a houſe execrated as the lurking-place of this tremendous drac.

DRACÆNA, in botany, a genus of the monogynia order, belonging to the hexandria claſs of plants. The corolla is ſexpartite and erect; the filaments a little thicker about the middle; the berry trilocular and monoſpermous.

DRACHM, a Grecian coin, of the value of ſevenpence three farthings. Drachm is alſo a weight uſed by our phyſicians; containing juſt ſixty grains three ſcruples, or the eighth part of an ounce.

DRACO, a celebrated lawgiver of Athens. When he exerciſed the office of archon, he made a code of laws for the uſe of his citizens, which, on account of their ſeverity, were ſaid to be written in letters of blood. By them idleneſs was puniſhed with as much ſeverity as murder; and death was denounced againſt the one as well as the other. Solon totally aboliſhed theſe ſanguinary laws, except that one which puniſhed a murderer with death. The popularity of Draco was uncommon, but the gratitude of his admirers proved fatal to him. When once he appeared on the theatre, he was received with repeated applauſe; and the people, according to the cuſtom of the Athenians, ſhowed their reſpect to their lawgiver by throwing garments upon him. This was done in ſuch profuſion, that Draco was ſoon hid under them, and ſmothered by the too great veneration of his citizens. He lived about 624 years before the Chriſtian era.

Draco, the *Dragon*, in zoology, a genus belonging to the order of amphibia reptilia; the characters of which are theſe: it has four legs, a cylindrical tail, and two membranaceous wings, radiated like the fins of a fiſh, by which he is enabled to fly, but not to any great diſtance at a time. There are two ſpecies. 1. The volans, or flying-dragon, with the wings entirely diſtinct from the fore-legs. It is found in Africa and the Eaſt Indies. 2. The præpos, with the wings fixed to the fore-legs. It is a native of America. They are both harmleſs creatures; and feed upon flies, ants, and ſmall inſects. See Plate 2.

Draco *Volans*, in meteorology, a fiery exhalation, frequent in marſhy and cold countries. It is moſt common in ſummer; and though principally ſeen playing near the banks of rivers, or in boggy places, yet ſometimes mounts up to a conſiderable height in the air, to the no ſmall terror of the amazed beholders; its appearance being that of an oblong,

ſometimes roundiſh, fiery body, with a long tail. It is entirely harmleſs, frequently ſticking to the hands and clothes of people without injuring them in the leaſt.

Draco, in aſtronomy, a conſtellation of the northern hemiſphere; whoſe ſtars, according to Ptolemy, are 81; according to Tycho, 32; according to Hevelius, 40; according to Bayer, 33; and according to Mr. Flamſtead, 80. See Astronomy.

DRACOCEPHALUM, dragon's head; a genus of the gymnoſpermia order, belonging to the didynamia claſs of plants. The throat of the corolla is inflated, the upper lip concave. There are 13 ſpecies, moſt of them herbaceous, annual, or perennial plants, from 18 inches to three feet high, garniſhed moſtly with entire leaves, and whorled ſpikes of ſmall monopetalous and ringent flowers of a blue, white, or purple colour. They are all eaſily propagated by ſeeds, which may be ſown either in the ſpring or autumn; and after the plants are come up, they will require no other culture but to be kept clear from weeds.

DRACONARIUS, in antiquity, dragon-bearer. Several nations, as the Perſians, Parthians, Scythians, &c. bore dragons on their ſtandards; whence the ſtandards themſelves were called *dracones*, "dragons." The Romans borrowed the ſame cuſtom from the Parthians; or, as Caſaubon has it, from the Dacæ; or, as Codin, from the Aſſyrians. The Roman dracones were figures of dragons painted in red on their flags, as appears from Ammianus Marcellinus: but among the Perſians and Parthians they were like the Roman eagles, figures in full relievo; ſo that the Romans were frequently deceived, and took them for real dragons. The ſoldier who bore the dragon or ſtandard was called by the Romans *draconarius*; and by the Greeks δρακοναριος and δρακοντειοφορος; for the emperors carried the cuſtom with them to Conſtantinople.

DRACONTIC month, the time of one revolution of the moon from her aſcending node, called *caput draconis*, to her return thither.

DRACONTIUM, dragons; a genus of the polyandria order, belonging to the gynandria claſs of plants; and in the natural method ranking under the firſt order, *Palmæ*. The ſpatha is cymbiform, or ſhaped like a boat; the ſpadix covered all over; there is no calyx; there are five petals; the berries polyſpermous. There are five ſpecies, all natives of the Indies. The only one which makes any appearance is the pertuſum, with leaves having holes, and a climbing ſtalk. This is a native of moſt of the Weſt India iſlands. It has trailing ſtalks which put out roots at every joint, that faſten to the trunks of trees, walls, or any ſupport which is near them, and thereby riſe to the height of 25 or 30 feet. The leaves are placed alternately upon long footſtalks: they are four or five inches long, two and an half broad; and have ſeveral oblong holes in each, which at firſt ſight appears as if eaten by inſects, but they are natural to the leaves. The flowers are produced at the top of the ſtalk, which always ſwells to a much larger ſize in that part than in any other: theſe are covered with an oblong ſpatha or hood of a whitiſh green colour, which opens longitudinally on one ſide, and ſhows the piſtil, which is cloſely covered with flowers of a pale yellow, inclining to white. This plant is eaſily propagated by cuttings; which if planted in pots filled with poor ſandy earth, and plunged into a hot-bed, will ſoon put out roots; but the plants are ſo tender, that they muſt be preſerved in a ſtove.

DRACUNCULI, in ſurgery, ſmall long worms, which breed in the ſkin and muſcular parts of the legs, called *Guinea worms*. The common way of getting out theſe worms is by ſecuring the head with the point of a needle, and then winding the worm, a little every day, round a quill or doſſil of lint, ſo as in a courſe of time to extract the whole. If this be not done very gradually, the worm will be broken, and the conſequence is ſaid to be a very great degree of inflammation, and in ſome caſes a mortification of the part.

DRACUNCULUS, in botany. See Arum.

DRAFF, a name given in ſome places to the waſh given to hogs, and the grains given to cows.

DRAG, in building. A door is ſaid to *drag* when in opening or ſhutting it hangs or grates upon the floor.

Drag, in ſea-language, is a machine conſiſting of a ſharp, ſquare, iron ring, encircled with a net, and commonly uſed to take the wheel off from the platform or bottom of the decks.

DRAGOMAN, or Drogman, a term of general uſe through the Eaſt for an interpreter, whoſe office is to facilitate commerce between the orientals and occidentals. Theſe are kept by the ambaſſadors of Chriſtian nations reſiding at the Porte for this purpoſe. The word is formed from the Arabic *targeman* or *targiman*, of the verb *taragem*, "he has interpreted." From *dragoman* the Italians formed *dragomano*, and, with a nearer relation to its Arabic etymology, *turcimanno*; whence the French and our *trucheman*, as well as *dragoman* and *drogman*.

DRAGON, in aſtronomy. See Draco.

Dragon's *Head and Tail* (*caput & cauda draconis*), are the nodes of the planets; or the two points wherein the ecliptic is interſected by the orbits of the planets, and particularly that of the moon; making with it angles of five degrees and eighteen minutes. One of theſe points looks northward; the moon beginning then to have northward latitude, and the other ſouthward, where ſhe commences ſouth. Thus her deviation from the ecliptic ſeems (according to the fancy of ſome) to make a figure like to that of a dragon, whoſe belly is where ſhe has the greateſt latitude; the interſection repreſenting the head and tail, from which reſemblance the denomination ariſes. But it muſt be obſerved, that theſe points abide not always in one place, but have a motion of their own in the zodiac, and retrograde-wiſe 3 minutes 11 ſeconds *per* day; completing their circle in 18 years 225 days: ſo that the moon can be but twice in the ecliptic during her monthly period, but at all other times ſhe will have a latitude or declination from the ecliptic. It is about theſe points of interſection that all eclipſes happen. They are uſually denoted by theſe characters ☊ dragon's head, and ☋ dragon's tail.

Dragon, in zoology. See Draco.

Dragon's *Blood*, a gummi-reſinous ſubſtance ſo called, which is brought from the Eaſt Indies, either in oval drops wrapped up in flag leaves, or in large maſſes compoſed of ſmaller tears. It is ſaid to be obtained from the palmijuncus draco, the calamus rotang, the dracena draco, the pterocarpus draco, and ſeveral other vegetables. In the preſent practice of medicine, it is very little if at all uſed, either externally or internally. A ſolution of dragon's blood in ſpirit of wine is uſed for ſtaining marble, to which it gives a red tinge, which penetrates more or leſs deeply according to the heat of the marble during the time of application. But as it ſpreads at the ſame time that it ſinks deep, for fine deſigns the marble ſhould be cold. Mr. du Fay ſays, that by adding pitch to this ſolution the colour may be rendered deeper.

Dragon-*Fiſh*, or *Dragonet*, in ichthyology. See Callionymus.

Dragon-*Fly*. See Libellula.

Dragon-*Shell*, in natural hiſtory, a name given by people curious in ſhells to a ſpecies of concamerated patella or limpet. This has a top very much bent; and is of an aſh-colour on the outſide, but of an elegant and bright fleſh colour within. It has been found ſticking on the back of a tortoiſe, as the com-

mon limpets do on the fides of rocks; and fome have been found affixed to large fhells of the pinna marina brought from the Eaft Indies at different times.

Dragons, in botany. See Dracontium.

DRAGONET, or Dragon-*Fifh*, in ichthyology. See Callionymus.

DRAGONNE'E, in heraldry. A lion dragonnée is where the upper half refembles a lion, the other half going off like the hinder part of a dragon. The fame may be faid of any other beaft as well as a lion.

DRAGOON, in military affairs, a mufqueteer mounted on horfeback, who fometimes fights or marches on foot, as occafion requires. Menage derives the word *dragoon* from the Latin *draconarius*, which in Vegetius is ufed to fignify *foldier*. But it is more probably derived from the German *tragen* or *dragen*, which fignifies *to carry*; as being infantry carried on horfeback. Dragoons are divided into brigades as the cavalry; and each regiment into troops; each troop having a captain, lieutenant, cornet, quarter-mafter, two ferjeants, three corporals, and two drummers: fome regiments have hautboys. They are very ufeful on any expedition that requires difpatch; for they can keep pace with the cavalry, and do the duty of infantry: they encamp generally on the wings of the army, or at the paffes leading to the camp; and fometimes they are brought to cover the general's quarters: they march in the front and rear of the army. The firft regiment of dragoons raifed in England was in 1681, and called the regiment of dragoons of North Britain. In battle or attacks they generally fight fword in hand after the firft fire.

DRAGOONING, one of the methods ufed by Papifts for converting refractory heretics, and bringing them within the pale of the true church. The following method of dragooning the French Proteftants, after the revocation of the edict of Nantes, under Louis XIV. is taken from a French work, tranflated in 1686. The troopers, foldiers, and dragoons went into the Proteftants' houfes, where they marred and defaced their houfehold ftuff, broke their looking-glaffes, and other utenfils and ornaments, let their wine run about their cellars, and threw about their corn and fpoiled it. And as to thofe things which they could not deftroy in this manner, fuch as furniture of beds, linen, wearing apparel, plate, &c. they carried them to the market-place, and fold them to the Jefuits and other Roman catholics. By thefe means the Proteftants in Montaubon alone, were, in four or five days, ftripped of above a million of money. But this was not the worft. They turned the dining-rooms of gentlemen into ftables for their horfes; and treated the owners of the houfes where they quartered with the higheft indignity and cruelty, lafhing them about from one to another, day and night, without intermiffion, not fuffering them to eat or drink; and when they began to fink under the fatigue and pains they had undergone, they laid them on a bed, and when they thought them fomewhat recovered, made them rife, and repeated the fame tortures. When they faw the blood and fweat run down their faces and other parts of their bodies, they fluiced them with water, and putting over their heads kettle-drums, turned upfide down, they made a continual din upon them till thefe unhappy creatures loft their fenfes. To recount all the ingenious cruelties exercifed in the practice of dragooning by thefe religious favages, would curdle the blood of even the moft inanimate.

DRAGS, in the fea-language, are whatever hangs over the fhip in the fea, as fhirts, coats, or the like; and boats, when towed, or whatever elfe that after this manner may hinder the fhip's way when fhe fails, are called *drags*.

DRAINS, a name given, in the fen countries, to certain large cuts or ditches of 20 or 30 feet wide, carried through marfhy ground to fome river or other place capable of difcharging the water. An effectual method of drawing off the water from fuch grounds as are rendered unfruitful by fprings oozing out upon them, has long been a defideratum in agriculture. This fubject having been fcientifically treated in Anderfon's Effays on Agriculture, we cannot give a better view of the matter than in the following extracts from vol. ii. of that work; his obfervations feeming to be very rational and well founded: "Springs (fays the author) are formed in the bowels of the earth, by water percolating through the upper ftrata where that is of a porous texture, which continues to defcend downwards till it meets with a ftratum of clay that intercepts it in its courfe; where, being collected in confiderable quantities, it is forced to feek a paffage through the porous ftrata of fand, gravel, or rock, that may be above the clay, following the courfe of thefe ftrata till they approach the furface of the earth, or are interrupted by any obftacle which occafions the water to rife upwards, forming fprings, bogs, and the other phenomena of this nature; which being varioufly diverfified in different circumftances, produce that variety of appearances in this refpect that we often meet with.

"This being the cafe, we may naturally conclude, that an abundant fpring need never be expected in any country that is covered to a great depth with fand without any ftratum of clay to force it upwards, as is the cafe in the fandy deferts of Arabia, and the immeafurable plains of Libya: neither are we to expect abundant fprings in any foil that confifts of an uniform bed of clay from the furface to a great depth; for it muft always be in fome porous ftratum that the water flows in abundance; and it can be made to flow horizontally in that, only when it is fupported by a ftratum of clay, or other fubftance that is equally impermeable by water. Hence the *rationale* of that rule fo univerfally eftablifhed in digging for wells, that if you begin with fand or gravel, &c. you need feldom hope to find water till you come to clay; and if you begin with clay, you can hope for none in abundance till you reach to fand, gravel, or rock.

"It is neceffary that the farmer fhould attend to this procefs of nature with care, as his fuccefs in draining bogs, and every fpecies of damp and fpouting ground, will in a great meafure depend upon his thorough knowledge of this,—his acutenefs in perceiving in every cafe the variations that may be occafioned by particular circumftances, and his fkill in varying the plan of his operations according to thefe. As the variety of cafes that may occur in this refpect is very great, it would be a very tedious tafk to enumerate the whole, and defcribe the particular method of treating each; I fhall therefore content myfelf with enumerating a few particular cafes, to fhow in what manner the principles above eftablifhed may be applied to practice.

"Let fig. 1. Plate 3. reprefent a perpendicular fection of a part of the earth, in which AB is the furface of the ground, beneath which are feveral ftrata of porous fubftances which allow the water to fink through them till it reaches the line CD, that is fuppofed to reprefent the upper furface of a folid bed of clay; above which lies a ftratum of rock, fand, or gravel. In this cafe, it is plain, that when the water reaches the bed of clay, and can fink no farther, it muft be there accumulated into a body; and feeking for itfelf a paffage, it flows along the furface of the clay, among the fand or gravel, from D towards C; till at laft it iffues forth, at the opening A, a fpring of pure water.

"If the quantity of water that is accumulated between D and C is not very confiderable, and the ftratum of clay approaches near the furface; in that cafe, the whole of it will iffue by the opening at A, and the ground will remain dry both above and below it. But, if the quantity of water is fo great as to raife it to a confiderable height in the bed of fand

or gravel, and if that ſtratum of ſand is not diſcontinued before it reaches the ſurface of the ground, the water, in this caſe, would not only iſſue at A, but would likewiſe ooze out in ſmall ſtreams through every part of the ground between A and *a;* forming a barren patch of wet ſandy or gravelly ground upon the ſide of a declivity, which every attentive obſerver muſt have frequently met with.

" To drain a piece of ground in this ſituation is perhaps the moſt unprofitable taſk that a farmer can engage in; not only becauſe it is difficult to execute, but alſo becauſe the ſoil that is gained is but of very little value. However, it is lucky that patches of this kind are ſeldom of great breadth, although they ſometimes run along the ſide of a declivity in a horizontal direction for a great length. The only effectual method of draining this kind of ground, is to open a ditch as high up as the higheſt of the ſprings at *a*, which ſhould be of ſuch a depth as not only to penetrate through the whole bed of ſand or gravel, but alſo to ſink ſo far into the bed of clay below, as to make a canal therein ſufficiently large to contain and carry off the whole of the water. Such a ditch is repreſented by the dotted lines *a e z*: but as the expence of making a ditch of ſuch a depth as this would ſuppoſe, and of keeping it afterwards in repair, is very great, it is but in very few caſes that this mode of draining would be adviſable; and never, unleſs where the declivity happens to be ſo ſmall, as that a great ſurface is loſt for little depth, as would have been the caſe here if the ſurface had extended in the direction of the dotted line *a d*.

" But ſuppoſing that the ſtratum of clay, after approaching toward the ſurface at A, continued to keep at a little depth below ground; and that the ſoil which lay above it was of a ſandy or ſpungy nature, ſo as to allow the water to penetrate it eaſily; even ſuppoſing the quantity of water that flowed from D to C was but very inconſiderable, inſtead of riſing out at the ſpring A, it would flow forward along the ſurface of the clay among the porous earth that forms the ſoil, ſo as to keep it conſtantly drenched with water, and of conſequence render it of very little value.

" Wetneſs ariſing from this cauſe, is uſually of much greater extent than the former: and, as it admits of an eaſy cure, it ought not to be one moment delayed; as a ditch of a very moderate depth opened at A, and carried through a part of the ſtratum of clay (as repreſented by the dotted lines A *k f*), would intercept and carry off the whole of the water, and render the field as dry as could be deſired. It is, therefore, of very great conſequence to the farmer, accurately to diſtinguiſh between theſe two caſes, ſo nearly allied to each other in appearance; and, as this can be eaſieſt done by boring, every one who has much ground of this kind ought to provide himſelf with a ſet of boring-irons, which he will likewiſe find uſe for on other occaſions.

" I might here enumerate a great variety of caſes which might be reduced to the ſame head with the foregoing: but as any attentive reader may, after what has been ſaid, be able eaſily to diſtinguiſh theſe, I ſhall only in general obſerve, that every ſoil of a ſoft and porous texture, that lies upon a bed of hard clay, whatever its ſituation in other reſpects may be, will in ſome meaſure be ſubjected to this diſeaſe. And if it is upon a declivity of any conſiderable length, the undermoſt parts of the field will be much damaged by it, unleſs ditches are thrown up acroſs the declivity at proper diſtances from one another, to intercept the water in its deſcent.

" It may not likewiſe be improper here to obſerve, that in caſes of this nature, unleſs where the ſoil is of a very great depth, the malady will always be increaſed, by raiſing the ridges to a conſiderable height; as will appear evident by examining fig. 2. in which the line A B repreſents the ſurface of a field of this nature, and C D the ſurface of the bed of clay. Now, if this field were raiſed into high ridges, as at F F F, ſo that the furrows E E E deſcended below the ſurface of the clay, it is plain, that all the water that ſhould ſink through the middle of the ridge, would run along the ſurface of the clay till it came to the ſides of the ridge L L L L L L, which would thus be kept continually ſoaked with water. Whereas, if the ground had been kept level, as in the part of the field from G to H, with open furrows H, at moderate diſtances from each other, the water would immediately ſink to the clay, and be carried off by the furrows, ſo as to damage the ſoil far leſs than when the ridges are high. If the ſoil is ſo thin as that the plough can always touch the clay, the ridges ought to be made narrow and quite flat, as from G to H: but if there is a little greater depth of ſoil, then it ought to be raiſed into ridges of a moderate height, as from H to B, ſo as to allow the bottom of the furrow to reach the clay: but neither is this neceſſary where the ſoil is of any conſiderable depth.

" I have ſeen ſome induſtrious farmers, who having ground in this ſituation, have been at the very great expence of making a covered drain in each furrow. But, had they rightly underſtood the nature of the diſeaſe, they never would have thought of applying ſuch a remedy; as muſt appear evident at firſt ſight to thoſe who examine the figure. The ſucceſs was what might be expected from ſuch a fooliſh undertaking.

" Theſe obſervations, it is hoped, will be ſufficient as to the manner of treating wet, ſandy, or porous ſoils. I now proceed to take notice of ſuch as are of a ſtiff clayey nature, which are often very different in appearance, and require a different treatment from theſe:

" Suppoſe that the ſtratum of ſand or gravel D C fig. 3. ſhould be diſcontinued, as at E, and that the ſtratum above it ſhould be of a coherent clayey nature: in this caſe, the water that flowed towards E, being there pent in on every ſide, and being accumulated there in great quantities, it muſt at length force a paſſage for itſelf in ſome way; and preſſing ſtrongly upon the upper ſurface, if any one part is weaker than the reſt, it there would burſt forth and form a ſpring (as ſuppoſe at A). But if the texture of every part of this ſtratum were equally ſtrong, the water would ſqueeze through many ſmall crannies, and would ooze out in numberleſs places, as between A and F, ſo as to occaſion that kind of wetneſs that is known by the name of a *ſpouting clayey ſoil.*

" The cure, in this caſe, is much more eaſily effected than in any of the former; for if a ditch of a conſiderable ſize is opened, as at A, towards the lowermoſt ſide of the ſpouting ground, ſo deep as to penetrate through the upper ſtratum of clay, and reach to the gravel, the water will riſe up through it at firſt with very great violence, which will gradually decreaſe as the preſſure from the water behind is diminiſhed; and when the whole of the water accumulated in this ſubterraneous reſervoir is run off, there being no longer any preſſure upon the clay above it, the whole ſoon becomes as dry as could be deſired, and continues ſo ever afterwards, if the ditch is always kept open. This I ſpeak from experience, I having rendered ſome fields of this kind that were very wet, quite dry by this method of treating them.

" It will hardly be neceſſary for me here to put the farmer upon his guard, to be particularly careful in his obſervations, that he may diſtinguiſh between the wetneſs that is produced from this cauſe, and that which proceeds from the cauſe before mentioned; becauſe the treatment that would cure the one would be of no uſe at all to the other. The attentive obſerver likewiſe will readily perceive, that if any field that is wet from this cauſe admits of being ploughed, it will be in equal danger of being hurt by being raiſed into high ridges, with the other kind of damp ground before mentioned. For as the depth of earth above the reſervoir would be ſmaller in the deep furrows

than any where elfe, there would, of confequence, be lefs refiftance to the water in that place, fo that it would arife there in greater abundance. And if, in this cafe, a farmer fhould dig a drain in each furrow, as a confiderable quantity of water would rife into them, in fome cafes, the ground might be improved, or even quite drained thereby, efpecially if they fhould have accidentally reached the gravel in any one place; although at an expence much greater than was neceffary. I take notice of this circumftance in fome meafure to prevent the prejudice that fome inattentive obfervers might entertain againft what was faid before of this method of draining, from their having accidentally feen fome fields that may have been bettered by it.

"Bogs are only a variety of this laft mentioned kind of wet ground; and, therefore, ought in general to be drained after the fame manner with them. Clay is a fubftance that ftrongly refifts the entrance of water into it: but when it is long drenched with it, it is, in procefs of time, in fome meafure diffolved thereby; lofes its original firmnefs of texture and confiftence; and becomes a fort of femi-fluid mafs, which is called a *bog*; and as thefe are fometimes covered with a ftrong fcurf of a particular kind of grafs, with very matted roots, which is ftrong enough to bear a fmall weight without breaking, although it yields very much, it is in thefe circumftances called a *fwaggle*. But, whatever be the nature of the bog, it is invariably occafioned by water being forced up through a bed of clay, as juft now defcribed, and diffolving or foftening, if you will, a part thereof. I fay only a part; becaufe whatever may be the depth of the bog or fwaggle, it generally has a partition of folid clay between it and the refervoir of water under it, from whence it originally proceeds: for if this were not the cafe, and the quantity of water were confiderable, it would meet with no fufficient refiftance from the bog, and would iffue through it with violence, and carry the whole femi-fluid mafs along with it. But this would more inevitably be the cafe, if there was a cruft at the bottom of the bog, and if that cruft fhould ever be broken, efpecially if the quantity of water under it were very confiderable: and as it is probable, that, in many cafes of this fort, the water flowly diffolves more and more of this under-cruft, I make no doubt, but that, in the revolution of many ages, a great many eruptions of this kind may have happened, although they may not have been deemed of importance enough to have the hiftory of them tranfmitted to pofterity. Of this kind, although formed of a different fubftance, I confider the flow of the Solway-mofs in Northumberland to have been; which, upon the 16th of November 1771, burft its former boundaries, and poured forth a prodigious ftream of femi-fluid matter, which in a fhort time covered feveral hundred acres of very fine arable ground. Nor will any one, who is acquainted with the nature of mofs, who knows its refemblance to clay in its quality of abforbing and retaining water, and its very eafy diffufibility therein, be furprifed at this; as, from all thefe properties, it is much better adapted for forming an extenfive bog, and therefore in greater danger of producing an extenfive devaftation by an eruption of the water into it, than thofe that are formed of any kind of clay whatever.

"If the bog, or fwampy ground, is upon a declivity, the ditch ought to be carried acrofs the field about the place where the loweft fprings arife. But if the furface of the ground is level or nearly fo, as between A and B, fig. 4. and the fprings break out in feveral places, *q q q q q q*, fo as to form foft quagmires interfperfed through the whole of the field, it will be of little confequence in what part the drain is opened; for if it is dug up fo deep as to allow the water to rife in it with freedom, it will iffue through that opening, and the field will be left perfectly dry.

"But as it may frequently happen that the ftratum of gravel fhould be at a confiderable depth beneath the furface of the earth, and as it may be fometimes even below the level of the place into which the drain muft be emptied, it might fometimes be extremely difficult to make a ditch fo deep as to reach the bed of fand or gravel. But it is lucky for us that this is not abfolutely neceffary in the prefent cafe; as a drain of two or three feet deep, as at D, will be equally effectual with one that fhould go to the gravel. All that is neceffary in this cafe, is to fink pits (P) in the courfe of the drain, at a moderate diftance from one another, which go fo deep as to reach the gravel; for as the water there meets with no refiftance, it readily flows out at thefe openings, and is carried off by the drain without being forced up through the earth; fo that the ground is left entirely dry ever after.

"I have likewife drained feveral fields in this way; and as I have generally found the appearances pretty much alike, I fhall, for the information of the inexperienced reader, give a fhort account of them:

"If you attempt to make your pit in one of thefe foft quaggy places where the water is found in great abundance, you will meet with very great difficulty in forming it; for, as the fubftance of which it is compofed is foft, it will always flow into the hole as faft as you dig it; on which account I would advife, not to attempt to make the pit in the fwaggle, but as near it in the folid earth as you conveniently can. However, if it is pretty firm, and of no great extent, it is fometimes practicable to make a pit in the foft bog at the drieft time of the year. This I have fometimes practifed, which gave me an opportunity of obferving the nature of thefe bogs more perfectly than I otherwife would have had. In the trials of this kind that I have made, this foft quaggy ground has feldom been above three or four feet deep, below which I have always found a ftratum of hard tough clay ufually mixed with ftones; and fo firm, that nothing but a mattock or pick-axe could penetrate it: and as this is comparatively fo much drier than the ground above it, an inexperienced operator is very apt to imagine that this is the bottom that he is in fearch of. In digging through this ftratum, you will frequently meet with fmall fprings oozing out in all directions; fome of them that might fill the tube of a fmall quill, and others fo fmall as to be fcarce perceptible: but without regarding thefe, you muft continue to dig on without intermiffion till you come to the main body of the refervoir, if I may fo call it, that is contained in the rock, gravel, or fand; which you will generally find from two to four feet below the bottom of the fwaggle, and which you will be in no danger of miftaking when you come to it: for, if there has been no opening made before that in the field, as foon as you break the cruft immediately above the gravel or rock, the water burfts forth like a torrent, and on fome occafions rifes like a *jet d'eau*, to a confiderable height above the bottom of the ditch; and continues to flow off with great impetuofity for fome time, till the pent-up water being drained off, the violent boiling up begins to fubfide, and the ftrength of the current to abate; and, in a fhort time, it flows gently out like any ordinary fpring: allowing it to remain in this ftate, the quaggy earth begins to fubfide, and gradually becomes firmer and firmer every day; fo that, in the fpace of a few months, thofe bogs which were formerly fo foft as hardly to fupport the weight of a fmall dog, become fo firm, that oxen and horfes may tread upon them without any danger of finking, at the very wetteft feafon of the year. I have had a field of this nature, that, by having only one fuch pit as I have now defcribed opened in it, was entirely drained to the diftance of above a hundred yards around it in every direction. But as it is poffible that the ftratum in which the water runs may be in fome places interrupted, it will be in general expedient to make fe-

veral of theſe pits, if the field is of great extent; always carrying the drain forward through the lowermoſt part of the field, or as near the quag as you conveniently can; and ſinking a pit wherever you may judge it will be moſt neceſſary. But if the ſtratum of gravel is not interrupted, there will be no violent burſt of water at opening any of theſe after the firſt, as I have frequently experienced. To keep theſe wells from cloſing up after they are made, it is always expedient to fill them up with ſmall ſtones immediately after they are made, which ought to riſe to the height of the bottom of the drain.

"I have often imagined that the expence of digging theſe pits might be ſaved by boring a hole through this ſolid ſtratum of clay with a large wimble made on purpoſe; but as I never experienced this, I cannot ſay whether or not it would anſwer the deſired end exactly.

"If the whole field that is to be drained conſiſts of one extenſive bog, it will require a long time before the whole work can be entirely finiſhed, as it will be impoſſible to open a drain through it till one part of it is firſt drained and becomes ſolid ground. In a ſituation of this kind, the undertaker, after having opened a drain to convey the water from the loweſt part of the bog, muſt approach as near to the ſwampy ground as he can, and there make his firſt pit; which will drain off the water from the neareſt parts of the bog. When this has continued open for ſome time, and that part of the bog is become ſo ſolid as to admit of being worked, let him continue the ditch as far forward through it as the ſituation it is in will admit of, and there ſink another pit; and proceed gradually forward in the ſame manner; making croſs cuts where neceſſary, till the whole be finiſhed.

"In this manner may any bog or track of ſpouting ground of this nature be rendered dry at a very inconſiderable expence; and as there can be no other method of draining ground of this ſort effectually, I recommend the ſtudy of it to the attention of every diligent farmer who may have occaſion for it. Let him firſt be extremely cautious in examining all the circumſtances of his particular fields, that he may be certain which of the claſſes above enumerated it may be ranked with; and, when he is perfectly ſure of that, he may proceed without fear, being morally certain of ſucceſs.

"There is, however, one kind of damp ground not yet particularly ſpecified, that I have purpoſely omitted taking notice of till this time, as I have never had any opportunity of examining particularly into the nature of it, nor of aſcertaining by experience what is the moſt proper method of treating it. The ſoil I have now particularly in my eye conſiſts of a deep ſtrong clay that does not vary its nature even on the ſurface, but in as far as manures may have rendered it more friable and tender, the colour uſually inclines to a reddiſh caſt, and, for the moſt part, it is ſituated upon the ſide of ſome declivity. This bed of clay reaches to a great depth, without any variation, and is intermixed with a conſiderable quantity of ſmall round ſtones. Many ſoils of the ſort now deſcribed, are apt to be continually moiſt and full of water during the winter ſeaſon; but when the dry weather of ſummer ſets in, the moiſture is diminiſhed, and the ſurface becomes hard, and it is rent into many large gaps which allow free admiſſion to the ſun and air, ſo as to ſcorch up almoſt every plant that is ſowed upon it: and as theſe ſoils are uſually in themſelves naturally fertile when drained, it were to be wiſhed that ſome method could be diſcovered that would be leſs expenſive than what is uſually practiſed with regard to ſome ſoils of this kind in Eſſex; where they make covered drains of two and a half feet deep, running diagonally through the whole field, at the diſtance of 20 feet from each other."

With regard to the making of theſe drains we have the following directions in the Georgical Eſſays, by T. B. Bayley, Eſq. of Hope near Mancheſter: "Firſt make the main drains down the ſlope or fall of the field. When the land is very wet, or has not much fall, there ſhould, in general, be two of theſe to a ſtatute acre; for the ſhorter the narrow drains are, the leſs liable they will be to accidents. The width of the trench for the main drains ſhould be 30 inches at top, but the width at the bottom muſt be regulated by the nature and ſize of the materials intended to be uſed. If the drain is to be made of bricks 10 inches long, 3 inches thick, and 4 inches in breadth, then the bottom of the drain muſt be 12 inches; but if the common ſale bricks are uſed, then the bottom muſt be proportionably contracted. In both caſes there muſt be an interſtice of one inch between the bottom brick and the ſides of the trench, and the vacuity muſt be filled up with ſtraw, ruſhes, or looſe mould. For the purpoſe of making theſe drains, I order my bricks to be moulded 10 inches long, 4 broad, and 3 thick; which dimenſions always make the beſt drain.

"The method I purſue in conſtructing my main drains is as follows: When the ground is ſoft and ſpongy, the bottom of the drain is laid with bricks placed acroſs. On theſe, on each ſide, two bricks are laid flat, one upon the other, forming a drain ſix inches high and four broad; which is covered with bricks laid flat. When the bottom of the trench is found to be a firm and ſolid body, as clay or marle, the bottom of the drain does not then require being laid with bricks. In that caſe the ſides are formed by placing one brick edgeways, inſtead of two laid flat.

"This latter method is much cheaper, and in ſuch land equally durable with the other. When ſtones are uſed inſtead of bricks, the bottom of the drain ſhould be about eight inches in width. And here it will be proper to remark, that, in all caſes, the bottom of the main drains muſt be ſunk four inches below the level of the narrow ones, even at the point where the latter fall into them.

"The main drains ſhould be kept open till the narrow ones are begun from them, after which they may be finiſhed; but before the earth is returned upon the ſtones or bricks, it will be adviſable to throw in ſtraw, ruſhes, or bruſh-wood, to increaſe the freedom of the drain.

"The ſmall narrow drains ſhould be cut at the diſtance of 16 or 18 feet from each other; and ſhould fall into the main drain at very acute angles, to prevent any ſtoppage. At the point where they fall in, and eight or ten inches above it, they ſhould be made firm with brick or ſtone. Theſe drains ſhould be 18 inches wide at top, and 16 at bottom. Fig. 5. repreſents a field with drains laid out according to Mr. Bayley's method. The black lines repreſent the main drains, and the dotted lines repreſent the narrow drains communicating with the former from all parts of the field." In the different vols. of the Tranſ. of the Soc. for the Encouragement of Arts, &c. various communications may be found on this important ſubject.

DRAKE, in ornithology, the male of the duck kind. See Anas.

Drake (Sir Francis), the renowned Engliſh admiral, was the ſon of Edward Drake a ſailor, and born near Taviſtock in Devonſhire, in the year 1545. He was brought up at the expence and under the care of Sir John Hawkins, who was his kinſman; and, at the age of 18, was purſer of a ſhip trading to Biſcay. At 20, he made a voyage to Guinea; and, at 22, had the honour to be made captain of the Judith. In that capacity he was in the harbour of St. John de Ulloa, in the gulph of Mexico, where he behaved moſt gallantly in the glorious actions under Sir John Hawkins, and returned with him to England, with great reputation, though not worth a groat. Upon this he projected a deſign againſt the Spaniards in the

West Indies; which he no sooner published, than he had volunteers enough ready to accompany him. In 1570 he made his first expedition with two ships; and the next year with one only, in which he returned safe, if not with such advantages as he expected. He made another expedition in 1572, wherein he did the Spaniards some mischief, and gained immense booties, with which he bore away for England, and arrived in August 1573.

His success in this expedition, joined to his honourable behaviour towards his owners, gained him a high reputation; and the use he made of his riches, a still greater. For, fitting out three stout frigates at his own expence, he sailed with them to Ireland; where, under Walter earl of Essex, the father of the famous unfortunate earl, he served as a volunteer, and did many glorious actions. After the death of his noble patron, he returned into England; where Sir Christopher Hatton introduced him to her majesty, and procured him countenance and protection at court. By this means he acquired a capacity of undertaking that grand expedition which will render his name immortal. The first thing he proposed was a voyage into the South Seas through the Straits of Magellan; which was what hitherto no Englishman had ever attempted. The project was well received at court: the queen furnished him with means; and his own fame quickly drew together a sufficient force. The fleet with which he sailed on this extraordinary undertaking, consisted only of five vessels, small when compared with modern ships, and no more than 164 able men. He sailed on the 13th of December 1577; on the 25th fell in with the coast of Barbary, and on the 29th with cape Verd. On the 13th of March he passed the equinoctial, made the coast of Brazil on the 5th of April, and entered the River de la Plata, where he lost the company of two of his ships; but meeting them again, and taking out their provisions, he turned them adrift. On the 29th of May he entered the port of St. Julian's, where he continued two months for the sake of laying in provisions: on the 20th of August he entered the Straits of Magellan, and on the 25th of September passed them, having then only his own ship. On the 25th of November he came to Machao, which he had appointed for a place of rendezvous in case his ships separated; but captain Winter, his vice-admiral, having repassed the Straits, was returned to England. Thence he continued his voyage along the coasts of Chili and Peru, taking all opportunities of seizing Spanish ships, and attacking them on shore, till his men were sated with plunder; and then, coasting America to the height of 48 degrees, he endeavoured to find a passage that way back into our seas, but could not. However, he landed, and called the country *New Albion*, taking possession of it in the name and for the use of queen Elizabeth; and, having careened his ship, set sail from thence, on the 29th of September 1579, for the Moluccas. He is supposed to have chosen this passage round, partly to avoid being attacked by the Spaniards at a disadvantage, and partly from the lateness of the season, whence dangerous storms and hurricanes were apprehended. On the 13th of October he fell in with certain islands inhabited by the most barbarous people he had met with in all his voyage: on the 4th of November he had sight of the Moluccas; and, coming to Ternate, was extremely well received by the king thereof, who appears, from the most authentic relations of this voyage, to have been a wise and polite prince. On the 10th of December he made Celebes; where his ship unfortunately ran upon a rock, the 9th of January following; from which, beyond all expectation, and in a manner miraculously, they got off, and continued their course. On the 16th of March he arrived at Java Major; and from thence he intended to have directed his course to Malacca; but found himself obliged to alter his purpose, and to think of returning home. On the 25th of March 1580, he put his design in execution; and on the 15th of June he doubled the Cape of Good Hope, having then on board 57 men, and but three casks of water. On the 12th of July he passed the line, reached the coast of Guinea on the 16th, and there watered. On the 11th of September he made the island of Tercera; and on the 3d of November entered the harbour of Plymouth. This voyage round the world was performed in two years and about ten months. Shortly after his arrival, the queen going to Deptford, went on board his ship; where, after dinner, she conferred on him the order of knighthood, and declared her absolute approbation of all he had done. She likewise gave directions for the preservation of his ship, that it might remain a monument of his own and his country's glory. This celebrated ship, which had been contemplated many years at Deptford, at length decaying, was broke up, and a chair, made out of the planks, and on which some verses by Cowley were inscribed, was presented to the university of Oxford.

In the year 1585 Drake sailed with a fleet to the West Indies; and took the cities of St. Jago, St. Domingo, Carthagena, and St. Augustin. In 1587 he went to Lisbon with a fleet of 30 sail; and having intelligence of a great fleet assembled in the bay of Cadiz, which was to have made part of the armada, he with great courage entered that port, and burnt there upwards of 10,000 tons of shipping: which he afterwards merrily called *burning the king of Spain's beard*. In 1588, when the armada from Spain was approaching our coasts, Sir Francis Drake was appointed vice-admiral under Charles lord Howard of Effingham, high admiral of England, where fortune favoured him as remarkably as ever: for he made prize of a very large galleon, commanded by Don Pedro de Valdez, who was reputed the projector of this invasion. In 1589 Sir Francis Drake commanded as admiral the fleet sent to restore Don Antonio king of Portugal, the command of the land-forces being given to Sir John Norris: but they were hardly got to sea, before the commanders differed, and so the attempt proved abortive. The war with Spain continuing, a more effectual expedition was undertaken by Sir John Hawkins and Sir Francis Drake, against their settlements in the West Indies, than had hitherto been made during the whole course of it: but the commanders here again not agreeing about the plan, this also did not turn out so successfully as was expected. All difficulties, before these two last expeditions, had given way to the skill and fortune of Sir Francis Drake; which probably was the reason why he did not bear these disappointments so well as he otherwise would have done. A strong sense of them is supposed to have thrown him into a melancholy, which occasioned a bloody flux; and of this he died on board his own ship, near the town of Nombre de Dios in the West Indies, on the 28th of January 1595-6. His death was lamented by the whole nation, and particularly by his countrymen; who had great reason to love him from the circumstances of his private life, as well as to esteem him in his public character. He was elected burgess for the town of Bossiney, alias Tintagal, in the county of Cornwall, in the 27th parliament of queen Elizabeth; and for Plymouth in Devonshire, in the 35th of the same reign. This town had very particular obligations to him: for, in the year 1587, he undertook to bring water into it, through the want of which, till then, it had been grievously distressed; and he performed it by conducting thither a stream from springs at eight miles distance, that is to say, in a straight line: for in the manner he brought it, the course of it runs upwards of 20 miles.

DRAKENBORCH (Arnold), professor of eloquence and history at Utrecht, made himself known by several works, and particularly by his Notes on Titus Livius and Silius Italicus; his fine editions of which are highly esteemed.

DRAMA, a poem containing ſome certain action, and repreſenting a true picture of human life, for the delight and improvement of mankind. The principal ſpecies of the drama are two, comedy and tragedy. Some others there are of leſs note, as paſtoral, ſatire, tragi-comedy, opera, &c. See the article POETRY.

DRAMATIC, an epithet given to pieces written for the ſtage. See POETRY.

DRANK, among farmers, a term uſed to denote wild oats, which never fail to infeſt worn-out lands; ſo that, when ploughed lands run to theſe weeds and thiſtles, the farmer knows it is high time to fallow them, or elſe to ſow them with hay-ſeed, and make paſture of them.

DRAPERY, in ſculpture and painting, ſignifies the repreſentation of the clothing of human figures, and alſo hangings, tapeſtry, curtains, and moſt other things of that particular nature or deſcription. See PAINTING, CRAYON, DRAWING, and MINIATURE.

DRASTIC, in medicine, an epithet applied to ſuch drugs as act immediately and powerfully on the primæ viæ. Moſt of the reſinous purgatives, as jallap, ſcammony, &c. being diſpoſed to operate both as emetics and cathartics, are called *draſtics*.

DRAVE, a large navigable river, which, taking its riſe in the archbiſhopric of Saltzburg, in Germany, runs ſouth-eaſt through Stiria; and, continuing its courſe, divides Hungary from Sclavonia, and falls into the Danube at Eſſeck.

DRAUGHT, in medicine. See POTION.

DRAUGHT, in trade, called alſo *cloff* or *clough*, is a ſmall allowance on weighable goods, made by the king to the importer, or by the ſeller to the buyer, that the weight may hold out when the goods are weighed again. The king allows 1 lb. draught for goods weighing no leſs than 1 cwt. 2 lb. for goods weighing between 1 and 2 cwt. 3 lb. for goods weighing between 2 and 3 cwt. 4 lb. from 3 to 10 cwt. 7 lb. from 10 to 18 cwt. 9 lb. from 18 to 30 cwt. or upwards.

DRAUGHT is alſo uſed ſometimes for a bill of exchange, and commonly for an order for the payment of any ſum of money due, &c. Then the perſon who gives the order is ſaid to *draw* upon the other.

DRAUGHT, or, as it is pronounced, DRAFT, in architecture, the figure of an intended building deſcribed on paper; wherein are laid down, by ſcale and compaſs, the ſeveral diviſions and partitions of the apartments, rooms, doors, paſſages, conveniencies, &c. in their due proportion. It is uſual, and exceedingly neceſſary, before a building is begun to be raiſed, to have draughts of the ichnography, or ground-plot of each floor or ſtory; as alſo of the form and faſhion of each front, with the windows, doors, ornaments, &c. in an orthography, or upright. Sometimes the ſeveral fronts, &c. are taken, and repreſented in the ſame draught, to ſhow the effect of the whole building: this is called a *ſcenography*, or *perſpective*.

DRAUGHT, the depth of a body of water neceſſary to float a ſhip: hence a ſhip is ſaid to *draw* ſo many feet of water, when ſhe is borne up by a column of water of that particular depth. Thus, if it requires a body of water whoſe depth is equal to 12 feet, to float or buoy up a ſhip on its ſurface, ſhe is ſaid to draw 12 feet water; and that this draught may be more readily known, the feet are marked on the ſtem and ſtern poſt, regularly from the keel upwards.

DRAUGHT-*Hooks*, are large hooks of iron, fixed on the cheeks of a gun-carriage, two on each ſide, one near the trunnion hole, and the other at the train, diſtinguiſhed by the name of *fore* and *hind draught-hooks*. Large guns have draught-hooks near the middle tranſom, to which are fixed the chains that ſerve to keep the ſhafts of the limbers on a march. The fore and hind hooks are uſed for drawing a gun backwards or forwards, by men, with ſtrong ropes called *draught-ropes*, fixed to theſe hooks.

DRAUGHT-*Horſe*, in farming, a ſort of coarſe-made horſe, deſtined for the ſervice of a cart or plough.

DRAWBACK, in commerce, certain duties, either of the cuſtoms or of the exciſe, allowed upon the exportation of ſome of our own manufactures; or upon certain foreign merchandiſe, that have paid duty on importation. The oaths of the merchants importing and exporting are required to obtain the drawback on foreign goods, affirming the truth of the officer's certificate on the entry, and the due payment of the duties: and theſe may be made by the agent or huſband of any corporation or company; or by the known ſervant of any merchant uſually employed in making his entries, and paying his cuſtoms. In regard to foreign goods entered outward, if leſs quantity or value be fraudulently ſhipped out than what is expreſſed in the exporter's certificate, the goods therein mentioned, or their value, are forfeited, and no drawback to be allowed for the ſame. Foreign goods exported by certificate in order to obtain the drawback, not ſhipped or exported, or relanded in Great Britain, unleſs in caſe of diſtreſs to ſave them from periſhing, are to loſe the benefit of the drawback, and are forfeited, or their value, with the veſſel, horſes, carriages, &c. employed in the relanding thereof; and the perſons employed in the relanding them, or by whoſe privity they are relanded, or into whoſe hands they ſhall knowingly come, are to forfeit double the amount of the drawback. Officers of the cuſtoms conniving at or aſſiſting in any fraud relating to certificate goods, beſides other penalties, are to forfeit their office, and ſuffer ſix months impriſonment without bail or mainpriſe; as are alſo maſters, or perſons belonging to the ſhips employed therein. Bonds given for the exportation of certificate-goods to Ireland muſt not be delivered up, nor drawback allowed for any goods, till a certificate under the hands and ſeals of the collector or comptroller, &c. of the cuſtoms be produced, teſtifying the landing.

DRAW-*Bridge*, a bridge made after the manner of a float, to draw up or let down, as occaſions ſerve, before the gate of a town or caſtle. See BRIDGE. A draw-bridge may be made after ſeveral different ways; but the moſt common are made with plyers, twice the length of the gate, and a foot in diameter. The inner ſquare is traverſed with a croſs, which ſerves for a counterpoiſe; and the chains which hang from the extremities of the plyers to lift up or let down the bridge, are of iron or braſs. In navigable rivers it is ſometimes neceſſary to make the middle arch of bridges with two moveable platforms, to be raiſed occaſionally, in order to let the maſts and rigging of ſhips paſs through. This kind of draw-bridge is repreſented in Plate 4, where A B is the width of the middle arch; A L and B L, the two piers that ſupport the draw-bridge N O, one of the platforms of which is raiſed, and the other let down, having the beam P Q for its plyer. To N O are ſuſpended two moveable braces E H, E H; which reſting on the ſupport E, preſs againſt the bracket M, and thereby ſtrengthen the draw-bridge. Theſe braces are conducted to the reſt by means of the weight S, pulling the chain S L F.

DRAW-*Net*, a kind of net for taking the largeſt ſort of wildfowl, which ought to be made of the beſt ſort of packthread, with wide meſhes; they ſhould be about two fathoms deep and ſix long, verged on each ſide with a very ſtrong cord, and ſtretched at each end on long poles. It ſhould be ſpread ſmooth and flat upon the ground: and ſtrewed over with graſs, ſedge, or the like, to hide it from the fowl; and the ſportſman is to place himſelf in ſome ſhelter of graſs, fern, or ſome ſuch thing.

DRAWING,

AN art which consists in justly representing the appearances of objects, upon paper or any plain surface, by means of lines and shades, formed with certain colouring materials adapted to the purpose.

Sect. I. *Of the Materials used for Drawing, and the Manner of employing them.*

Whoever would acquire this elegant art, must begin by furnishing himself with proper materials, such as black-lead pencils, crayons of black, white, or red chalk, crow-quill pens, a rule and compasses, camels-hair pencils, and Indian ink. He must accustom himself to hold the pencil farther from the point than a pen is held in writing; which will give him a better command of it, and contribute to render his strokes more free and bold. The use of the pencil is to draw the first sketch or outline of the piece, as any stroke that is amiss may in this be easily rubbed out; and when he has made the sketch as correct as he can with the pencil, he may then draw carefully the best outline he has got, with his crow-quill pen dipped in a liquid Indian ink; after which he may discharge the pencil-lines, by rubbing the piece gently with the crumb of stale bread or Indian rubber. Having thus got the outline clear, his next work is to shade the piece properly, either by drawing fine strokes with his pen where it requires to be shaded, or by washing it with his pencil and the Indian ink. As to his rule and compasses, they are never or very rarely to be used, except in measuring the proportions of figures after he has drawn them, to prove whether they are right or not; or in houses, fortifications, and other works of architecture.

Having got all these implements in readiness, the first practice must be to draw straight and curve lines, with ease and freedom, upwards and downwards, sideways to the right or left, or in any direction whatsoever. He must also learn to draw accurately, by command of hand only, squares, circles, ovals, and other geometrical figures: for as the alphabet, or a knowledge of the letters, is an introduction to grammar; so is geometry to drawing. The practice of drawing these simple figures till he is master of them, will enable him to imitate, with greater ease and accuracy, many appearances both in nature and art. And here it is proper to admonish him, never to be in a hurry; but to make himself perfectly master of one figure before he proceeds to another: the advantage, and even necessity, of this, will appear as he proceeds. Two observations more may be added: 1. That he accustom himself to draw all his figures very large, which is the only way of acquiring a free bold manner of designing. 2. That he practise drawing till he has gained a tolerable mastership of his pencil, before he attempts to shadow any figure or object of any kind whatever.

Sect. II. *Of the Method of drawing Eyes, Ears, Legs, Arms, Hands, Feet, &c.*

As to the drawing of eyes and ears, legs and arms, the learner will have very little more to do than to copy carefully the different examples given in Plate 5 taken from one of the most approved drawing-books extant. But the actions and postures of the hands are so many and various, that no certain rules can be given for drawing them that will universally hold good. Yet as the hands and feet are difficult members to draw, it is very necessary, and well worth while, to bestow some time and pains about them, carefully imitating their various postures and actions, so as not only to avoid all sameness and imperfection, but also to give them life and spirit. To arrive at this, great care, study and practice are requisite; particularly in imitating the best prints or drawings that can be got of hands and feet; for, as to the mechanical way of drawing them by lines and measures, they are not only perplexed and difficult, but also contrary to the practice of the best masters. One general rule, however, may be given (which is universally to be observed in all subjects), viz. Not to finish perfectly, at first, any single part, but to sketch out faintly, and with light strokes of the pencil, the shape and proportion of the whole hand, with the action and turn of it; and after considering carefully whether this first sketch be perfect, and altering it wherever it is amiss, you may then proceed to the bending of the joints, the knuckles, the veins, and other small particulars, which, when the learner has got the whole shape and proportion of the hand or foot, will not only be more easily but also more perfectly done.

Sect. III. *Of Drawing the Human Face.*

It is usual with artists to divide the head into four equal parts. 1. From the crown of the head to the top of the forehead. 2. From the top of the forehead to the eye-brows. 3. From the eye-brows to the bottom of the nose. 4. From thence to the bottom of the chin. But this proportion is not constant; those features in different men being often very different as to length and shape. In a well-proportioned face, however, they are nearly right. To direct the learner, therefore, in forming a perfect face, his first business is to draw an oval, or rather the form of an egg; in the middle of which, from the top to the bottom, draw a perpendicular line. Through the centre or middle of this line draw a diameter line, directly across from one side to the other of your oval. On these two lines all the features of the face are to be placed as follows: Divide your perpendicular line into four equal parts: the first must be allotted to the hair of the head; the second is from the top of the forehead to the top of the nose between the eye-brows; the third is from thence to the bottom of the nose; and the fourth includes the lips and chin. Your diameter line, or the breadth of the face, is always supposed to be the length of five eyes; you must therefore divide it into five equal parts, and place the eyes upon it so as to leave exactly the length of one eye betwixt them. This is to be understood only of a full front face, as *a* in Plate 6; for if it turn to either side, then the distances are to be lessened on that side which turns from you, less or more, in proportion to its turning, as in the examples *b b b*. The top of the ear is to rise parallel to the eye-brows, at the end of the diameter line; and the bottom of it must be equal to the bottom of the nose. The nostrils ought not to come out farther than the corner of the eye in any face; and the middle of the mouth must always be placed upon the perpendicular line.

Sect. IV. *Of delineating Human Figures.*

When the pupil is become tolerably expert in drawing faces, heads, hands, and feet, he may next attempt to draw the whole of the human figure at length. In order to this, let him first sketch the head; then draw a perpendicular line from the bottom of the head seven times its length (for the length of the head is about one-eighth part of the length of the figure). The best proportioned figures of the ancients are $7\frac{3}{4}$ heads in

height. If, therefore, the figure ftands upright, as in the example *a*, Plate 5, draw a perpendicular line from the top of the head to the heel, which muft be divided into two equal parts. The bottom of the belly is exactly the centre. Divide the lower part into two equal parts again, the middle of which is the middle of the knee. For the upper part of the figure, the method muft be varied. Take off with your compaffes the length of the face (which is three parts in four of the length of the head); from the throat pit to the pit of the ftomach is one face, from thence to the navel is another, and from thence to the lower rim of the belly is a third. The line muft be divided into feven equal parts. Againft the end of the firft divifion, place the breafts; the fecond comes dowu to the navel; the third to the privities; the fourth to the middle of the thigh; the fifth to the lower part of the knee; the fixth to the lower part of the calf; and the feventh to the bottom of the heel, the heel of the bearing-leg being always exactly under the pit of the throat. But as the effence of all drawing confifts in making at firft a good fketch, the learner muft in this particular be very careful and accurate; he ought to draw no one part perfect or exact till he fee whether the whole draught be good; and when he has altered that to his mind, he may then finifh one part after another as exactly as he is able.

Some artifts, in copying a ftatue, begin with the head, which they finifh, and then proceed in the fame manner to the other parts of the body, finifhing as they go on: but this method is a bad one; for if they make the head in the leaft too big or too little, the confequence is a difproportion between all the parts, occafioned by their not having fketched the whole proportionably at firft. Let the learner remember, therefore, in whatever he intends to draw, firft to fketch its feveral parts, meafuring the diftances and proportions between each with his finger or pencil, without ufing the compaffes; and then judge of them by the eye, which by degrees will be able to judge of truth and proportion, and will become his beft and principal guide. And let him obferve, as a general rule, always to begin with the right fide of the piece he is copying: for by that means he will always have what he has done before his eyes; and the reft will follow more naturally, and with greater eafe: whereas if he begin with the left fide, his hand and arm will cover what he does firft, and deprive him of the fight of it; by which means he will not be able to proceed with fo much alacrity.

With regard to the proper order and manner of proceeding in drawing the human body, he muft firft fketch the head; then the fhoulder in the exact breadth; then draw the trunk of the body, beginning with the arm-pits (leaving the arms till afterwards), and fo draw down to the hips on both fides; and be fure he obferve the exact breadth of the waift. When he has done this, let him then draw that leg which the body ftands upon, and afterwards the other which ftands loofe; then the arms, and laft of all the hands. He muft take notice alfo of the bowings and bendings that are in the body; making the part which is oppofite to that which bends, correfpond to it. For inftance: if one fide of the body bend in, the other muft ftand out anfwerable to it; if the back bend in, the belly muft ftick out; if the knee bend out, the ham muft fall in; and fo of any other joint in the body. Finally, he muft endeavour to form all the parts of the figure with truth, and in juft proportion: not one arm or one leg bigger or lefs than the other; not broad Herculean fhoulders, with a thin and flender waift; nor raw and boney arms, with thick and gouty legs: but let there be a kind of harmonious agreement amongft the members, and a beautiful fymmetry throughout the whole figure.

SECT. V. *Of the Proportions and Meafures of the Human Body.*

THE centre or middle part, between the two extremes of the head and feet of a new-born child, is in the navel, but that of an adult is in the os pubis; and the practice of dividing the meafures of children into four, five, or fix parts, whereof the head is one, is made ufe of by painters and fculptors. A child of two years old has about five heads in its whole length, but one of four or five years old has near fix; about the fifteenth or fixteenth year, feven heads are the proportion or meafure, and the centre inclines to the upper part of the pubis. Hence it appears, as the growth of the body advances, there is a gradual approach to the proportion of an adult of near eight heads in the whole length, of which, as mentioned above, the head makes one.

In conformity to thefe principles, the following Table is conftructed, exhibiting the proportions of the parts of a man and of a woman, as they were fixed by the ancients, and meafured by M. Audran from the Apollo Pythius in the garden of the Vatican at Rome, and the Venus Aphroditus (See Plate 7) belonging to the family of Medicis. Suppofing the figures to ftand upright and duly poifed on both legs, the whole height of the former is divided into $31\frac{1}{2}$ parts, being 7 heads 3 parts and 6 minutes; and that of the latter into 31 parts, being 7 heads and 3 parts.

LENGTH *of the* HEAD *and* TRUNK *of the* BODY.	*Apollo.* Hds.	Pts.	Min.	*Venus.* Hds.	Pts.	Min.
From the top of the head to the bottom of the chin 4 parts or	1	0	0	1	0	0
the bottom of the chin to the top of the fternum or breaft-bone	0	1	7	0	1	8
the top of the fternum to the pit of the ftomach	0	3	10	0	3	6
the pit of the ftomach to the navel	0	2	10	0	2	7
the navel to the pubis	0	3	6	0	3	9
Length of the head and trunk of the body	3	3	9	3	3	6
LENGTH *of the* LOWER EXTREMITIES.						
From the pubis to the fmall of the thigh above the patella or knee-pan	1	2	6	1	2	3
the fmall of the thigh to the joint or middle of the knee	0	1	9	0	1	6
the joint of the knee to the fmall of the leg above the ankle	1	1	9	1	2	0
the top to the bottom of the ankle	0	1	0	0	1	0
the bottom of the ankle to the bottom of the heel	0	0	9	0	0	9
Length of the lower extremities	3	3	9	3	3	6
Length of the head and trunk, as above	3	3	9	3	3	6
Total length of the figures	7	3	6	7	3	0

Length *of the* Fore-Arm *or* Upper Extremities.	*Apollo.* Hds.	Pts.	Min.	*Venus.* Hds.	Pts.	Min.
From the top of the ſhoulder to the elbow	1	2	3	1	2	3
the elbow to the hand	1	1	2	1	0	6
the joint of the hand to the root of the middle finger	0	1	8	0	1	6
the root to the tip of the middle finger	0	1	10	0	1	7
Length of the upper extremities	3	2	11	3	1	10
Breadth between the outward angles of the eyes	0	1	6	0	1	7
of the face at the temples	0	2	2	0	2	2
of the upper part of the neck	0	2	0	0	1	11
over the ſhoulders	2	0	0	1	3	8
of the body below the arm-pits	1	2	5	1	1	8
between the nipples	1	0	7	0	3	8
from the bottom of the chin to the horizontal line of the nipples	1	0	7	1	0	1
of the body at the ſmall of the waiſt	1	1	0	1	0	8
over the loins or os ilium	1	1	3	1	1	6
over the haunches or tops of the thigh-bones	1	1	5	1	2	3
of the thigh at the top	0	3	0	0	3	1
of the thigh below the middle	0	2	8½	0	2	7
of the thigh above the knee	0	1	8	0	2	0
of the leg below the knee	0	1	6	0	1	10½
at the calf of the leg	0	2	4	0	2	3
below the calf	0	1	7	0	1	11½
above the ankle	0	1	2	0	1	2
of the ankle	0	1	4	0	1	3
below the ankle	0	1	1½	0	1	1
middle of the foot	0	1	4	0	1	3
at the roots of the toes	0	1	7	0	1	7
of the arm over the biceps muſcle	0	1	8	0	1	9
of the arm above the elbow	0	1	6	0	1	5
of the arm below the elbow over the long ſupinator	0	1	10	0	1	7
at the wriſt	0	1	1	0	1	0
of the hand over the firſt joint of the thumb	0	1	9	0	1	8
of the hand over the roots of the fingers	0	1	7	0	1	6
over the heads of the ſcapulæ or ſhoulder blades	1	2	0	1	1	4
Length of both arms and hands, each of the Apollos being 3h. 2p. 11m. and the Venus 3h. 1p. 5m.	7	1	10	6	2	10
Breadth betwixt the tips of the middle fingers of each hand when the arms are ſtretched out horizontally	8	3	10	8	0	2

Side View.

Length from the top of the head to the ſhoulder	1	1	8	1	1	6
from the top of the ſhoulder to the loins above the hip	1	3	3	1	1	7
from the loins to the lower part of the hip	1	0	2	1	2	1
from the hip to the ſide of the knee, oppoſite to the top of the patella	1	2	0	1	0	11
from the ſide of the knee to the bottom of the heel	2	0	5	2	0	11
Length of the figures	7	3	6	7	3	0

Side View.

Thickness from the fore to the back part of the ſkull	0	3	6	0	3	4
from the wing of the noſe to the tip of the ear	0	1	8½	0	1	6
of the upper part of the neck	0	2	0	0	1	11
from the breaſt to the back over the nipples	1	0	6	1	0	6
from the belly to the ſmall of the back	0	3	6	0	3	7
from the belly above the navel to the back of the loins	0	3	9	1	0	2
from the bottom of the belly to the round of the hip	1	0	0	1	0	5
from the fore part of the thigh to the bottom of the hip	0	3	2	0	3	7
of the thigh at the middle	0	3	3	0	3	6½
of the thigh above the knee	0	2	1	0	2	3
at the middle of the knee below the patella	0	2	1	0	2	2
of the leg below the knee	0	1	9	0	1	11
of the leg at the calf	0	1	8	0	1	9

	Apollo. Hds.	Pts.	Min.	Venus. Hds.	Pts.	Min.
THICKNESS of the leg at the ankle	0	1	5½	0	1	4
of the foot at the thickeſt part	0	0	0	0	1	3
length of the foot	1	0	6	1	0	4½
from the fore-part of the bend of the foot to the lower and back part of the heel	0	0	0	0	2	2
of the arm over the biceps	0	2	0	0	1	9
over the elbow	0	1	6	0	1	6
below the elbow	0	1	5	0	1	7
at the wriſt	0	1	1	0	0	11
below the joint of the wriſt	0	1	0	0	0	10
of the hand at the roots of the fingers	0	0	5½	0	0	5
at the roots of the nails	0	0	3½	0	0	3

The other moſt admired antique ſtatues differ a little from theſe proportions, the Laocoon meaſuring 7h. 2p. 3m. the Hercules 7h. 3p. 7m. the Pyramus 7h. 2p. the Antinous 7h. 7h. 2p. the Grecian ſhepherdeſs 7h. 3p. 6m. and the Mirmillo 8h. But all their other proportions are allowed to be harmonious and agreeable to the characters they repreſent.

The moſt remarkable differences of the ſymmetry or proportions of a man and of a woman to be obſerved from the Table are: Firſt, the ſhoulders of a man are broader, meaſuring two heads; and the haunches narrower, meaſuring 1h. 1p. 5m. whereas the ſhoulders of a woman meaſure only 1h. 3p. 8m. and the haunches meaſure 1h. 2p. 3m. The ſternum or breaſt bone of a man is longer, meaſuring 3p. 8m. and the ſternum of the woman only 3p. 3m. On the contrary, the pelvis of a man is leſs, meaſuring from the top to the bottom only 4p. whereas the pelvis of a woman meaſures from the top to the bottom 4p. 3m.

It is a leading principle, in which every perſon converſant in deſigning has agreed, that without a perfect knowledge of the proportions, nothing can be produced but monſtrous and extravagant figures; and it is alſo univerſally admitted, that the ancient Greek and Roman ſculptors attained the higheſt ſucceſs in producing the moſt perfect models. Indeed, the greateſt of the modern artiſts who have examined their figures with attention admit, that ſeveral of the ancient ſculptors in ſome degree have excelled nature, they never having found any man ſo perfect in all his parts as ſome of their figures are. Their opportunities indeed were great: Greece abounded with beauties; and Rome being miſtreſs of the world, every thing that was curious and beautiful was brought to it from all parts. Their motives were alſo powerful; religion, glory, and intereſt. They conſidered it as a kind of religious worſhip to give the figures of their gods ſo much nobleneſs and beauty as to be able to attract the love and veneration of the people. Their own glory was alſo concerned, particular honours being beſtowed on thoſe who ſucceeded; and for their fortune they had no further care to take when they once arrived at a certain degree of merit.

SECT. VI. *Of the different Attitudes of the Human Figure.*

IF we are to repreſent, in a ſtate of vigorous action, a figure ſuch as that of Hercules, it is of importance to attend to the parts or limbs principally employed in performing that action. If the figure is ſtanding, the foot muſt be placed in a right line, or perpendicular to the trunk or bulk of the body, where the centre of gravity may be ſuppoſed to fall. This centre is determined by the heel; or, if the figure is upon tiptoe, then the ball of the great toe is in the centre. The muſcles of the leg which ſupports the body ought to be ſwelled, and their tendons drawn more to an extenſion than thoſe of the other leg, which is only placed ſo as to receive the weight of the body towards that way to which the action inclines it. For example, ſuppoſe Hercules with a club ſtriking at any thing before him towards the left ſide: then let his right leg be placed ſo as to receive the whole weight of the body, and the left looſely touching the ground with its toes. Here the external muſcles of the right leg ought to be expreſſed very ſtrong; but thoſe of the left ſcarcely appearing more than if it were in ſome ſedentary poſture, except in the preſent caſe. The foot being extended, the muſcles which compoſe the calf of the leg are in action and appear very ſtrong; though it is not meant that *all* the muſcles of the right leg, which ſupports the weight of the body, ought to be expreſſed very ſtrong or equally ſwelled, but thoſe moſt tumefied which are chiefly concerned in the action or poſture that the leg is then in. For example, if the leg or tibia is extended, then the extending muſcles placed on the thigh are moſt ſwelled: if it be bent, then the bending muſcles and their tendons appear moſt. The like may be obſerved of the whole body in general when it is put into vigorous action. The Laocoon in the Vatican garden at Rome furniſhes an example of this muſcular appearance through the whole; but in the Antinous, Apollo, and other figures of the ancients, in the Vatican and other places, in poſtures where no conſiderable actions are deſigned, we ſee their muſcles expreſſed but faintly, or ſcarcely to be diſcerned.

In general, neither the clavicles or collar bones, nor the muſcles, appear ſo ſtrongly in women as in men; nor will any action in which a woman uſes her utmoſt ſtrength occaſion ſuch ſwellings or riſings of the muſcles as to give the appearance they do in men, ſince beſides the greater quantity of fat placed under the ſkin in women, their muſcles are by no means ſo large and conſpicuous.

SECT. VII. *Effects of the Exertion of the Muſcles.*

IT is of great importance to an artiſt to be acquainted with the moſt obvious effects of the action of thoſe muſcles which are placed externally on the human body; for theſe vary with every alteration of poſture, and are variouſly enlarged and changed in their appearance by every effort that is dictated by the will.

Thus, if either of the *maſtoid* muſcles act, the head is turned to the contrary ſide, and the muſcle which performs that action appears very plain under the ſkin. If the arms are lifted up, the *deltoid* muſcles placed on the ſhoulders, which perform that action, ſwell, and make the extremities of the ſpines of the ſhoulder-blades, called the tops of the ſhoulders, appear indented or hollow. The ſhoulder-blades following the elevation of the arms, their baſes incline at that time obliquely downward. If the arms are drawn down, put forwards, or pulled backwards, the ſhoulder-blades neceſſarily vary their poſitions accordingly. All theſe particulars are to be learned by conſulting the life only: when being well acquainted with what then appears in every action, the artiſt will be able to form an adequate idea how it ought to be expreſſed. Theſe circumſtances are little known; and ſeldom enough attended to in deſigning.

When the cubit or fore-arm is bent, the *biceps* has its belly very much raiſed. The ſame happens in the *triceps*, when the

arm is extended. The ſtraight muſcles of the abdomen appear very ſtrong when riſing from a decumbent poſture. Thoſe parts of the great *ſerratus* muſcle which are received in the teeth or beginnings of the *obliquus deſcendens* muſcle immediately below, are very much ſwelled when the ſhoulder on the ſame ſide is brought forwards; that ſerratus muſcle then being employed in drawing the ſcapula forwards.

The long extending muſcles of the trunk act alternately in walking, after this manner: if the right leg bears the weight of the body, and the left is in tranſlation as on tiptoe, the laſt mentioned muſcles of the back on the left ſide may be obſerved to be tumefied on the other ſide about the region of the loins, and ſo on the other ſide. The *trochanters*, or outward and uppermoſt heads of the thigh-bones, vary ſo greatly in their poſitions, that no preciſe obſervations can explain their ſeveral appearances; but the ſtudy after the life ought to be chiefly relied on. If the thigh is extended, as when the whole weight of the body reſts on that ſide, the *glutæus* or buttock muſcle makes a very different appearance from what offers at another time; but if the thigh be drawn backwards, that muſcle appears ſtill more and more tumefied. When the whole leg is drawn upwards and forwards, and at the ſame time the foot is inclined inwards, the upper part of the *ſartorius* muſcle appears to riſe very ſtrong; in other poſitions of the thigh, that muſcle makes a furrowing appearance in its whole progreſs. If a man is upon tiptoe, the extending muſcles of the leg placed on the fore part of the thigh, and thoſe of the foot that compoſe the calf of the leg, appear very ſtrong, and the long *peronæus* makes a conſiderable indentation or furrowing at that time, in its progreſs on the outſide of the leg.

Many other remarks might here be offered; but a knowledge of this ſubject will be beſt acquired, by drawing after ſome anatomical model, or by an accurate examination of the *muſcular figures* given in plates 10 and 13 in the Treatiſe on ANATOMY, for which reaſon we forbear any farther mention of this part of our ſubject.

SECT. VIII. *Of the Diſtribution of Light and Shade.*

As ſoon as the learner has made himſelf in ſome meaſure perfect in drawing outlines, his next endeavour muſt be to ſhade them properly. It is this which gives an appearance of ſubſtance, ſhape, diſtance, and diſtinction, to whatever bodies he endeavours to repreſent, whether animate or inanimate. The beſt rule for doing this is, to conſider from what point, and in what direction, the light falls upon the objects which he is delineating, and to let all his lights and ſhades be placed according to that direction throughout the whole work. That part of the object muſt be lighteſt which has the light moſt directly oppoſite to it: if the light falls ſideways on the picture, he muſt make that ſide which is oppoſite to it lighteſt, and that ſide which is fartheſt from it darkeſt. If he is drawing the figure of a man, and the light be placed above the head, then the top of the head muſt be made lighteſt, the ſhoulders next lighteſt, and the lower parts darker by degrees. That part of the object, whether in naked figures, or drapery, or buildings, that ſtands fartheſt out, muſt be made the lighteſt, becauſe it comes neareſt to the light; and the light loſes ſo much of its brightneſs, by how much any part of the body bends inward, becauſe thoſe parts that ſtick out hinder the luſtre and full brightneſs of the light from ſtriking on thoſe parts that fall in. Titian uſed to ſay, that he knew no better rule for the diſtribution of lights and ſhadows than his obſervations drawn from a bunch of grapes. Sattins and ſilks, and all other ſhining ſtuffs, have certain glancing reflections, exceedingly bright where the light falls ſtrongeſt. The like is ſeen in armour, braſs pots, or any other glittering metal, where you ſee a ſudden brightneſs in the middle or centre of the light, which diſcovers the ſhining nature of ſuch things. Obſerve alſo, that a ſtrong light requires a ſtrong ſhade, a fainter light a fainter ſhade; and that an equal balance be preſerved throughout the piece, between the lights and ſhades. Thoſe parts which muſt appear round require but one ſtroke in ſhading, and that ſometimes but very faint; ſuch parts as ſhould appear ſteep or hollow, require two ſtrokes acroſs each other, or ſometimes three, which is ſufficient for the deepeſt ſhade. Care muſt be alſo taken to make the outlines faint and ſmall in ſuch parts as receive the light; but where the ſhades fall, the outline muſt be ſtrong and bold. The learner muſt begin his ſhadings from the top, and proceed downward, and uſe his utmoſt endeavours both by practice and obſervation to learn how to vary the ſhadings properly; for in this conſiſts a great deal of the beauty and elegance of drawing. Another thing to be obſerved is, that as the human ſight is weakened by diſtances, ſo objects muſt ſeem more or leſs confuſed or clear according to the places they hold in the piece: Thoſe that are very diſtant muſt be weak, faint, and confuſed; thoſe that are near and on the foremoſt ground, clear, ſtrong, and accurately finiſhed.

SECT. IX. *Of Drapery.*

In the art of clothing the figures, or caſting the drapery properly and elegantly upon them, many things are to be obſerved. 1. The eye muſt never be in doubt of its object; but the ſhape and proportion of the part or limb, which the drapery is ſuppoſed to cover, muſt appear; at leaſt ſo far as art and probability will permit: and this is ſo material a conſideration, that many artiſts draw firſt the naked figure, and afterwards put the garments upon it. 2. The drapery muſt not fit too cloſe to the parts of the body: but let it ſeem to flow round, as it were to embrace them; yet ſo as that the figure may be eaſy, and have a free motion. 3. The draperies which cover thoſe parts that are expoſed to great light muſt not be ſo deeply ſhaded as to ſeem to pierce them; nor ſhould thoſe members be croſſed by folds that are too ſtrong, leſt by the too great darkneſs of their ſhades the limbs look as if they were broken. 4. The great folds muſt be drawn firſt, and then ſtroked into leſſer ones: and great care muſt be taken that they do not croſs one another improperly. 5. Folds in general ſhould be large, and as few as poſſible. However, they muſt be greater or leſs according to the quantity and quality of the ſtuffs of which the drapery is ſuppoſed to be made. The quality of the perſons is alſo to be conſidered in the drapery. If they are magiſtrates, their draperies ought to be large and ample; if country clowns or ſlaves, they ought to be coarſe and ſhort; if ladies or nymphs, light and ſoft. 6. Suit the garments to the body, and make them bend with it, according as it ſtands in or out, ſtraight or crooked; or as it bends one way or another; and the cloſer the garment fits to the body, the narrower and ſmaller muſt be the folds. 7. Folds well imagined give much ſpirit to any kind of action; becauſe their motion implies a motion in the acting member, which ſeems to draw them forcibly, and makes them more or leſs ſtirring as the action is more or leſs violent. 8. An artful complication of folds in a circular manner greatly helps the fore-ſhortenings. 9. All folds conſiſt of two ſhades, and no more; which you may turn with the garment at pleaſure, ſhadowing the inner ſide deeper, and the outer more faintly. 10. The ſhades in ſilk and fine linen are very thick and ſmall, requiring little folds and a light ſhadow. 11. Obſerve the motion of the air or wind, in order to draw the looſe apparel all flying one way: and draw that part of the garment that adheres cloſeſt to the body before you draw the looſer part that flies off from it; leſt, by drawing the looſe part of the garment firſt, you ſhould miſtake the poſition of the figure, and place it improperly.

12. Rich ornaments, when judiciouſly and ſparingly uſed, may ſometimes contribute to the beauty of draperies. But ſuch ornaments are far below the dignity of angels or heavenly figures; the grandeur of whoſe draperies ought rather to conſiſt in the boldneſs and nobleneſs of the folds, than in the quality of the ſtuff or the glitter of ornaments. 13. Light and flying draperies are proper only to figures in ſtrong motion, or in the wind: but when in a calm place, and free from violent action, their draperies ſhould be large and flowing; that, by their contraſt and the fall of the folds, they may appear with grace and dignity. Thus much for drapery; ſome examples of which we have given in the Plates. But ſee farther the articles Crayon and Painting.

Sect. X. *Of the Effects of the Paſſions.*

The paſſions, ſays M. Le Brun, are motions of the ſoul, either upon her purſuing what ſhe judges to be for her good, or ſhunning what ſhe thinks hurtful to her; and commonly, whatever cauſes emotion or paſſion in the ſoul creates alſo ſome action in the body. It is therefore neceſſary for a painter to know which are the different actions in the body that expreſs the ſeveral paſſions of the ſoul, and how to delineate them. M. Le Brun has been extremely happy in expreſſing many of the paſſions, and the learner cannot ſtudy any thing better than the examples which he has left us of them. However, as M. De Piles juſtly obſerves, it is abſurd as well as impoſſible to pretend to give ſuch particular demonſtrations of them as to fix their expreſſion to certain ſtrokes, which the painter ſhould be obliged to make uſe of as eſſential and invariable rules. This, ſays he, would be depriving the art of that excellent variety of expreſſion which has no other principle than diverſity of imagination, the number of which is infinite. The ſame paſſion may be finely expreſſed ſeveral ways, each yielding more or leſs pleaſure in proportion to the painter's underſtanding and the ſpectator's diſcernment.

Though every part of the face contributes towards expreſſing the ſentiments of the heart, yet the eye-brow, according to M. Le Brun, is the principal ſeat of expreſſion, and where the paſſions beſt make themſelves known. It is certain, ſays he, that the pupil of the eye, by its fire and motion, very well ſhows the agitation of the ſoul, but then it does not expreſs the kind or nature of ſuch an agitation; whereas the motion of the eye-brow differs according as the paſſions change their nature. To expreſs a ſimple paſſion, the motion is ſimple; to expreſs a mixed paſſion, the motion is compound: if the paſſion be gentle, the motion is gentle; and if it be violent, the motion is ſo too. We may obſerve farther, ſays he, that there are two kinds of elevation in the eye-brows. One, in which the eye-brows riſe up in the middle; this elevation expreſſes agreeable ſenſations, and it is to be obſerved that then the mouth riſes at the corners: another, in which the eye-brows riſe up at the ends, and fall in the middle; this motion denotes bodily pain, and then the mouth falls at the corners. In laughter, all the parts agree; for the eye-brows, which fall toward the middle of the forehead, make the noſe, the mouth, and the eyes, follow the ſame motion. In weeping, the motions are compound and contrary; for the eye-brows fall toward the noſe and over the eyes, and the mouth riſes that way. It is to be obſerved alſo, that the mouth is the part of the face which more particularly expreſſes the emotions of the heart: for when the heart complains, the mouth falls at the corners; when it is at eaſe, the corners of the mouth are elevated; and when it has an averſion, the mouth ſhoots forward, and riſes in the middle.

"The head (ſays M De Piles) contributes more to the expreſſion of the paſſions than all the other parts of the body put together. Thoſe ſeparately can only ſhow ſome few paſſions, but the head expreſſes them all. Some, however, are more peculiarly expreſſed by it than others: as humility, by hanging it down; arrogance, by lifting it up; languiſhment, by inclining it on one ſide; and obſtinacy, when with a ſtiff and reſolute air it ſtands upright, fixed, and ſtiff between the two ſhoulders. The head alſo beſt ſhows our ſupplications, threats, mildneſs, pride, love, hatred, joy, and grief. The whole face, and every feature, contributes ſomething: eſpecially the eyes; which, as Cicero ſays, are the windows of the ſoul. The paſſions they more particularly diſcover are, pleaſure, languiſhing, ſcorn, ſeverity, mildneſs, admiration, and anger; to which one might add joy and grief, if they did not proceed more particularly from the eye-brows and mouth; but when thoſe two paſſions fall in alſo with the language of the eyes, the harmony will be wonderful. But though the paſſions of the ſoul are moſt viſible in the lines and features of the face, they often require the aſſiſtance alſo of the other parts of the body. Without the hands, for inſtance, all action is weak and imperfect; their motions, which are almoſt infinite, create numberleſs expreſſions: it is by them that we *deſire*, *hope*, *promiſe*, *call*, *ſend back*; they are the inſtruments of *threatening*, *prayer*, *horror*, and *praiſe*; by them we *approve*, *condemn*, *refuſe*, *admit*, *fear*, *aſk*; expreſs our *joy* and *grief*, our *doubts*, *regrets*, *pain*, and *admiration*. In a word, it may be ſaid, as they are the language of the dumb, that they contribute not a little to ſpeak a language common to all nations, which is the language of painting. But to ſay how theſe parts muſt be diſpoſed for expreſſing the various paſſions, is impoſſible, nor can any exact rules be given for it, both becauſe the taſk would be infinite, and becauſe every one muſt be guided in this by his own genius and the particular turn of his own ſtudies." See the article Passions, and the Plate there referred to.

Sect. XI. *Of drawing Flowers, Fruit, Birds, &c.*

It may not be improper for the learner now to proceed in making ſome attempts at drawing flowers, fruit, birds, beaſts, and the like; not only as it will be a more pleaſing employment, but as it is an eaſier taſk, than the drawing of hands and feet, and other parts of the human body, which require not only more care, but greater exactneſs and nicer judgment. Very few rules or inſtructions are requiſite upon this head; the beſt thing the learner can do is, to furniſh himſelf with good prints or drawings by way of examples, and with great care and exactneſs to copy them. If it is the figure of a beaſt, begin with the forehead, and draw the noſe, the upper and under jaw, and ſtop at the throat. Then go to the top of the head, and form the ears, neck, back, and continue the line till you have given the full ſhape of the buttock. Then form the breaſt, and mark out the legs and feet, and all the ſmaller parts. And, laſt of all, finiſh it with the proper ſhadows. It is not amiſs, by way of ornament, to give a ſmall ſketch of landſcape; and let it be ſuitable and natural to the place or country of the beaſt you draw. Much the ſame may be ſaid with regard to birds. Of theſe, as well as beaſts and other ſubjects, the learner will find many examples, among the plates given in this publication.

Sect. XII. *Of drawing Landſcapes, Buildings, &c.*

Of all the parts of drawing, this is perhaps the moſt uſeful and neceſſary, as it is what every man may have occaſion for at one time or another. To be able, on the ſpot, to take the ſketch of a fine building, or a beautiful proſpect; of any curious production of art, or uncommon appearance in nature; is not only a very deſirable accompliſhment, but a very agreeable amuſement. Rocks, mountains, fields, woods, rivers, cataracts, cities, towns, caſtles, houſes, fortifications, ruins, or whatſoever elſe may preſent itſelf to view on our journeys or

travels in our own or foreign countries, may be thus brought home, and preſerved for our future uſe either in buſineſs or converſation. On this part, therefore, more than ordinary pains ſhould be beſtowed.

All drawing conſiſts in nicely meaſuring the diſtances of each part of the piece by the eye. In order to facilitate this, let the learner imagine in his own mind, that the piece he copies is divided into ſquares. For example: ſuppoſe or imagine a perpendicular and a horizontal line croſſing each other in the centre of the picture you are drawing from; then ſuppoſe alſo two ſuch lines croſſing your own copy. Obſerve in the original, what parts of the deſign thoſe lines interſect, and let them fall on the ſame parts of the ſuppoſed lines in the copy: we ſay, the ſuppoſed lines; becauſe though engravers, and others who copy with great exactneſs, divide both the copy and original into many ſquares, yet this is a method not to be recommended, as it will be apt to deceive the learner, who will fancy himſelf a tolerable proficient, till he comes to draw after nature, where theſe helps are not to be had, and then he will perhaps find himſelf miſerably defective in his attempts.

If he is to draw a landſcape from nature, let him take his ſtation on a riſing ground, where he will have a large horizon; and mark his tablet into three diviſions, downwards from the top to the bottom; and divide in his own mind the landſcape he is to take, into three diviſions alſo. Then let him turn his face directly oppoſite to the midſt of the horizon, keeping his body fixed, and draw what is directly before his eyes upon the middle diviſion of the tablet; then turn his head, but not his body, to the left hand, and delineate what he views there, joining it properly to what he had done before; and, laſtly, do the ſame by what is to be ſeen upon his right hand, laying down every thing exactly both with reſpect to diſtance and proportion. Some examples are given in Plate 9. and others may be found in ſeveral of the plates which appear in this work.

The beſt artiſts of late, in drawing their landſcapes, make them ſhoot away one part lower than another. Thoſe who make their landſcapes mount up higher and higher, as if they ſtood at the bottom of a hill to take the proſpect, commit a great error: the beſt way is to get upon a riſing ground, make the neareſt objects in the piece the higheſt, and thoſe that are farther off to glance away lower and lower till they come almoſt level with the line of the horizon, leſſening every thing proportionably to its diſtance, and obſerving alſo to make the objects fainter and leſs diſtinct the farther they are removed from the eye. He muſt make all his lights and ſhades fall one way, and let every thing have its proper motion: as trees ſhaken by the wind, the ſmall boughs bending more, and the large ones leſs: water agitated by the wind, and daſhing againſt ſhips or boats; or falling from a precipice upon rocks and ſtones, and ſpirting up again into the air, and ſprinkling all about: clouds alſo in the air, now gathered with the winds; now violently condenſed into hail, rain, and the like: always remembering, that whatever motions are cauſed by the wind muſt be made all to move the ſame way, becauſe the wind can blow but one way at once. Finally, it muſt be obſerved, that in order to attain any conſiderable proficiency in drawing, a knowledge of Perspective is abſolutely neceſſary. See the Treatiſe on that ſubject.

DRAY, a kind of cart uſed by brewers for carrying barrels of beer or ale; alſo a ſledge drawn without wheels.

Dray, a term uſed among ſportſmen, to denote ſquirrels' neſts built in the tops of trees.

DRAYTON (Michael), an eminent Engliſh poet, born of an ancient family in Warwickſhire in 1563. His propenſity to poetry was extremely ſtrong, even from his infancy; and we find the moſt of his principal poems publiſhed, and himſelf highly diſtinguiſhed as a poet, by the time he was about 30 years of age. It appears from his poem of Moſes's Birth and Miracles, that he was a ſpectator at Dover of the famous Spaniſh armada, and it is not improbable that he was engaged in ſome military employment there. It is certain, that not only for his merit as a writer, but his valuable qualities as a man, he was held in high eſtimation, and ſtrongly patronized by ſeveral perſonages of conſequence; particularly by Sir Henry Goodere, Sir Walter Aſton, and the Counteſs of Bedford; to the firſt of whom he owns himſelf indebted for great part of his education, and by the ſecond he was for many years ſupported. His poems are very numerous; and ſo elegant, that his manner has been copied by many modern writers of eminence ſince. Among theſe the moſt celebrated one is the Poly-Albion, a chorographical deſcription of England, with its commodities, antiquities, and curioſities, in metre of 12 ſyllables; which he dedicated to Prince Henry, by whoſe encouragement it was written: and whatever may be thought of the poetry, his deſcriptions are allowed to be exact. He was ſtyled *poet laureat* in his time: which, as Ben Jonſon was then in that office, is to be underſtood in a looſe ſenſe of approbation as an excellent poet; and was beſtowed on others as well as Drayton, without being confined ſtrictly to the office known by that appellation. He died in 1631; and was buried in Weſtminſter-abbey among the poets, where his buſt is to be ſeen, with an epitaph penned by Ben Jonſon.

DREAMS, are all thoſe thoughts which people feel paſſing through their minds, and thoſe imaginary tranſactions in which they often fancy themſelves engaged, when aſleep. Scarcely any part of nature is leſs open to our obſervation than the human mind in this ſtate. The dreamer himſelf cannot well obſerve the manner in which dreams ariſe or diſappear to him. When he awakes, he cannot recollect the circumſtances of his dreams with ſufficient accuracy. Were we to watch over him with the moſt vigilant attention, we could not perceive with certainty what emotions are excited in his mind, or what thoughts paſs through it, during his ſleep. But though we could aſcertain theſe phenomena, many other difficulties would ſtill remain. What parts of a human being are active, what dormant, when he dreams? Why does not he always dream while aſleep? Or why dreams he at all? Do any circumſtances in our conſtitution, ſituation, and peculiar character, determine the nature of our dreams? In attempting to reaſon on theſe intricate points, the following facts are at leaſt worthy of being attended to:

1. In dreaming, we are not conſcious of being aſleep. This is well known from a thouſand circumſtances. When awake, we often recollect our dreams; and we remember on ſuch occaſions, that while thoſe dreams were paſſing through our minds, it never occurred to us that we were ſeparated by ſleep from the active world. We are often obſerved to act and talk in dreaming as if we were buſily engaged in the intercourſe of ſocial life.

2. In dreaming, we do not conſider ourſelves as witneſſing

or bearing a part in a fictitious fcene: we feem not to be in a fimilar fituation with the actors in a dramatic performance, or the fpectators before whom they exhibit, but engaged in the bufinefs of real life. All the varieties of thought that pafs through our minds when awake may alfo occur in dreams; all the images which imagination prefents in the former ftate, fhe is alfo able to call up in the latter; all the fame emotions may be excited, and we are often actuated by equal violence of paffion; none of the tranfactions in which we are capable of engaging while awake are impoffible in dreams: in fhort, our range of action and obfervation is equally wide in the one ftate as in the other; and while dreaming, we are not fenfible of any diftinction between our dreams and the events and tranfactions in which we are actually concerned in our intercourfe with the world.

3. It is faid, that all men are not liable to dream. Dr. Beattie, in a very pleafing effay on this fubject, relates, that he knew a gentleman who never dreamed except when his health was in a difordered ftate: and Locke mentions fomewhere, that a certain perfon of his acquaintance was a ftranger to dreaming till the 26th year of his age; and then began to dream in confequence of having a fever. Thefe inftances, however, are too few, and we have not been able to obtain more; and, befides, it does not appear that thofe perfons had always attended, with the care of a philofopher making an experiment, to the circumftances of their fleep. They might dream, but not recollect their dreams on awaking; and they might both dream and recollect their dreams immediately upon awaking, yet afterwards fuffer the remembrance of them to flip out of their minds. We do not advance this therefore as a certain fact concerning dreaming; we are rather inclined to think it a miftake.

But though it appears to be by no means certain that any of the human race are through the whole of life abfolute ftrangers to dreaming; yet it is well known that all men are not equally liable to dream. The fame perfon dreams more or lefs at different times; and as one perfon may be more expofed than another to thofe circumftances which promote this exercife of fancy, one perfon may therefore dream more than another. The fame diverfity will naturally take place in this as in other accidents to which mankind are in general liable.

4. Though in dreams imagination appears to be free from all reftraint, and indulges in the moft wanton freaks; yet it is generally agreed, that the imaginary tranfactions of the dreamer bear always fome relation to his particular character in the world, his habits of action, and the circumftances of his life. The lover, we are told, dreams of his miftrefs; the mifer of his money; the philofopher renews his refearches in fleep often with the fame pain and fatigue as when awake; and even the merchant, at times, returns to balance his books, and compute the profits of an adventure, when flumbering on his pillow. And not only do the more general circumftances of a perfon's life influence his dreams; his paffions and habits are nearly the fame when afleep as when awake. A perfon whofe habits of life are virtuous, does not in his dreams plunge into a feries of crimes: nor are the vicious reformed when they pafs into this imaginary world. The choleric man finds himfelf offended by flight provocations as well in his dreams as in his ordinary intercourfe with the world, and a mild temper continues pacific in fleep.

5. The character of a perfon's dreams is influenced by his circumftances when awake in a ftill more unaccountable manner. Certain dreams ufually arife in the mind after a perfon has been in certain fituations. Dr. Beattie relates, that he once, after riding 30 miles in a high wind, paffed a part of the fucceeding night in dreams beyond defcription terrible. The ftate of a perfon's health, and the manner in which the vital functions are carried on, have a confiderable influence in determining the character of dreams. After too full a meal, or after eating of an unufual fort of food, a perfon has always dreams of a certain nature.

6. In dreaming, the mind for the moft part carries on no intercourfe through the fenfes with furrounding objects. Touch a perfon gently who is afleep, he feels not the impreffion. You may awake him by a fmart blow; but when the ftroke is not fufficiently violent to awake him, he remains infenfible of it. We fpeak foftly befide a perfon afleep without fearing that he will overhear us. His eye-lids are fhut; and even though light fhould fall upon the eye-ball, yet ftill his powers of vifion are not awakened to active exertion, unlefs the light be fo ftrong as to roufe him from fleep. He is infenfible both to fweet and to difagreeable fmells. It is not eafy to try whether his organs of tafte retain their activity, without awakening him; yet from analogy it may be prefumed that thefe too are inactive. With refpect to the circumftances here enumerated, it is indifferent whether a perfon be dreaming or buried in a deep fleep.

Yet there is one remarkable fact concerning dreaming which may feem to contradict what has been here afferted. In dreams, we are liable not only to fpeak aloud in confequence of the fuggeftions of imagination, but even to get up, and walk about and engage in little enterprifes, without awaking. Now, as we are in this inftance fo active, it feems that we cannot be then infenfible of the prefence of furrounding objects. The fleep-walker is really fenfible in a certain degree of the prefence of the objects around him; but he does not attend to them with all their circumftances, nor do they excite in him the fame emotions as if he were awake. He feels no terror on the brink of a precipice; and in confequence of being free from fear, he is alfo without danger in fuch a fituation unlefs fuddenly awaked. This is one of the moft inexplicable phenomena of dreaming.

There is alfo another fact not quite confonant with what has been above advanced. It is faid, that in fleep a perfon will continue to hear the noife of a cataract in the neighbourhood, or regular ftrokes with a hammer, or any fimilar found fufficiently loud, and continued uninterruptedly from before the time of his falling afleep. We know not whether he awakes on the fudden ceffation of the noife. This fact is afferted on fufficient evidence, and it is curious. Even when awake, if very deeply intent on any piece of ftudy, or clofely occupied in bufinefs, the found of a clock ftriking in the neighbourhood, or the beating of a drum, will efcape us unnoticed: and it is therefore the more furprifing that we fhould thus continue fenfible to founds when afleep.

7. Not only do a perfon's general character, habits of life, and ftate of health, influence his dreams; but thofe concerns in which he has been moft deeply interefted during the preceding day, and the views which have arifen moft frequently to his imagination, very often afford the fubjects of his dreams. When I look forward with anxious expectation towards any future event, I am likely to dream either of the difappointment or the gratification of my wifhes. Have I been engaged through the day, either in bufinefs or amufements which I have found exceedingly agreeable, or in a way in which I have been extremely unhappy? either my happinefs or my mifery is likely to be renewed in my dreams.

8. Though dreams have been regarded among almoft all nations through the world, at leaft in fome periods of their hiftory, as prophetic of future events; yet it does not appear that this popular opinion has been eftablifhed on good grounds. Chriftianity, indeed, teaches us to believe, that the Supreme Being may, and actually does, operate on our minds, and influence at times the determinations of our will, without making

us ſenſible of the reſtraint to which we are thus ſubjected. And, in the ſame manner, no doubt, the ſuggeſtions which ariſe to us in dreams may be produced. The imaginary tranſactions in which we are then engaged, may be ſuch as are actually to occupy us in life; the ſtrange and ſeemingly incoherent appearances which are then preſented to the mind's eye, may allude to ſome events which are to befall ourſelves or others. It is, therefore, by no means impoſſible, or inconſiſtent with the general analogy of nature, that dreams ſhould have a reſpect to futurity. We have no reaſon to regard the dreams which are deſcribed in the Holy Scriptures to have been prophetic of future events, as not inſpired by heaven, or to laugh at the idea of a prophetic dream as abſurd or ridiculous.

Yet it would be too much to allow to dreams all that importance which has been aſcribed to them by the prieſthood among heathen nations, or by the vulgar among ourſelves. We know how eaſily ignorance impoſes on itſelf, and what arts impoſture adopts to impoſe upon others. We cannot trace any certain connection between our dreams and thoſe events to which the ſimplicity of the vulgar pretends that they refer. And we cannot, therefore, if diſpoſed to confine our belief to certain or probable truths, join with the vulgar in believing them really referable to futurity.

9. It appears that brutes are alſo capable of dreaming. The dog is often obſerved to ſtart ſuddenly up in his ſleep, in a manner which cannot be accounted for any other way than by ſuppoſing that he is rouſed by ſome impulſe received in a dream. The ſame thing is obſervable of others of the inferior animals. That they ſhould dream, is not an idea inconſiſtent with what we know of their economy and manners in general. We may, therefore, conſider it as a pretty certain truth, that many, if not all, of the lower ſpecies are liable to dream as well as human beings.

It appears, then, that in dreaming we are not conſcious of being aſleep: that to a perſon dreaming, his dreams ſeem realities: that though it be uncertain whether mankind are all liable to dreams, yet it is well known that they are not all *equally* liable to dream: that the nature of a perſon's dreams depends in ſome meaſure on his habits of action, and on the circumſtances of his life: that the ſtate of the health too, and the manner in which the vital functions are carried on, have a powerful influence in determining the character of a perſon's dreams: that in ſleep and in dreaming, the ſenſes are either abſolutely inactive, or nearly ſo: that ſuch concerns as we have been very deeply intereſted in during the preceding day, are very likely to return upon our minds in dreams in the hours of reſt: that dreams may be rendered prophetic of future events; and therefore, wherever we have ſuch evidence of their having been prophetic as we would accept on any other occaſion, we cannot reaſonably reject the fact on account of its abſurdity; but that they do not appear to have been actually ſuch, in thoſe inſtances in which the ſuperſtition of nations, ignorant of true religion, has repreſented them as referring to futurity, nor in thoſe inſtances in which they are viewed in the ſame light by the vulgar among ourſelves: and, laſtly, that dreaming is not a phenomenon peculiar to human nature, but common to mankind with the brutes.

We know of no other facts that have been fully aſcertained concerning *dreaming*. But we are by no means ſufficiently acquainted with this important phenomenon in the hiſtory of the human mind. We cannot tell by what laws of our conſtitution we are thus liable to be ſo frequently engaged in imaginary tranſactions, nor what are the particular means by which the deluſion is accompliſhed. The deluſion is indeed remarkably ſtrong. One will ſometimes have a book preſented to him in a dream, and fancy that he reads, and actually enter into the nature of the imaginary compoſition before him, and even remember, after he awakes, what he knows, and that he only fancied himſelf reading. Can this be deluſion? If deluſion, how or for what purpoſes is it produced? The mind, it would appear, does not, in ſleep, become inactive like the body; or at leaſt is not always inactive while we are aſleep. When we do not dream, the mind muſt either be inactive, or the connection between the mind and the body muſt be conſidered as in ſome manner ſuſpended: and when we dream, the mind, though it probably acts in concert with the body, yet does not act in the ſame manner as when we are awake. It ſeems to be clouded or bewildered, in conſequence of being deprived for a time of the ſervice of the ſenſes. Imagination becomes more active and more capricious: and all the other powers, eſpecially judgment and memory, become diſordered and irregular in their operation. Various theories have been propoſed to explain what appears here moſt inſcrutable; but we ſhall not enter into a ſubject in which the moſt ingenious have been able to effect ſo little. If the reader be diſpoſed to ſpeculate farther on it, he may conſult Beattie's Eſſays, Hartley on Man, and the principal writers on phyſiology.

DRELINCOURT (Charles), miniſter of the reformed church at Paris, was born at Sedan in 1595, where his father enjoyed a conſiderable poſt. He had all the qualifications that compoſe a reſpectable clergyman; and though he defended the Proteſtant cauſe againſt the Romiſh religion, was much eſteemed even among the Catholics. He is beſt known in England by his Conſolations againſt the Fears of Death, which work was tranſlated, and often printed. He married the daughter of a rich merchant at Paris, by whom he had 16 children. His third ſon, profeſſor of phyſic at Leyden, was phyſician to the Prince and Princeſs of Orange before their acceſſion to the crown of England. Bayle has given a character of Mr. Drelincourt, who died in the year 1660.

DRENCH, among farriers, a phyſical potion for horſes. The ingredients for this purpoſe are to be pulveriſed, and mingled either with a decoction or with wine. Then let all infuſe about a quarter of an hour, and give it to the horſe with a horn after he has been tied up two hours to the rack.

DREPANE, the ancient name of Corcyra, from the curvity of its figure, reſembling a ſickle.

DRESDEN, a town of Germany, and capital of Saxony. It is divided by the Elbe into the Old and New Town, which are joined together by a bridge 685 paces long. Both towns are ſurrounded by ſtrong fortifications: however, it was taken by the king of Pruſſia in 1745, but was ſoon reſtored, in conſequence of a peace between him and the then elector. All the houſes are built of free-ſtone, and are almoſt all of the ſame height. There is a magnificent church for the Roman Catholics, which ſtands between the Elbe, the bridge, and the caſtle; and there are ſo many palaces, that it is one of the handſomeſt cities in Germany. Before the place where they keep guard, in the New Town, is an equeſtrian ſtatue of Auguſtus II. looking toward Poland. Travellers take much notice of the elector's ſtables, of the cabinet of curioſities, the arſenal, the court of the hunters, the garden, the palaces of Japan and of Holland, the mint, the green magazine, the elector's library, the great garden without the walls, and other things, which cannot be ſeen without admiration. With regard to eccleſiaſtic affairs, there is a ſuperior conſiſtory, on which the two univerſities depend, as well as the two conſiſtories of Wirtemburg and Leipſic. The principal church is that of the Holy Croſs, which is a ſuperb ſtructure. The ſituation of this city is low, and yet there is a fine proſpect all round it. The palaces of Holland and Japan are full of curioſities from that country and China, with a great variety of Dreſden porcelain. This city was again taken by the king of

Pruſſia in 1756; but it was retaken in 1759. It is 75 miles N. W. of Prague. Lon. 13. 50. E. Lat. 51. 10. N.

DRESSING of Hemp and Flax. See Flax-*Dreſſing*.

Dressing *of Meats*, the preparing them for food by means of culinary fire. The deſign of dreſſing fleſh meat is to coagulate its juices, and ſo alter its texture as to diſpoſe it for diſſolution and digeſtion in the ſtomach. Fleſh not being a proper food without dreſſing, is alleged as an argument that man was not intended by nature for a carnivorous animal. The uſual operations are roaſting, boiling, and ſtewing, concerning which abundant and very circumſtantial particulars appear in our *Cookery* books. In roaſting, it is obſerved, meat will bear a much greater and longer heat than either in boiling or ſtewing; and in boiling, greater and longer than in ſtewing.

Dressing, in ſurgery, any application to a wound or diſordered part. The apparatus of dreſſing conſiſts of lint, plaſters, compreſſes, bandages, &c. &c. See Surgery.

DREVET (Peter) the Younger, an eminent French engraver, was a member of the royal academy of painting and ſculpture; and died at Paris in 1739, at 42 years of age. His portraits are neat and elegant; but laboured to the laſt degree. He particularly excels in repreſenting lace, ſilk, fur, velvet, and other ornamental parts of dreſs.—His father was excellent in the ſame art; and had inſtructed, but was ſurpaſſed by the ſon. The younger Drevet did not confine himſelf to portraits. We have ſeveral hiſtorical prints by him, which in point of neatneſs and exquiſite workmanſhip are ſcarcely to be equalled. His moſt eſteemed and beſt hiſtorical print is very valuable; but the firſt impreſſions of it are rarely to be met with: it is, The Preſentation of Chriſt in the Temple; a very large plate, lengthwiſe, from Louis de Bologna. The following deſerve alſo to be particularized. The Meeting of Abraham's Servant with Rebecca at the Well; a large upright plate, from An. Coypel: and Abraham, with his ſon Iſaac on the altar, the ſame, from the ſame, dated 1707; the firſt impreſſions of which are, before the work upon the right thigh of Iſaac was altered, the curved lines from the button almoſt down to the knee being in thoſe impreſſions arched downwards, but in poſterior ones arched upwards. Among his portraits, the two following are juſtly held in the higheſt eſtimation: M. Boſſuet Biſhop of Meaux; a whole length figure ſtanding, a middling ſized upright plate, from Rigaud: and Samuel Bernard; a whole-length figure ſitting in a chair, a large upright plate. The firſt impreſſions of the laſt, are before the words *Conſeiller d'Etat* were inſerted upon the plate.

DREUX, a large and ancient town in the department of Eure and Loire and late province of Beauce, in France, which has a conſiderable manufacture in cloth for the army. It is ſeated on the river Blaiſe, at the foot of a mountain, 48 miles W. of Paris. Lon. 1. 26. E. Lat. 48. 44. N.

DREXELIUS (Jeremiah), a Jeſuit celebrated for his piety and writings, was born at Augſburg, and became preacher in ordinary to the elector of Bavaria. He wrote ſeveral pious and practical pieces, which have been printed together in two volumes folio; and died in 1638.

DRIEPER, or Dnieper, a river of Ruſſia, which riſes in the foreſt of Volkonſki, near the ſource of the Volga, about 100 miles from Smolenſko. It paſſes by Smolenſko and Mohilef, ſeparates the Ukraine from Poland, flows by Kiof, and falls into the Black Sea between Otzakof and Kinburn. By the acquiſition of the province of Mohilef, its whole courſe is now included within the Ruſſian territories. It begins to be navigable at a little diſtance above Smolenſko, though in ſome ſeaſons of the year it is ſo ſhallow near the town, that the goods muſt be tranſported upon rafts and ſmall flat-bottomed boats.

DRIFT, in navigation, the angle which the line of a ſhip's motion makes with the neareſt meridian, when ſhe drives with her ſide to the wind and waves, and is not governed by the power of the helm; it alſo implies the diſtance which the ſhip drives on that line. A ſhip's way is only called *drift* in a ſtorm; and then when it blows ſo vehemently as to prevent her from carrying any ſail, or at leaſt reſtrains her to ſuch a portion of ſail as may be neceſſary to keep her ſufficiently inclined to one ſide, that ſhe may not be diſmaſted by the violent labouring produced by the turbulence of the ſea.

Drift, in mining, a paſſage cut out under the earth betwixt ſhaft and ſhaft, or turn and turn; or a paſſage or way wrought under the earth to the end of a meer of ground, or part of a meer.

Drift-*Sail*, a ſail uſed under water, veered out right a-head by ſheets, as other ſails are. It ſerves to keep the ſhip's head right upon the ſea in a ſtorm, and to hinder her driving too faſt in a current.

DRILL, in mechanics, a ſmall inſtrument for making ſuch holes as punches will not conveniently ſerve for. Drills are of various ſizes, and are chiefly uſed by ſmiths and turners.

Drill, or *Drill-Box*, a name given to an inſtrument for ſowing land in the new method of horſe-hoeing huſbandry. See Husbandry.

Drill-*Sowing*, a method of ſowing grain or ſeed of any kind, ſo that it may all be at a proper depth in the earth, which is neceſſary to its producing healthful and vigorous plants. For this purpoſe a variety of drill-ploughs have been invented and recommended; but partly from the expence attending the purchaſe, partly from the complication of their ſtructure, and partly from the attachment of the illiterate farmer to long habits, theſe excellent ſchemes for diminiſhing labour have not received that ſhare of encouragement to which they ſeem entitled. This method, however, is greatly recommended in the Georgical Eſſays; and farther particulars will be given on this ſubject under the Article Husbandry.

DRILLING is popularly uſed for exerciſing ſoldiers. The word is derived from the French *drille*, which ſignifies a *raw ſoldier*.

DRIMYS, in botany; a genus changed by Murray, in the 14th edit. of *Syſt. Veget.* to Wintera; which ſee.

DRINK, a part of our ordinary food in a liquid form. See Food. The general uſe of drink is, to ſupply fluids; facilitate ſolution; in conſequence of that, to help the evacuation of the ſtomach, and promote the progreſs of the aliment through the inteſtines. Another effect of drink is, to facilitate the mixture of the lymph, refluent from every part of the ſyſtem, with the chyle. In the blood-veſſels, where all muſt be kept fluid in order to a proper mixture, drink increaſes the fluidity, and gives tenſion by its bulk: hence drink contributes to ſanguification, as ſometimes food gives too denſe a nutriment to be acted upon by the ſolids; and hence alſo we can ſee how drink promotes the ſecretions. Theſe are the effects of drink in general; but what has been ſaid muſt be taken with ſome limitations; for the more liquid the food is, the ſooner it is evacuated, and leſs nouriſhment is extracted. Hence drink is, in ſome degree, oppoſed to nouriſhment; and ſo, *cæteris paribus*, thoſe who uſe leaſt drink are moſt nouriſhed. All theſe effects of drink are produced by ſimple water; and it may be ſaid, that other liquors are fit for drink in proportion to the water they contain. Water, when uſed as drink, is often impregnated with vegetable and farinaceous ſubſtances; but, as drinks, theſe impregnations are of little conſequence: they add, indeed, a little nouriſhment; but this is not to be regarded in a healthy ſtate. Sometimes we impregnate water with the ſubacid fruits; and then, indeed, it acquires other qualities, of conſiderable uſe in the animal economy. All drinks, however, may be reduced to two heads: firſt, pure water, or

where the additional ſubſtance gives no additional virtue; ſecondly, the *fermentatæ*. Of the firſt we have juſt ſpoken: the latter have not only the qualities of the firſt, but alſo qualities peculiar to themſelves. Fermented liquors are peculiarly adapted for ſtimulating the mouth, fauces, and ſtomach, to throw out the ſaliva and gaſtric liquor. By their aceſcency they are fitted for ſome beneficial purpoſes in certain ſtates of the ſyſtem: by their fluidity they dilute viſcid food; though here, indeed, they anſwer no better than common water. Carried into the blood-veſſels, in ſo far as they retain any of the ſaline nature, they ſtimulate the excretories, and promote urine and ſweat. Many phyſicians, in treating of fermented liquors, have rejected their nutritious virtues, which certainly ought to be taken into the account, though by expediting the evacuation by ſtool they cauſe leſs of the nutritious parts of the aliment to be taken up, and by ſtimulating the excretories make theſe nutritious parts to reſt for a ſhorter time in the ſyſtem. Add to this, that in the inordinate quantities in which they are occaſionally drunk with a view of conviviality, they have a tendency to undermine the health while they appear to fatten the body; occaſioning dropſy and other fatal diſeaſes. The ſtrong ale ſo much drunk in the country certainly has had many victims, as well as fermented liquors of ſome other kinds; but that beverage univerſally drunk at our meals under the name of *Table Beer*, is certainly a moſt wholeſome drink, and anſwers every ſalutary purpoſe in the animal œconomy.

DRIVERS, among ſportſmen, a machine for driving pheaſant-powts, conſiſting of good ſtrong ozier wands, ſuch as the baſket-makers uſe; theſe are to be ſet in a handle, and twiſted or bound with ſmall oziers in two or three places. With this inſtrument the ſportſman drives whole eyes of young powts into his nets. See the next article.

DRIVING, among ſportſmen, a method of taking pheaſant-powts. It is thus: The ſportſman finds out the haunts of theſe birds; and having fixed his nets there, he calls many of them together by a pheaſant-call, imitating the voice of the dam; after this he makes a noiſe with his driver, which will make them run a little way forward in a cluſter; and this he is to repeat till he has made ſure of them, which an expert ſportſman never fails to do, by driving them into his nets.

Driving, in metallurgy, is ſaid of ſilver, when, in the operation of refining, the lead being burnt away, the remaining copper riſes upon its ſurface in red fiery bubbles.

Driving, in the ſea-language, is ſaid of a ſhip, when an anchor being let fall will not hold her faſt, nor prevent her ſailing away with the wind or tide. The beſt way in this caſe is to let fall more anchors, or to veer out more cable; for the more cable ſhe has out, the ſafer ſhe rides. When a ſhip is a-hull or a-try, they ſay ſhe drives to leeward.

DROGHEDA, by the Engliſh called *Tredah*, a town of Ireland, in the province of Leinſter and county of Lowth, and ſituated on a bay of the ſame name, in W. long. 6. 17. N. lat. 53. 45. It was formerly very remarkable for its ſituation and ſtrength. In conſequence of this it was much diſtinguiſhed by the old Engliſh monarchs. Edward II. granted it a market and fair; and to theſe were added other great privileges in ſucceeding ages, particularly the right of coinage. It was bravely defended againſt the rebels in 1641. After the ceſſation of arms it was taken by the duke of Ormond and the earl of Inchiquin; but was retaken by Cromwell in 1649. At this time it ſuffered ſo much, that for a long time after it remained almoſt in ruins. The buildings were exceedingly ſhattered; and the town being taken by ſtorm, not only the garriſon, but the inhabitants, men, women, and children, were moſtly put to the ſword. By degrees, however, it recovered, and is at preſent a large and populous place. It is a town and county; and, as ſuch, ſends two repreſentatives to parliament. It has a great ſhare of inland trade, and an advantageous commerce with England: and though the port is but indifferent, and narrow at its entrance, with a bar over which ſhips of burden cannot paſs but at high water, yet a great deal of buſineſs is done; ſo that, from a low and declining port, it is now become rich and thriving. Drogheda is perhaps one of the ſtrongeſt inſtances that can be mentioned of the ineſtimable benefit of a river in any degree navigable: for, though the Boyne is not capable of carrying veſſels bigger than barges, or pretty large boats, yet the opportunity that this affords of conveying coals by water-carriage through a great extent of country, introduced a correſpondence between this place and Whitehaven in Cumberland, to which the revival of its commerce has been in a great meaſure owing.

DROITWICH, a town of Worceſterſhire in England, noted for excellent white ſalt, made from the ſalt ſprings in its neighbourhood. It ſends two members to parliament. W. long. 2. 16. N. lat. 52. 20.

DROMEDARY. See Camelus.

DROMORE, a town of Ireland, in the county of Down. It is a very ancient town, and the ſeat of a biſhopric. The ſee was founded by St. Colman in the 6th century. It was refounded by King James I. who by his charters (now preſerved in the Rolls-office) granted it very great and uncommon privileges.

DRONE, a kind of large bees which make their appearance in hives about the month of May, but never work nor prepare any honey; and are at laſt all killed by the reſt. See the article Bee.

Drone-*Fly*, a two-winged inſect, extremely like the common drone-bee, whence alſo the name.

DROPS, in meteorology, ſmall ſpherical bodies which the particles of fluids ſpontaneouſly form themſelves into when let fall from any height. This ſpherical figure the Newtonian philoſophers demonſtrate to be the effect of corpuſcular attraction; for, conſidering that the attractive force of one ſingle particle of a fluid is equally exerted to an equal diſtance, it muſt follow that other fluid particles are on every ſide drawn to it, and will therefore take their places at an equal diſtance from it, and conſequently form a round ſuperficies. See the articles Attraction, Fluid, and Rain.

Drops, in medicine, a liquid remedy, the doſe of which is eſtimated by a certain number of drops.

Engliſh Drops, *Guttæ Anglicanæ*, a name given to a chemical preparation eſteemed of great virtue againſt nervous affections, and purchaſed at an expence of 5000l. by king Charles II. from the inventor Dr. Goddard. This medicine appeared to be only a ſpirit drawn by the retort from raw ſilk, and afterwards rectified with oil of cinnamon, or any other eſſential oil. It was in reality no better than the common ſal volatile oleoſum, or any of the volatile ſpirits impregnated with an eſſential oil, except that it was leſs diſagreeable than any of them to the taſte

DROPSY, in medicine, an unnatural collection of water in any part of the body. See Medicine.

DROPWORT, in botany. See Filipendula.

Water Dropwort, in botany. See Oenanthes.

DROSERA, ros solis, or *Sun-Dew*, in botany; a genus of the pentagynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 14th order, *Gruinales*. The calyx is quinquefid, the petals five; the capſule unilocular, and quinquevalved at top; the ſeeds very numerous. There are three ſpecies, which grow naturally in boggy places in many parts of the kingdom. They ſeem to receive the name of *ſun-dew* from a very ſtriking circumſtance in their appearance. The leaves, which are circular, are fringed with hairs ſupporting ſmall drops or globules of a

pellucid liquor like dew, which continue even in the hotteſt part of the day and in the fulleſt expoſure to the ſun. The whole plant is acrid, and ſufficiently cauſtic to erode the ſkin: but ſome ladies mix the juice with milk, and apply it to remove freckles. The juice that exſudes from it unmixed, will deſtroy warts and corns. The plant has the ſame effect upon milk as the common butterwort; and like that too is ſuppoſed to occaſion the rot in ſheep.

DROWNING, ſignifies the extinction of life by a total immerſion in water. In ſome reſpects there ſeems to be a great ſimilarity between the death occaſioned by immerſion in water, and that by ſtrangulation, ſuffocation by fixed air, apoplexies, epilepſies, ſudden faintings, violent ſhocks of electricity, or even violent falls and bruiſes. Phyſicians, however, are not agreed with regard to the nature of the injury done to the animal ſyſtem in any or all of theſe accidents. It is indeed certain, that in all the caſes above mentioned, particularly in drowning, there is very often ſuch a ſuſpenſion of the vital powers as to us hath the appearance of a total extinction of them; while yet they may be again ſet in motion, and the perſon reſtored to life, after a much longer ſubmerſion than has been generally thought capable of producing abſolute death.

De Haen, in his treatiſe on this ſubject, aſcribes the diverſity of opinion among phyſicians to their having been ſo ready to draw general concluſions from a few experiments. Some, having never found water in the lungs, have thought that it never was there; and others, from its preſence, have drawn a contrary concluſion. Some have aſcribed the death which happens in caſes of drowning, to that ſpecies of apoplexy which ariſes from a great fullneſs of the ſtomach. But this opinion our author rejects, becauſe in 13 dogs which he had drowned and afterwards diſſected, no ſigns of ſuch a fullneſs appeared. Another reaſon is drawn from the want of the common marks of apoplexy on the diſſection of the brain, and from the actual preſence of water in the lungs. He is of opinion, that the death of drowned perſons happens in conſequence of water getting into the lungs, and ſtopping the blood in the arteries, and of courſe, that blowing into the lungs muſt be hurtful, as it will increaſe the preſſure on the blood-veſſels.

Dr. Cullen, in his Letter on this ſubject to Lord Cathcart, ſays, that very often the water does not enter the lungs, nor even the ſtomach, in any material quantity; and that, in moſt caſes, no hurt is done to the organization of the vital parts. Hence he argues, that the death which ſeems to enſue, is owing to the ſtoppage of reſpiration, and the conſequent ceaſing of the circulation of the blood, whereby the body loſes its heat and vital principle.

In the Phil. Tranſ. vol. lxvi. Mr. Hunter advances the following theory.—The loſs of motion in drowning ſeems to ariſe from the loſs of reſpiration; and the immediate effect this has upon the other vital motions of the animal, at leaſt this privation of breathing, appears to be the firſt cauſe of the heart's motion ceaſing. It is moſt probable, therefore, Mr. Hunter obſerves, that the reſtoration of breathing is all that is neceſſary to reſtore the heart's motion; for if a ſufficiency of life ſtill remains to produce that effect, we may ſuppoſe every part equally ready to move the very inſtant in which the action of the heart takes place, their actions depending ſo much upon it. What makes it very probable that the principal effect depends upon throwing air into the lungs, is, that children in the birth, when too much time has been ſpent after the loſs of that life which is peculiar to the fetus, loſe altogether the diſpoſition for the new life. In ſuch caſes there is a total ſuſpenſion of the actions of life; the child remains to all appearance dead; and would die, if air was not thrown into its lungs, and the firſt principle of action by that means reſtored. To put this in a clearer light, Mr. Hunter gives the reſult of ſome experiments made on a dog in 1755.—A pair of double bellows were provided, which were ſo conſtructed, that by one action air was thrown into the lungs, and by the other the air was ſucked out which had been thrown in by the former, without mixing them together. The muzzle of theſe bellows was fixed into the trachea of a dog, and by working them he was kept perfectly alive. While this artificial breathing was going on, the ſternum was taken off, ſo that the heart and lungs were expoſed to view. The heart then continued to act as before, only the frequency of its action was greatly increaſed. Mr. Hunter then ſtopped the motion of the bellows; and obſerved that the contraction of the heart became gradually weaker and leſs frequent, till it left off moving altogether; but by renewing the operation, the motion of the heart alſo revived, and ſoon became as ſtrong and frequent as before. This proceſs was repeated upon the ſame dog ten times; ſometimes ſtopping for five, eight, or ten minutes. Mr. Hunter obſerved, that every time he left off working the bellows, the heart became extremely turgid with blood, and the blood in the left ſide became as dark as that in the right, which was not the caſe when the bellows were working. Theſe ſituations of the animal, he obſerves, ſeem to be exactly ſimilar to drowning.

Dr. Goodwyn, in a ſubſequent treatiſe on this ſubject, has endeavoured to aſcertain the effects of ſubmerſion upon living animals in a ſtill more accurate manner; and this inveſtigation is accompanied with a moſt careful and ingenious inquiry concerning the cauſes of the different phenomena which he remarked in the courſe of a great number of experiments. From a review of theſe, Dr. Goodwyn draws the following concluſions: 1. "A ſmall quantity of fluid uſually paſſes into the lungs in drowning. 2. This water enters the lungs during the efforts to inſpire; and mixing with the pulmonary mucus, occaſions the frothy appearance mentioned by authors. 3. The whole of this fluid in the lungs is not ſufficient to produce the changes that take place in drowning. And hence it follows, that the water produces all the changes that take place in drowning *indirectly*, by excluding the atmoſpheric air from the lungs." This naturally leads to an inveſtigation of the uſes of reſpiration, and the effects of the air upon the blood and lungs in that action, which our author traces with great accuracy and very convincing experiments. He begins with attempting to determine the quantity of air drawn in at each inſpiration, with the proportional quantity left after expiration. The experiments by which he endeavoured to aſcertain theſe quantities ſeem to be more uncertain than the others, as indeed there are not data ſufficient for them. Concerning the chemical changes produced in the air by reſpiration, and the effects of the air upon the blood itſelf, we ſhall only obſerve in general, that his experiments evidently ſhow that the diſeaſe produced by drowning ariſes entirely from the excluſion of the atmoſpheric air or its dephlogiſticated part; for which reaſon he recommends inflating the lungs with that kind of air in preference to any other.

From theſe different views of the matter, phyſicians have differed conſiderably in their account of the methods to be followed in attempting the recovery of drowned perſons. De Haen recommends agitation of all kinds; every kind of ſtimulus applied to the mouth, noſe, and rectum; bleeding; heat, both by warm cloths and warm water; blowing air into the trachea; ſtimulants, ſuch as bliſters, warm aſhes, &c. applied to the head, ankles, thighs, pit of the ſtomach, and other parts. Dr. Cullen's inſtructions on this ſubject, however, are of much more importance; but they are detailed too much at length to admit of an adequate abridgement in this article. For every practical purpoſe, indeed, the plan of recovery diſtri

buted by the Royal Humane Society in London is ſufficient. It is as follows:

1. As ſoon as the patient is taken out of the water, the wet clothes, if the perſon is not naked at the time of the accident, ſhould be taken off with all poſſible expedition on the ſpot (unleſs ſome convenient houſe be very near), and a great coat or two, or ſome blankets if convenient, ſhould be wrapped round the body.

2. The patient is to be thus carefully conveyed in the arms of three or four men, or on a bier, to the neareſt public or other houſe, where a good fire, if in the winter ſeaſon, and a warm bed, can be made ready for its reception. As the body is conveying to this place, great attention is to be paid to the poſition of the head; it muſt be kept ſupported in a natural and eaſy poſture, and not ſuffered to hang down.

3. In cold or moiſt weather, the patient is to be laid on a mattreſs or bed before the fire, but not too near, or in a moderately heated room: in warm and ſultry weather, on a bed only. The body is then to be wrapped as expeditiouſly as poſſible with a blanket, and thoroughly dried with warm coarſe cloths or flannels.

4. In ſummer or ſultry weather too much air cannot be admitted. For this reaſon it will be neceſſary to ſet open the windows and doors, as cool refreſhing air is of the greateſt importance in the proceſs of reſuſcitation.

5. Not more than ſix perſons are to be preſent to apply the proper means; a greater number will be uſeleſs, and may retard, or totally prevent, the reſtoration of life, by rendering the air of the apartment unwholeſome. It will be neceſſary, therefore, to requeſt the abſence of thoſe who attend merely from motives of curioſity.

6. It will be proper for one of the aſſiſtants, with a pair of bellows of the common ſize, applying the pipe a little way up one noſtril, to blow with ſome force, in order to introduce air into the lungs; at the ſame time the other noſtril and the mouth are to be cloſed by another aſſiſtant, whilſt a third perſon gently preſſes the cheſt with his hands, after the lungs are obſerved to be inflated. By purſuing this proceſs, the noxious and ſtagnant vapours will be expelled, and natural breathing imitated. If the pipe of the bellows be too large, the air may be blown in at the mouth, the noſtrils at the ſame time being cloſed, ſo that it may not eſcape that way: but the lungs are more eaſily filled, and natural breathing better imitated, by blowing up the noſtril.

7. Let the body be gently rubbed with common ſalt, or with flannels, ſprinkled with ſpirits, as rum or geneva. A warming-pan heated (the body being ſurrounded with flannel) may be lightly moved up and down the back. Fomentations of hot brandy are to be applied to the pit of the ſtomach, loins, &c. and often renewed. Bottles filled with hot water, heated tiles covered with flannel, or hot bricks, may be efficaciouſly applied to the ſoles of the feet, palms of the hands, and other parts of the body. The temples may be rubbed with ſpirits of hartſhorn, and the noſtrils now and then tickled with a feather; and ſnuff, or *eau de luce*, ſhould be occaſionally applied.

8. Tobacco fumes ſhould be thrown up the fundament; if a fumigator be not at hand, a common pipe may anſwer the purpoſe. The operation ſhould be frequently performed, as it is of importance; for the good effects of this proceſs have been experienced in a variety of inſtances of ſuſpended animation. But ſhould the application of tobacco ſmoke in this way not be immediately convenient, or other impediments ariſe, clyſters of this herb, or other acrid infuſions with ſalt, &c. may be thrown up with advantage.

9. When theſe means have been employed a conſiderable time without ſucceſs, and any brewhouſe or warm bath can be readily obtained, the body ſhould be carefully conveyed to ſuch a place, and remain in the bath, or ſurrounded with warm grains, for three or four hours. If a child has been drowned, its body ſhould be wiped perfectly dry, and immediately placed in bed between two healthy perſons. The ſalutary effects of the natural vital warmth, conveyed in this manner, have been proved in a variety of ſucceſsful caſes.

10. While the various methods of treatment are employed, the body is to be well ſhaken every ten minutes, in order to render the proceſs of animation more certainly ſucceſsful; and children, in particular, are to be much agitated, by taking hold of their legs and arms frequently and for a continuance of time. In various inſtances agitation has forwarded the recovery of boys who have been drowned, and continued for a conſiderable time apparently dead.

11. If there be any ſigns of returning life, ſuch as ſighing, gaſping, or convulſive motions, a ſpoonful of any warm liquid may be given; and if the act of ſwallowing can be performed, a cordial of warm brandy or wine may be given in ſmall quantities, and frequently repeated.

12. Electricity may be tried by the judicious and ſkilful, as its application neither prevents nor retards the various modes of recovery already recommended; but, on the other hand, will moſt probably tend to render the other means employed more certainly and more expeditiouſly efficacious. This ſtimulus bids fair to prove an important auxiliary in caſes of apparent death; and therefore deſerves the ſerious regard and attention of the Faculty.

The methods which have been deſcribed, are to be employed with vigour for three hours or upwards, although no favourable circumſtances ſhould ariſe; for it is a vulgar and dangerous error to ſuppoſe that perſons are irrecoverable, becauſe life does not ſoon make its appearance; an opinion that has conſigned to the grave an immenſe number of the ſeemingly dead, who might have been reſtored to life by reſolution and perſeverance. *Bleeding* is never to be employed in ſuch caſes, unleſs by the direction of one of the medical aſſiſtants, or ſome other gentleman of the faculty who has paid attention to the reſuſcitating art.

DRUG, a general term for goods of the druggiſt and grocery kinds, eſpecially thoſe uſed in medicine and dyeing. See Materia Medica, Pharmacy, and Dyeing.

DRUGGET, in commerce, a ſtuff ſometimes all wool, and ſometimes half wool half thread, ſometimes corded, but uſually plain. Thoſe that have the woof of wool, and the warp of thread, are called *threaded druggets;* and thoſe wrought with the ſhuttle on a loom of four marches, as the ſerges of Moui, Beauvois, and other like ſtuffs corded, are called *corded druggets*. As to the plain, they are wrought on a loom of two marches, with the ſhuttle, in the ſame manner as cloth, camblets, and other ſuch ſtuffs not corded.

DRUIDS, Druides, or Druidæ, the prieſts or miniſters of religion among the ancient Celtæ or Gauls, Britons, and Germans. Some authors derive the word from the Hebrew דרושים *deruſſim*, or *druſſim*, which they tranſlate *contemplatores*. Picard, Celtopæd. lib. ii. p. 58. believes the druids to have been thus called from *Druis*, or *Dryius*, their leader, the fourth or fifth king of the Gauls, and father of Saron or Naumes. Pliny, Salmaſius, Vigenere, &c. derive the name from δρυς *oak;* on account of their inhabiting, or at leaſt frequenting, and teaching in foreſts; or perhaps becauſe, as Pliny ſays, they never ſacrificed but under the oak. But it is hard to imagine how the druids ſhould come to ſpeak Greek. Menage derives the word from the old Britiſh *drus*, "dæmon, magician." Borel, from the Saxon *dry*, "magician;" or rather from the old Britiſh *dru*, or *derw*, "oak," whence he takes δρυς to be derived; which is the moſt probable ſuppoſition.

Gorop. Becanus, lib. i. takes *druis* to be an old Celtic and German word, formed from *trowis* or *truwis*, "a doctor of the truth and the faith;" which etymology Vossius acquiesces in.

The druids were the first and most distinguished order among the Gauls and Britons; they were chosen out of the best families; and the honours of their birth, joined with those of their function, procured them the highest veneration among the people. The authority of the kings of Britain was greatly controuled by the Druids, who were not only the ministers of religion, but also possessed the right of making laws, of explaining and executing them. Their power, and consequently the honour paid them, was incredibly great. They were considered as the interpreters of the gods; they were exempted from all taxes and military services; and their persons were held sacred and inviolable.

The Druids commonly resided in thick groves, chiefly of oak; whence Pliny derives their name. They were objects of such veneration, that the rage of hostile armies about to engage was not only suspended, but entirely suppressed, by their interposition. *Diodor.* v. 31. *Strab.* iv. 197. There was a chief Druid chosen by the suffrages of the rest; which was an office of so great dignity, that the appointment to it was sometimes determined by arms. The chief residence of the Archdruid of Gaul was at Dreux, in Pais Chartrain (*in finibus Carnutum, quæ regio totius Galliæ media habebatur*), whither all those who had law-suits came to get them determined, *Cæsar.* vi. 13. The Archdruid of Britain resided, as it is thought, in the island of Anglesey (*in Mona*), where the vestiges of his palace, and of the houses of the other Druids, who attended him, are said still to be visible. *Rowland's Mona Antiqua*, p. 83, &c.

The religious principles of the Druids are thought to have been similar to those of the Gymnosophists and Brahmans of India, the Magi of Persia, and the Chaldeans of Assyria, and therefore to have been derived from the same origin. Cæsar thinks that the doctrine of the Druids was transferred from Britain into Gaul; and therefore, in his time, such Gauls as wished to understand their doctrines more accurately, repaired to Britain for instruction. But Pliny supposes druidism to have crossed from Britain into Gaul. The Druids, like the other priests just now mentioned, kept some of their opinions secret, and taught others publicly. The education of youth was one of their most important charges. They taught their scholars a great number of verses; and some spent twenty years in learning them. They thought it unlawful to commit their tenets to writing; although in other public affairs, and in their private accounts, they used the Greek letters: *Cæs. ib.* Whatever opinions the Druids privately entertained, in public they worshipped a multiplicity of deities: *Cæsar. B. G.* The names of their two chief divinities were *Teutâtes* and *Hesus*, to whom they offered human victims, *Lucan.* i. 445.; *Lactant. de fals. relig.* i. 21. It was an article in their creed, that nothing but the life of man could atone for the life of man. On solemn occasions they reared huge images, whose members, wrought with osiers, they filled with living men, and, as Strabo says, with other animals, *Strab.* iv. 198. then setting fire to the images, they burnt these miserable creatures, as an offering to their cruel divinities. Thieves, and robbers, and other malefactors, were preferred for this purpose; but if these were wanting, innocent persons were taken: *Cæsar, ibid.* Diodorus says, that condemned criminals used to be reserved for five years, and on a certain day burnt all together. Captives in war also used to be immolated in the same manner, v. 32.

The Druids performed all their acts of worship in the open air; for they thought it derogated from the greatness of the gods, to confine them within walls, or to resemble them to any human form: *Tacit. Mor. Ger.* 9. Several circles of stones are to be seen in different parts of Britain and the western islands, which still go by the name of *Druid temples;* of which those at Stonehenge, about six miles from Salisbury in Wiltshire, and at Stennes, a small lake near Stromness in Pomona, one of the Orkney islands, are the most remarkable.

The most sacred solemnities of the Druids were usually held on the sixth day of the moon, which was always the first day of their months: *Plin.* xvi. *fin.* To be excluded from these sacred rites (*sacrificiis interdici*) was esteemed the most grievous punishment, which the Druids inflicted on such as they judged proper. Those against whom this sentence of excommunication was pronounced, were considered as impious and wicked, and avoided by every one as if infected with a contagious disease. They were denied the protection of law, and rendered incapable of any honour or trust: *Cæsar, ib.* The Druids enforced their authority by holding forth to their votaries the rewards and punishments of a future state; and thus inspired them with a contempt of danger and of death. *Mela*, iii. 2. Cæsar and Diodorus say, that the Druids taught the Pythagorean doctrine of the transmigration of souls into other bodies. But Lucan and Marcellinus represent them as teaching that the soul after death ascended into an higher orb, where it enjoyed a more perfect happiness. Thus Lucan, i. 455. *Umbræ non tacitas Erebi sedes, Ditisque profundi Pallida regna petunt; regit idem spiritus artus Orbe alio:—Certè populis, quos despicit Arctos, Felices errore suo quos ille timorum Maximus, haud urget leti metus,—inde ruendi In ferrum mens prona viris*, &c. So Marcellinus, xv. 9.—The Druids also taught their disciples many other things, about astrology, astronomy, geography, physiology, and theology.

The great power of the Druids brought upon them the vengeance of the Romans, who in other instances were seldom intolerant. The pretext for this was the cruelty committed by the Druids in their sacred rites; but the true reason was their influence over the people. The authority of the Druids in Gaul was by various means so much reduced in the time of Claudius, that that emperor is said to have destroyed them altogether, about the year 45. *Suet. Cl.* 25. And in Britain; Suetonius Paulinus, the governor of that country under Nero, having taken the island of Anglesey, not only cut down the sacred groves of the Druids in that place, and overturned their altars, but also burnt many of the Druids themselves on those fires which they had kindled for sacrificing the Roman captives, if the Britons had gained the victory, *Tacit. Annal.* xiv. 30. So many of the Druids were destroyed on this occasion, and in the subsequent revolt under Queen Boudicea or Boadicea, that they never afterwards made any figure. Their superstition, however, continued, and prevailed even long after the introduction of Christianity.

DRUM, is a martial musical instrument in form of a cylinder, hollow within, and covered at the two ends with vellum, which is stretched or slackened at pleasure by the means of small cords or sliding knots. It is beat upon with sticks. Drums are sometimes made of brass, but most commonly they are of wood. The drum is by Le Clerc said to have been an oriental invention, and to have been brought by the Arabians, or perhaps rather the Moors, into Spain.

Kettle DRUMS, are two sorts of large basons of copper or brass, rounded in the bottom, and covered with vellum or goat skin, which is kept fast by a circle of iron round the body of the drum, with a number of screws to draw up and down. They are much used among the horse; as also in operas, oratorios, concerts, &c.

DRUM, or *Drummer*, he that beats the drum; of whom each company of foot has one, and sometimes two. Every regiment has a drum-major, who has the command over the

other drums. They are diſtinguiſhed from the ſol liers by clothes of a different faſhion: their poſt, when a battalion is drawn up, is on the flanks, and on a march it is betwixt the diviſions.

Drum *of the Ear*, the ſame with the *tympanum*. See Anatomy, page 211.

DRUMMOND (William), a native of Scotland, was born in 1585: his father was Sir John Drummond of Hawthornden, gentleman uſher to James VI. He had his education at Edinburgh, and after that was ſent to France in 1606. He ſtudied the civil law at Bourges, in which he made ſuch a progreſs as occaſioned the preſident Lockhart to ſay, that if Drummond had followed the practice, he would have made the beſt figure of any lawyer in his time. But his genius leading him to politer literature, he relinquiſhed all thoughts of the bar, and betook himſelf to his pleaſant ſeat at Hawthornden. Here he ſpent his time in reading Greek and Latin authors, and obliged the world with ſeveral fine productions. He wrote his "Cypreſs Grove," a piece of excellent proſe, after a dangerous fit of ſickneſs; and about this time his "Flowers of Sion," in verſe. But the death of an amiable lady, he was juſt going to eſpouſe, obliged him to quit his retirement. This affected him ſo deeply, that he went to Paris and Rome, between which places he reſided eight years. He travelled alſo through Germany, France, and Italy; where he viſited univerſities, converſed with learned men, and made a choice collection of the beſt ancient Greek, and of the modern Spaniſh, French, and Italian books. He then returned to his native country, where a civil war was juſt ready to break out: upon which he retired again, and in this retirement is ſuppoſed to have written his "Hiſtory of the Five James's," ſucceſſively kings of Scotland, which was not publiſhed till after his death. Beſides this, he compoſed ſeveral other tracts againſt the meaſures of the Covenanters, and thoſe engaged in the oppoſition of Charles I. In a piece called "Irene," he harangues the king, nobility, and clergy, about their mutual miſtakes, fears, and jealouſies: he lays before them the conſequences of a civil war from indiſputable arguments and the hiſtories of paſt times. The great marquis of Montroſe wrote a letter to him, deſiring him to print this "Irene," as the beſt means to quiet the minds of a diſtracted people: he likewiſe ſent him a protection, dated Auguſt 1645, immediately after the battle of Kilſyth, with a letter, in which he commends his learning and loyalty. He wrote other things alſo, with the ſame view of promoting peace and union; of calming the diſturbed minds of the people; of reaſoning the better ſort into moderation, and checking the growing evils, which would be the conſequence of their obſtinacy. He died in 1649, after having married a wife five years before, by whom he had ſome children: William, who was knighted in Charles the Second's time: Robert; and Elizabeth, who was married to Dr. Henderſon, a phyſician at Edinburgh. He had a great intimacy and correſpondence with the two famous Engliſh poets, Drayton and Jonſon; the latter of whom travelled from London on foot, to ſee him at his ſeat at Hawthornden. His works conſiſt of ſeveral things in verſe and proſe; an edition of which, with his life prefixed, was printed in folio at Edinburgh, 1711.

DRUNKENNESS, a well known affection of the brain, occaſioned by drinking too freely of intoxicating liquors. Drunkenneſs appears in different ſhapes in different conſtitutions: ſome it makes gay, ſome ſullen, and ſome furious. The miſchief of drunkenneſs conſiſts in the following bad effects: 1. It betrays moſt conſtitutions either into extravagances of anger, or ſins of lewdneſs. 2. It diſqualifies men for the duties of their ſtation, both by the temporary diſorder of their faculties, and at length by a conſtant incapacity and ſtupefaction. 3. It is attended with expences, which can often be ill ſpared. 4. It is ſure to occaſion uneaſineſs to the family of the drunkard. 5. It ſhortens life. To theſe conſequences of drunkenneſs muſt be added the peculiar danger and miſchief of the example. "Drunkenneſs (ſays Mr. Paley) is a ſocial feſtive vice. The drinker collects his circle; the circle naturally ſpreads; of thoſe who are drawn within it, many become the corrupters and centres of ſets and circles of their own; every one countenancing, and perhaps emulating the reſt, till a whole neighbourhood be infected from the contagion of a ſingle example. With this obſervation upon the ſpreading quality of drunkenneſs, may be connected a remark which belongs to the ſeveral evil effects above recited. The conſequences of a vice, like the ſymptoms of a diſeaſe, though they be all enumerated in the deſcription, ſeldom all meet in the ſame ſubject. In the inſtance under conſideration, the age and temperature of one drunkard may have little to fear from inflammations of luſt or anger; the fortune of a ſecond may not be injured by the expence; a third may have no family to be diſquieted by his irregularities; and a fourth may poſſeſs a conſtitution fortified againſt the poiſon of ſtrong liquors. But if, as we always ought to do, we comprehend within the conſequences of our conduct the miſchief and tendency of the example, the above circumſtances, however fortunate for the individual, will be found to vary the guilt of his intemperance leſs, probably, than he ſuppoſes. Although the waſte of time and money may be of ſmall importance to you, it may be of the utmoſt to ſome one or other whom your ſociety corrupts. Repeated, or long continued exceſſes, which hurt not your health, may be fatal to your companion. Although you have neither wife nor child, nor parent, to lament your abſence from home, or expect your return to it with terror; other families, whoſe huſbands and fathers have been invited to ſhare in your ebriety, or encouraged to imitate it, may juſtly lay their miſery or ruin at your door. This will hold good, whether the perſon ſeduced be ſeduced immediately by you, or the vice be propagated from you to him, through ſeveral intermediate examples."

The ancient Lacedemonians uſed to make their ſlaves frequently drunk, to give their children an averſion and horror towards it. The Indians hold drunkenneſs a ſpecies of madneſs; and in their language, the ſame term (*ramgam*), that ſignifies "drunkard," ſignifies alſo a "phrenetic."

Drunkenneſs, by our laws, is very properly looked upon as an aggravation rather than an excuſe for any crime. For the offence of drunkenneſs a man may be puniſhed in the eccleſiaſtical court, as well as by juſtices of peace by ſtatute. And by 4 *Jac.* I. *c.* 5. and 21 *Jac.* I. *c.* 7. if any perſon ſhall be convicted of drunkenneſs by the view of a juſtice, oath of one witneſs, &c. he ſhall forfeit 5s. for the firſt offence, to be levied by diſtreſs and ſale of his goods; and for want of a diſtreſs, ſhall ſit in the ſtocks ſix hours: and, for the ſecond offence, he is to be bound with two ſureties in 10l. each, to be of good behaviour, or to be committed. And he who is guilty of any crime through his own voluntary drunkenneſs, ſhall be puniſhed for it as if he had been ſober. It has been held that drunkenneſs is a ſufficient cauſe to remove a magiſtrate: and the proſecution for this offence by the ſtatute of 4 *Jac.* I. *c.* 5. was to be, and ſtill may be, before juſtices of peace in their ſeſſions by way of indictment, &c. Equity will not relieve againſt a bond, &c. given by a man when drunk, unleſs the drunkenneſs is occaſioned through the management or contrivance of him to whom the bond is given.

The appetite for intoxicating liquors appears to be almoſt always acquired. One proof of this is, that it is apt to return only at particular times and places; as after dinner, in the evening, on the market day, at the market town, in ſuch a company, at ſuch a tavern. And this may be the reaſon, that

if a habit of drunkenneſs be ever overcome, it is upon ſome change of place, ſituation, company, or profeſſion. A man ſunk deep in a habit of drunkenneſs, will upon ſuch occaſions as theſe, when he finds himſelf looſened from the aſſociations which held him faſt, ſometimes make a plunge, and get out. In a matter of ſuch great importance, it is well worth while, where it is tolerably convenient, to change our habitation and ſociety, for the ſake of the experiment.

Habits of drunkenneſs commonly take their riſe either from a fondneſs for and connection with ſome company, or ſome companion, already addicted to this practice; which affords an almoſt irreſiſtible invitation to take a ſhare in the indulgences which thoſe about us are enjoying with ſo much apparent reliſh and delight; or from want of regular employment, which is ſure to let in many ſuperfluous cravings and cuſtoms, and often this amongſt the reſt; or, laſtly, from grief or fatigue, both which ſtrongly ſolicit that relief which inebriating liquors adminiſter for the preſent, and furniſh a ſpecious excuſe for complying with the inclination. But the habit, when once ſet in, is continued by different motives from thoſe to which it owes its origin. Perſons addicted to exceſſive drinking ſuffer, in the intervals of ſobriety, and near the return of their accuſtomed indulgence, a faintneſs and oppreſſion about the *præcordia* which it exceeds the ordinary patience of human nature to endure. This is uſually relieved for a ſhort time by a repetition of the ſame exceſs: and to this relief, as to the removal of every long continued pain, they who have once experienced it are urged almoſt beyond the power of reſiſtance. This is not all: as the liquor loſes its ſtimulus, the doſe muſt be increaſed, to reach the ſame pitch of elevation or eaſe; which increaſe proportionably accelerates the progreſs of all the maladies that drunkenneſs brings on. Whoever reflects, therefore, upon the violence of the craving in advanced ſtages of the habit, and the fatal termination to which the gratification of it leads, will, the moment he perceives the leaſt tendency in himſelf of a growing inclination to intemperance, collect his reſolution to this point; or (what perhaps he will find his beſt ſecurity) arm himſelf with ſome peremptory rule, as to the times and quantity of his indulgences.

DRUPA, or DRUPPA, in botany, a ſpecies of *pericarpium* or ſeed-veſſel, which is ſucculent or pulpy, has no valve or external opening like the capſule and pod, and contains within its ſubſtance a ſtone or nut. The cherry, plum, peach, apricot, and all other ſtone-fruit are of this kind. The term, which is of great antiquity, is ſynonymous to Tournefort's *fructus mollis oſſiculo*, "ſoft fruit with a ſtone;" and to the *prunus* of other botaniſts. The ſtone or nut, which in this ſpecies of fruit is ſurrounded by the ſoft pulpy fleſh, is a kind of ligneous or woody cup, which contains a ſingle kernel or ſeed. This definition, however, will not apply to every ſeed-veſſel denominated *drupa* in the *Genera Plantarum*. The almond is a *drupa*, ſo is the ſeed-veſſel of the elm-tree and the genus *rumphia*, though far from being pulpy or ſucculent; the firſt and third are of a ſubſtance like leather, the ſecond like parchment. The ſame may be ſaid of the walnut, piſtachio-nut, *guettarda*, *quiſqualis*, jack-in-a-box, and ſome others. Again, the ſeeds of the elm, *ſchrebera*, *flagellaria*, and the mango-tree, are not contained in a ſtone. The ſeed-veſſel of burr-reed is dry, ſhaped like a top, and contains two angular ſtones. This ſpecies of fruit, or more properly ſeed-veſſel, is commonly roundiſh, and, when ſeated below the calyx or receptacle of the flower, is furniſhed, like the apple, at the end oppoſite to the foot-ſtalk, with a ſmall umbilicus or cavity, which is produced by the ſwelling of the fruit before the falling off of the flower-cup.

DRUSES, or DRUZES, a remarkable nation in Paleſtine, inhabiting the environs of Mount Lebanon, of whoſe origin and hiſtory a very entertaining detail is given in the writings of M. Volney. The proper and diſtinctive character of the Druzes is a ſort of republican ſpirit, which gives them more energy than any other ſubjects of the Turkiſh government, and an indifference for religion, which forms a ſtriking contraſt with the zeal of the Mahometans and Chriſtians. In other reſpects, their private life, their cuſtoms and prejudices, are the ſame with other orientals. They may marry ſeveral wives, and repudiate them when they chooſe; but, except by the emir and a few men of eminence, that is rarely practiſed. Occupied with their rural labours, they experience neither artificial wants, nor thoſe inordinate paſſions which are produced by the idleneſs of the inhabitants of cities and towns. The veil, worn by their women, is of itſelf a preſervative againſt thoſe deſires which are the occaſion of ſo many evils in ſociety. No man knows the face of any other woman than his wife, his mother, his ſiſter, and ſiſters-in-law. Every man lives in the boſom of his own family, and goes little abroad. The women, thoſe even of the ſhaiks, make the bread, roaſt the coffee, waſh the linen, cook the victuals, and perform all domeſtic offices. The men cultivate their lands and vineyards, and dig canals for watering them. In the evening they ſometimes aſſemble in the court, the area, or houſe of the chief of the village or family. There, ſeated in a circle, with legs croſſed, pipes in their mouths, and poniards at their belts, they diſcourſe of their various labours, the ſcarcity or plenty of their harveſts, peace or war, the conduct of the emir, or the amount of the taxes; they relate paſt tranſactions, diſcuſs preſent intereſts, and form conjectures on the future. Their children, tired with play, come frequently to liſten; and a ſtranger is ſurpriſed to hear them, at ten or twelve years old, recounting, with a ſerious air, why Djezzar declared war againſt the emir Youſef, how many purſes it coſt that prince, what augmentation there will be of the miri, how many muſkets there were in the camp, and who had the beſt mare. This is their only education. They are neither taught to read the pſalms as among the Maronites, nor the koran like the Mahometans; hardly do the ſhaiks know how to write a letter. But if their mind be deſtitute of uſeful or agreeable information, at leaſt it is not pre-occupied by falſe and hurtful ideas; and, without doubt, ſuch natural ignorance is well worth all our artificial folly. This advantage reſults from it, that their underſtandings being nearly on a level, the inequality of conditions is leſs perceptible. For, in fact, we do not perceive among the Druzes that great diſtance which, in moſt other ſocieties, degrades the inferior, without contributing to the advantage of the great. All, whether ſhaiks or peaſants, treat each other with that rational familiarity which is equally remote from rudeneſs and ſervility. The grand emir himſelf is not a different man from the reſt: he is a good country gentleman, who does not diſdain admitting to his table the meaneſt farmer. In a word, their manners are thoſe of ancient times, and of that ruſtic life which marks the origin of every nation; and prove that the people among whom they are ſtill found are as yet only in the infancy of the ſocial ſtate.

DRUSIUS (John), a Proteſtant writer of great learning, born at Oudenarde in Flanders in 1555. He was deſigned for the ſtudy of divinity; but his father being outlawed, and deprived of his eſtate, they both retired to England, where the ſon became profeſſor of the oriental languages at Oxford: but upon the pacification of Ghent, they returned to their own country, where Druſius was alſo appointed profeſſor of the oriental languages. From thence he removed to Frieſland, where he was admitted Hebrew profeſſor in the univerſity of Franeker; the functions of which he diſcharged with great honour till his death in 1616. His works ſhow him to have been well ſkilled in Hebrew; and the States General employed him

in 1600 to write notes on the moſt difficult paſſages in the Old Teſtament, with a penſion of 400 florins a year: but being frequently diſturbed in this undertaking, it was not publiſhed till after his death. He held a vaſt correſpondence with the learned; for, beſides letters in Hebrew, Greek, and other languages, there were found 2300 Latin letters among his papers. He had a ſon, John, who died in England at 21, and was a prodigy for his early acquiſition of learning; he wrote Notes on the Proverbs of Solomon, with many letters and verſes in Hebrew.

DRYADS, in the heathen theology, a ſort of deities, or nymphs, which the ancients thought inhabited groves and woods. They differed from the Hamadryades; theſe latter being attached to ſome particular tree, with which they were born, and with which they died; whereas the Dryades were goddeſſes of trees and woods in general. See HAMADRYADES.

DRYAS, in botany; a genus of the polygynia order, belonging to the icoſandria claſs of plants; and in the natural method ranking under the 35th order, *Senticoſæ*. The calyx is octofid; the petals eight; the ſeeds long and hairy with a train.

DRYDEN (John), one of the moſt eminent Engliſh poets of the 17th century, deſcended of a genteel family in Huntingdonſhire, was born in that county at Oldwincle 1631, and educated at Weſtminſter ſchool under Dr. Buſby. From thence he was removed to Cambridge in 1650, being elected ſcholar of Trinity-college, of which he appears, by his *Epithalamia Cantabrigienſ.* 4to, 1662, to have been afterwards a fellow. Yet in his earlier days he gave no extraordinary indications of genius; for even the year before he quitted the univerſity, he wrote a poem on the death of Lord Haſtings, which was by no means a preſage of that amazing perfection in poetical talents which he afterwards poſſeſſed.

On the death of Oliver Cromwell he wrote ſome heroic ſtanzas to his memory; but on the Reſtoration, being deſirous of ingratiating himſelf with the new court, he wrote firſt a poem intitled *Aſtræa Redux*, and afterwards a panegyric to the king on his coronation. In 1662 he addreſſed a poem to the lord chancellor Hyde, preſented on New Year's day; and in the ſame year a ſatire on the Dutch. In 1668 appeared his *Annus Mirabilis*, which was an hiſtorical poem in celebration of the duke of York's victory over the Dutch. Theſe pieces at length obtained him the favour of the crown; and Sir William Davenant dying the ſame year, Mr. Dryden was appointed to ſucceed him as poet laureat. About this time alſo his inclination to write for the ſtage ſeems firſt to have ſhown itſelf. For, beſides his concern with Sir William Davenant in the alteration of Shakeſpeare's Tempeſt, in 1669 he produced his Wild Gallants, a comedy. This met with very indifferent ſucceſs; yet the author, not being diſcouraged by its failure, ſoon publiſhed his Indian Emperor. This finding a more favourable reception, encouraged him to proceed; and that with ſuch rapidity, that in the key to the Duke of Buckingham's Rehearſal he is recorded to have engaged himſelf by contract for the writing of four plays per year; and, indeed, in the years 1679 and 1680 he appears to have fulfilled that contract. To this unhappy neceſſity that our author lay under, are to be attributed all thoſe irregularities, thoſe bombaſtic flights, and ſometimes even puerile exuberances, for which he has been ſo ſeverely criticiſed; and which, in the unavoidable hurry in which he wrote, it was impoſſible he ſhould find time either for lopping away or correcting.

In 1675 the Earl of Rocheſter, whoſe envious and malevolent diſpoſition would not permit him to ſee growing merit meet with its due reward, and was therefore ſincerely chagrined at the very juſt applauſe with which Mr. Dryden's dramatic pieces had been received, was determined if poſſible to ſhake his intereſt at court; and ſucceeded ſo far as to recommend Mr. Crowne, an author by no means of equal merit, and at that time of an obſcure reputation, to write a maſk for the court, which certainly belonged to Mr. Dryden's office as poet laureat. Nor was this the only attack, nor indeed the moſt potent one, that Mr. Dryden's juſtly acquired fame drew on him. For, ſome years before, the Duke of Buckingham, a man of not much better character than Lord Rocheſter, had moſt ſeverely ridiculed ſeveral of our author's plays in his admired piece called the *Rehearſal*. But though the intrinſic wit which runs through that performance cannot even to this hour fail of exciting our laughter, yet at the ſame time it ought not to be the ſtandard on which we ſhould fix Mr. Dryden's poetical reputation, if we conſider, that the pieces there ridiculed are not any of thoſe looked on as the *chef d'œuvres* of this author; that the very paſſages burleſqued are frequently, in their original places, much leſs ridiculous than when thus detached, like a rotten limb, from the body of the work; and expoſed to view with additional diſtortions, and diveſted of that connection with the other parts, which, while preſerved, gave it not only ſymmetry but beauty; and laſtly, that the various inimitable beauties, which the critic has ſunk in oblivion, are infinitely more numerous than the deformities which he has thus induſtriouſly brought forth to our more immediate inſpection.

Mr. Dryden, however, did not ſuffer theſe attacks to paſs with impunity; for in 1679 there came out an Eſſay on Satire, ſaid to be written jointly by that gentleman and the Earl of Mulgrave, containing ſome very ſevere reflections on the Earl of Rocheſter and the Ducheſs of Portſmouth, who, it is not improbable, might be a joint inſtrument in the above-mentioned affront ſhown to Mr. Dryden; and in 1681 he publiſhed his Abſalom and Achitophel, in which the well-known character of Zimri, drawn for the Duke of Buckingham, is certainly ſevere enough to repay all the ridicule thrown on him by that nobleman in the character of Bayes. The reſentment ſhown by the different peers was very different. Lord Rocheſter, who was a coward as well as a man of the moſt depraved morals, baſely hired three ruffians to cudgel Dryden in a coffee-houſe: but the Duke of Buckingham, as we are told, in a more open manner, took the taſk upon himſelf: and at the ſame time preſented him with a purſe containing no very trifling ſum of money; telling him, that he gave him the beating as a puniſhment for his impudence, but beſtowed that gold on him as a reward for his wit.

In 1680 was publiſhed a tranſlation of Ovid's Epiſtles in Engliſh verſe by ſeveral hands, two of which, together with the preface, were by Mr. Dryden; and in 1682 came out his *Religio Laici*, deſigned as a defence of revealed religion, againſt Deiſts, Papiſts, &c. Soon after the acceſſion of king James II. our author changed his religion for that of the church of Rome, and wrote two pieces in vindication of the Romiſh tenets; viz. A Defence of the Papers written by the late King, found in his ſtrong box; and the celebrated poem, afterwards anſwered by Lord Halifax, intitled The Hind and the Panther. By this extraordinary ſtep he not only engaged himſelf in controverſy, and incurred much cenſure and ridicule from his cotemporary wits; but on the completion of the Revolution, being, on account of his newly-choſen religion, diſqualified from bearing any office under the government, he was ſtripped of the laurel, which, to his ſtill greater mortification, was beſtowed on Richard Flecknoe, a man to whom he had a moſt ſettled averſion. This circumſtance occaſioned his writing the very ſevere poem called *Mac Flecknoe*.

Mr. Dryden's circumſtances had never been affluent; but now being deprived of this little ſupport, he found himſelf re-

duced to the neceſſity of writing for mere bread. We conſequently find him from this period engaged in works of labour as well as genius, viz. in tranſlating the works of others; and to this neceſſity perhaps our nation ſtands indebted for ſome of the beſt tranſlations extant. In the year he loſt the laurel, he publiſhed the life of St. Francis Xavier from the French. In 1693 came out a tranſlation of Juvenal and Perſius; in the firſt of which he had a conſiderable hand, and of the latter the entire execution. In 1695 was publiſhed his proſe verſion of Freſnoy's Art of Painting; and the year 1697 gave the world that tranſlation of Virgil's works entire, which ſtill does, and perhaps ever will, ſtand foremoſt among the attempts made on that author. The petite pieces of this eminent writer, ſuch as prologues, epilogues, epitaphs, elegies, ſongs, &c. are too numerous to ſpecify here, and too much diſperſed to direct the reader to. The greater part of them, however, are to be found in a collection of miſcellanies in 6 vols. 12mo. His laſt work is what is called his *Fables*, which conſiſts of many of the moſt intereſting ſtories in Homer, Ovid, Boccace, and Chaucer, tranſlated or modernized in the moſt elegant and poetical manner; together with ſome original pieces, among which is that amazing ode on St. Cecilia's day, which, though written in the very decline of the author's life, and at a period when old age and diſtreſs conſpired as it were to damp his poetic ardor and clip the wings of fancy, yet poſſeſſes ſo much of both, as would be ſufficient to have rendered him immortal had he never written a ſingle line beſides.

Dryden married the lady Elizabeth Howard, ſiſter to the Earl of Berkſhire, who ſurvived him eight years; though for the laſt four of them ſhe was a lunatic, having been deprived of her ſenſes by a nervous fever. By this lady he had three ſons; Charles, John, and Henry. Of the eldeſt of theſe there is a circumſtance related by Charles Wilſon, Eſq. in his Life of Congreve, which ſeems ſo well atteſted, and is itſelf of ſo very extraordinary a nature, that we cannot avoid giving it a place here.—Dryden, with all his underſtanding, was weak enough to be fond of judicial aſtrology, and uſed to calculate the nativity of his children. When his lady was in labour with his ſon Charles, he being told it was decent to withdraw, laid his watch on the table, begging one of the ladies then preſent, in a moſt ſolemn manner, to take exact notice of the very minute that the child was born; which ſhe did, and acquainted him with it. About a week after, when his lady was pretty well recovered, Mr. Dryden took occaſion to tell her that he had been calculating the child's nativity; and obſerved, with grief, that he was born in an evil hour: for Jupiter, Venus, and the Sun, were all under the earth, and the lord of his aſcendant afflicted with a hateful ſquare of Mars and Saturn. "If he lives to arrive at the 8th year," ſays he, "he will go near to die a violent death on his very birth-day; but if he ſhould eſcape, as I ſee but ſmall hopes, he will in the 23d year be under the very ſame evil direction; and if he ſhould eſcape that alſo, the 33d or 34th year is, I fear——" Here he was interrupted by the immoderate grief of his lady, who could no longer hear calamity propheſied to befal her ſon. The time at laſt came, and Auguſt was the inauſpicious month in which young Dryden was to enter into the eighth year of his age. The court being in progreſs, and Mr. Dryden at leiſure, he was invited to the country-ſeat of the Earl of Berkſhire his brother-in-law, to keep the long vacation with him in Charleton in Wilts; his lady was invited to her uncle Mordaunt's to paſs the remainder of the ſummer. When they came to divide the children, lady Elizabeth would have him take John, and ſuffer her to take Charles: but Mr. Dryden was too abſolute, and they parted in anger; he took Charles with him, and ſhe was obliged to be content with John. When the fatal day came, the anxiety of the lady's ſpirits occaſioned ſuch an efferveſcence of blood, as threw her into ſo violent a fever that her life was deſpaired of, till a letter came from Mr. Dryden, reproving her for her womaniſh credulity, and aſſuring her that her child was well; which recovered her ſpirits, and in ſix weeks after ſhe received an eclairciſſement of the whole affair. Mr. Dryden, either through fear of being reckoned ſuperſtitious, or thinking it a ſcience beneath his ſtudy, was extremely cautious of letting any one know that he was a dealer in aſtrology; therefore could not excuſe his abſence, on his ſon's anniverſary, from a general hunting-match which Lord Berkſhire had made, to which all the adjacent gentlemen were invited. When he went out, he took care to ſet the boy a double exerciſe in the Latin tongue, which he taught his children himſelf, with a ſtrict charge not to ſtir out of the room till his return; well knowing the taſk he had ſet him would take up longer time. Charles was performing his duty in obedience to his father; but, as ill fate would have it, the ſtag made towards the houſe; and the noiſe alarming the ſervants, they haſted out to ſee the ſport. One of them took young Dryden by the hand, and led him out to ſee it alſo; when, juſt as they came to the gate, the ſtag being at bay with the dogs, made a bold puſh, and leaped over the court-wall, which was very low and very old; and the dogs following, threw down a part of the wall 10 yards in length, under which Charles Dryden lay buried. He was immediately dug out; and after ſix weeks languiſhing in a dangerous way, he recovered. So far Dryden's prediction was fulfilled. In the 23d year of his age, Charles fell from the top of an old tower belonging to the Vatican at Rome, occaſioned by a ſwimming in his head with which he was ſeized, the heat of the day being exceſſive. He again recovered, but was ever after in a languiſhing ſickly ſtate. In the 33d year of his age, being returned to England, he was unhappily drowned at Windſor. He had with another gentleman ſwam twice over the Thames; but returning a third time, it was ſuppoſed he was taken with the cramp, becauſe he called out for help, though too late. Thus the father's calculation proved but too prophetical.

At laſt, after a long life, haraſſed with the moſt laborious of all fatigues, viz. that of the mind, and continually made anxious by diſtreſs and difficulty, our author departed this life on the firſt of May 1701. The day after Mr. Dryden's death, the dean of Weſtminſter ſent word to Mr. Dryden's widow, that he would make a preſent of the ground and all other abbey-fees for the funeral: the Lord Halifax likewiſe ſent to the lady Elizabeth, and to Mr. Charles Dryden, offering to defray the expences of our poet's funeral, and afterwards to beſtow 500l. on a monument in the abbey; which generous offer was accepted. Accordingly, on Sunday following, the company being aſſembled, the corpſe was put into a velvet hearſe, attended by 18 mourning coaches. When they were juſt ready to move, Lord Jefferys, ſon of Lord Chancellor Jefferys, a name dedicated to infamy, with ſome of his rakiſh companions, riding by, aſked whoſe funeral it was; and being told it was Mr. Dryden's, he proteſted he ſhould not be buried in that private manner; that he would himſelf, with the lady Elizabeth's leave, have the honour of the interment, and would beſtow 1000l. on a monument in the abbey for him. This put a ſtop to their proceſſion; and the Lord Jefferys, with ſeveral of the gentlemen who had alighted from their coaches, went up ſtairs to the lady, who was ſick in bed. His lordſhip repeated the purport of what he had ſaid below; but the lady Elizabeth refuſing her conſent, he fell on his knees, vowing never to riſe till his requeſt was granted. The lady under a ſudden ſurpriſe fainted away; and Lord Jefferys, pretending to have obtained her conſent, ordered the body to be carried to Mr. Ruſſel's an undertaker in Cheapſide, and to be left there till further orders. In the mean time the abbey was

lighted up, the ground opened, the choir attending, and the bishop waiting some hours to no purpose for the corpse. The next day Mr. Charles Dryden waited on the Lord Halifax and the bishop; and endeavoured to excuse his mother, by relating the truth. Three days after, the undertaker, having received no orders, waited on the Lord Jefferys; who pretended that it was a drunken frolic, that he remembered nothing of the matter, and he might do what he pleased with the body. Upon this the undertaker waited upon the lady Elizabeth, who desired a day's respite, which was granted. Mr. Charles Dryden immediately wrote to the Lord Jefferys, who returned for answer, that he knew nothing of the matter, and would be troubled no more about it. Mr. Dryden hereupon applied again to Lord Halifax and the Bishop of Rochester, who absolutely refused to do any thing in the affair.

In this distress, Dr. Garth, who had been Mr. Dryden's intimate friend, sent for the corpse to the college of physicians, and proposed a subscription; which succeeding, about three weeks after Mr. Dryden's decease, Dr. Garth pronounced a fine Latin oration over the body, which was conveyed from the college, attended by a numerous train of coaches, to Westminster-abbey, but in very great disorder. At last the corpse arrived at the abbey, which was all unlighted. No organ played, no anthem sung; only two of the singing boys preceding the corpse, who sung an ode of Horace, with each a small candle in their hand. When the funeral was over, Mr. Charles Dryden sent a challenge to Lord Jefferys; who refusing to answer it, he sent several others, and went often himself; but could neither get a letter delivered, nor admittance to speak to him: which so incensed him, that finding his lordship refused to answer him like a gentleman, he resolved to watch an opportunity, and brave him to fight, though with all the rules of honour; which his lordship hearing, quitted the town, and Mr. Charles never had an opportunity to meet him, though he sought it to his death with the utmost application.

Mr. Dryden had no monument erected to him for several years; to which Mr. Pope alludes in his epitaph intended for Mr. Rowe, in this line,

> Beneath a rude and nameless stone he lies.

In a note upon which, we are informed, that the tomb of Mr. Dryden was erected upon this hint by Sheffield duke of Buckingham, to which was originally intended this epitaph:

> This *Sheffield* rais'd.—The sacred dust below
> Was *Dryden* once; the rest, who does not know?

Which was since changed into the plain inscription now upon it, viz.

J. DRYDEN,
Natus Aug. 9, 1631.
Mortuus Maii 1, 1701.
Johannes Sheffield, dux Buckinghamiensis, fecit.

Mr. Dryden's character has been very differently drawn by different writers, some of whom have exalted it to the highest degree of commendation, and others debased it by the severest censure. The latter, however, we must charge to that strong spirit of party which prevailed during great part of Dryden's time, and ought therefore to be taken with great allowances. Were we indeed to form a judgment of the author from some of his dramatic writings, we should perhaps be apt to conclude him a man of the most licentious morals; many of his comedies containing a great share of looseness, even extending to obscenity: but if we consider, that, as the poet tells us,

> Those who live to please, must please to live;

if we then look back to the scandalous licence of the age he lived in, the indigence which at times he underwent, and the necessity he consequently lay under of complying with the public taste, however depraved; we shall surely not refuse our pardon to the compelled writer, nor our credit to those of his cotemporaries who were intimately acquainted with him, and who have assured us there was nothing remarkably vicious in his personal character.

From some parts of his history he appears unsteady, and to have too readily temporized with the several revolutions in church and state. This however might in some measure have been owing to that natural timidity and diffidence in his disposition, which almost all the writers seem to agree in his possessing. Congreve, whose authority cannot be suspected, has given us such an account of him, as makes him appear no less amiable in his private character as a man, than he was illustrious in his public one as a poet. In the former light, according to that gentleman, he was humane, compassionate, forgiving, and sincerely friendly: of an extensive reading, a tenacious memory, and a ready communication: gentle in the correction of the writings of others, and patient under the reprehension of his own deficiencies: easy of access himself, but slow and diffident in his advances to others; and of all men the most modest and the most easy to be discountenanced in his approaches either to his superiors or his equals. As to his writings, he is perhaps the happiest in the harmony of his numbers, of any poet who ever lived either before or since his time, not even Mr. Pope himself excepted. His imagination is ever warm, his images noble, his descriptions beautiful, and his sentiments just and becoming. In his prose he is poetical without bombast, concise without pedantry, and clear without prolixity. His dramatic have, perhaps, the least merit of all his writings. Yet there are many of them which are truly excellent; though he himself tells us that he never wrote any thing in that way to please himself but his *All for Love*. This last, indeed, and his *Spanish Friar*, may be reckoned two of the best plays our language has been honoured with.

DRYPIS, in botany; a genus of the trigynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 22d order, *Caryophyllei*. The calyx is quinquedentated; the petals five; the opening at the capsule as if cut round horizontally, monospermous.

DUBLIN, by the Saxons called Duffin, by the Welch Dinas-dulin, and in the Irish language Ballacloigh; i. e. a town upon hurdles, on which the people think the city is founded, the ground being soft and quaggy. But the original words signify a walled town, particularly raised with stones.

It is the capital of Ireland, in magnitude and number of inhabitants the second city in the British dominions; much about the size of Stockholm, Copenhagen, Berlin, and Marseilles. It is built in the form of a square, about two miles and a half long, and nearly as much in breadth, and is supposed to contain 160,000 inhabitants. It is situated 270 miles N. W. of London, and 60 miles W. from Holyhead, in N. Wales, the usual station of the passage vessels between Great Britain and Ireland. Dublin stands about seven miles from the sea, at the bottom of a large and spacious bay, to which it gives name, upon the river Liffey, which divides it almost into two equal parts, and is banked in through the whole length of the city, on both sides, which form spacious quays, where vessels below the first bridge load and unload before the merchants doors and warehouses.

A stranger, upon entering the bay of Dublin, which is about seven miles broad, and in stormy weather extremely dangerous, is agreeably surprised with the beautiful prospect on each side, and the distant view of Wicklow mountains; but Dublin, from its low situation, makes no great appearance. The increase of Dublin, within 20 years last past, is incredible, and it is generally supposed that 4000 houses have been added to the city

and suburbs since the reign of Queen Anne. This city in its appearance bears a near resemblance to London. The houses are of brick; the old streets are narrow and mean, but many of the new streets are more elegant and better planned than those of the metropolis of Great Britain. Sackville-street, which is sometimes called the Mall, is particularly noble. The houses are elegant, lofty, and uniformly built, and a gravel walk runs through the whole at an equal distance from the sides.

Near the Exchange, on a little eminence, is the Castle, the residence of the lord-lieutenant, which consists of two large courts, called the Upper and Lower Castle-Yard; in the latter of which are the Treasury, &c. Though there is little grandeur in the outward appearance of either, yet upon the whole this castle is far superior to St. James's.

The river Liffey, though navigable for sea vessels as far as the Custom-House, or centre of the city, is but small, when compared to the Thames at London. It runs for two miles almost in a straight line through the city. Over it are two handsome bridges, lately built of stone, in imitation of that at Westminster, and three others that have little to recommend them. Hitherto the centre of Dublin towards the Custom-House was crowded and inconvenient for commercial purposes; but of late a new street has been opened, leading from Essex-Bridge to the Castle, where the lord lieutenant resides. A New Exchange has lately been built upon the most magnificent plan, the first stone of which was laid by Lord Townshend, the then lord-lieutenant, in the centre of which is a statue of his present majesty George III. erected in 1779. Several other useful undertakings and embellishments are in agitation.

The Barracks are pleasantly situated on an eminence near the river. They consist of four large courts, in which are generally quartered four battalions of foot, and one regiment of horse; from hence the castle and city guards are relieved daily. They are said to be the largest and completest buildings of the kind in Europe. A new square, called Palatine-Square, has lately been erected near this spot.

The Linen-Hall was erected at the public expence, and opened in the year 1728, for the reception of such linen cloths as were brought to Dublin for sale, for which there are convenient apartments. It is entirely under the direction of the Trustees for the Encouragement of the Linen Manufactory of Ireland, who are composed of the Lord-Chancellor, the Primate, the Archbishop of Dublin, and the principal part of the nobility and gentry. This national institution is productive of great advantages, by preventing many frauds which otherwise would be committed in a capital branch of trade, by which many thousands are employed, and the kingdom greatly enriched.

Steven's-Green is a most extensive square, being one mile in circumference. It is partly laid out in gravel-walks, like St. James's Park: in the midst is a statue of George II. on horseback, with trees on each side, in which may be seen, in fine weather, a resort of as much beauty, gaiety, and elegant finery, as at any of the public places in England. Many of the houses round the Green are very stately, but a want of uniformity is observable throughout the whole. Ample amends will be made for this defect by another spacious square near Steven's-Green, called Merryon's-Square. The houses being lofty, uniform, and carried up with stone as far as the first floor, give the whole an air of magnificence, not exceeded by any thing of the kind in Britain, if we except Bath.

The front of Trinity-College, extending above 300 feet, is built of Portland-stone in the finest taste. The house of lords is a beautiful room, and is ornamented with an equestrian statue of William III. The parliament-house was begun in 1729, and finished in 1739, at the expence of 40,000l. This superb pile is in general of the Ionic order, and is at this day justly accounted one of the foremost architectural beauties. The portico, in particular, is perhaps without parallel; the internal parts have also many beauties, and the manner in which the building is lighted has been much admired. But one of the greatest and most laudable undertakings that this age can boast of, is the building of a stone wall about the breadth of a moderate street, a proportionable height, and three miles in length, to confine the channel of the bay, and to shelter vessels in stormy weather.

The civil government of Dublin is by a lord mayor, &c. the same as in London. Every third year, the lord mayor and the 24 companies, by virtue of an old charter, are obliged to perambulate the city and its liberties, which they call riding the franchises. Upon this occasion the citizens vie with each other, in show and ostentation, which is sometimes productive of disagreeable consequences to many of their families. In Dublin are two large theatres, that are generally well filled, and which serve as a kind of nursery to those of London.

In this city are two cathedrals, 18 parish-churches, eight chapels, three churches for French, and one for Dutch Protestants, seven Presbyterian meeting-houses, one for Methodists, two for Quakers, and 16 Roman Catholic chapels. At Kilmainham is a royal hospital like that at Chelsea, for invalids; here is also a lying-in-hospital, with gardens, built and laid out in the finest taste; and an hospital for lunatics, built by Dean Swift, who himself died a lunatic; and sundry other hospitals for patients of every kind. It has, however, been matter of surprise, that with all this spirit of national improvement, few or no good inns are to be met with in Ireland. In the capital, which may be classed among the second order of cities in Europe, there is not one inn that deserves that name. Lat. 53. 10. Long. 6. 32.

Dublin, a county of Ireland, 27 miles in length, and 17 in breadth; bounded on the E. by the Irish Sea, on the W. and N. W. by Kildare and East-Meath, and on the S. by Wicklow. It contains 21,304 houses, seven baronies, 87 parishes, four market-towns, and sends 10 members to parliament. It is but a small county, but the soil is very rich and fertile in corn and grass, and the chief place is the city of Dublin.

DUBOS (John Baptist), a learned and ingenious French author, born at Beauvais in 1670. He finished his studies at Paris, and at length was intrusted with the management of several important affairs in Italy, England, and Holland. At his return to Paris, he had a prebendary given him; afterwards he had a pension of two thousand livres, and the abbey of Notre Dame at Ressons, near Beauvais. He died at Paris, when perpetual secretary of the French Academy, on the 23d of March 1742. His principal works are, 1. Critical Reflections on Poetry and Painting, in three volumes duodecimo. 2. A Critical History of the French Monarchy in Gaul, two volumes 4to.

DUCAL, in general, something belonging to a duke. See Duke. The letters patent granted by the senate of Venice are called *ducals*: so also are the letters written, in the name of the senate, to foreign princes. The denomination of ducal is derived hence; that, at the beginning of such patents, the name of the duke or doge is written in capitals, thus, *N— Dei Gratia Dux Venetiarum*, &c. The date of ducals is usually in Latin, but the body is in Italian. A courier was dispatched with a ducal to the emperor, returning him thanks for renewing the treaty of alliance, in 1716, against the Turks, with the republic of Venice.

DUCAS, a learned Greek, who wrote an history of what passed under the last emperors of Constantinople, till the ruin of that city. This work, which is esteemed, was printed at the Louvre in 1649, with the Latin translation and notes of Bouillaud.

DUCAT, a foreign coin, either of gold or filver, ftruck in the dominions of a duke; being about the fame value with a Spanifh piece of eight, or a French crown, or four fhillings and fixpence fterling when of filver; and twice as much when of gold. See Coin. The origin of ducats is referred to one Longinus, governor of Italy; who, revolting againft the emperor Juftin the Younger, made himfelf duke of Ravenna, and called himfelf *Exarcha*, i. e. *without lord or ruler;* and, to fhow his independence, ftruck pieces of money of very pure gold in his own name, and with his own ftamp, which were called *ducati, ducats;* as Procopius relates the ftory. After him, the firft who ftruck ducats were the Venetians, who called them *Zecchini* or *fequins*, from Zecca, the place where they firft were ftruck. This was about the year 1280, in the time of John Danduli: but we have pretty good evidence that Roger king of Sicily had coined ducats as early as 1240. And Du Cange fcruples not to affirm, that the firft ducats were ftruck in the duchy of Apulia in Calabria. The chief gold ducats now current are, the fingle and double ducats of Venice, Florence, Genoa, Germany, Hungary, Poland, Sweden, Denmark, Flanders, Holland, and Zurich. The heavieft of them weighs 5 pennyweights 17 grains, and the lighteft 5 pennyweights 10 grains; which is to be underftood of the double ducats, and of the fingle in proportion. The Spaniards have no ducats of gold; but, in lieu thereof, they make ufe of the filver one; which, with them, is no real fpecies, but only a money of account like our pound. It is equivalent to 11 rials. See Rial. The filver ducats of Florence ferve there for crowns.

DUCATOON, a filver coin, ftruck chiefly in Italy; particularly at Milan, Venice, Florence, Genoa, Lucca, Mantua, and Parma: though there are alfo Dutch and Flemifh ducatoons. They are all nearly on the fame footing; and being a little both finer and heavier than the piece of eight, are valued at two pence or three pence more, viz. at about four fhillings and eightpence fterling. There is alfo a gold ducatoon, ftruck and current chiefly in Holland: it is equivalent to twenty florins, on the footing of one fhilling and eleven pence half-penny the florin.

DUCENARIUS, in antiquity, an officer in the Roman army, who had the command of 2000 men. The emperors had alfo ducenarii among their procurators or intendants, called *procuratores ducenarii*. Some fay, that thefe were fuch whofe falary was two hundred fefterces; as in the games of the circus, horfes hired for two hundred fefterces were called *ducenarii*. Others hold, that ducenarii were thofe who levied the two hundredth penny, the officers appointed to infpect the raifing of that tribute. In the infcription at Palmyra, the word *ducenarius*, in Greek δεκεναριος, occurs very often.

DUCENTESIMA, in antiquity, a tax of the two hundredth penny, exacted by the Romans.

DUCHY, in geography, an appellation given to the dominions of a duke.

Duchy *Court*, a court wherein all matters belonging to the duchy or county palatine of Lancafter are decided by decree of the chancellor of that court. The origin of this court was in Henry the Fourth's time, who obtained the crown by depofition of Richard II. and having the duchy of Lancafter, by defcent, in right of his mother, became feifed thereof as king, not as duke: fo that all the liberties, franchifes, and jurifdictions of the faid county paffed from the king, by his great feal, and not by livery or attornment, as the earldom of March, and other poffeffions, which defcended to him by other anceftors than the king's did. Henry IV. by authority of parliament, fevered the poffeffions, liberties, &c. of the faid duchy from the crown: but Edward IV. reftored them to their former ftate. The officers belonging to this court, are, a chancellor, attorney-general, receiver-general, clerk of the court, and meffenger; befide the affiftants, as an attorney in the exchequer, another in chancery, and four counfellors.

DUCK, in ornithology. (See Anas and Decoy.) This fowl is furnifhed with a peculiar ftructure of veffels about the heart, which enables it to live a confiderable time under water, as is neceffary for it in diving. This made Mr. Boyle think it a more proper fubject for experiments with the air-pump than any other bird. A full grown duck being put into the receiver of an air-pump, of which fhe filled one third part, and the air exhaufted, the creature feemed to bear it better for the firft moments than a hen or other fuch fowl; but, after about a minute, fhe fhowed great figns of uneafinefs, and in lefs than two minutes her head fell down, and fhe appeared dying, till revived by the letting in of the air. Thus, whatever facility of diving this and other water-fowl may have, it does not appear that they can fubfift, without air for refpiration, any longer than other animals. A young callow duck was afterwards tried in the fame manner, and with the fame fuccefs, being reduced very near death in lefs than two minutes. But it is obfervable, that both birds fwelled very much on pumping out the air, fo that they appeared greatly larger to the fpectators, efpecially about the crop; it not being intended that any water-fowl fhould live in an exceedingly rarefied air, but only be able to continue occafionally fome time under water. Nature, though fhe has provided them with the means of this, has done nothing for them in regard to the other.

The ftrongeft inftance of thefe creatures being calculated to live almoft in any fituation, we have in the accounts of the blind ducks in the Zirchnitzer lake in Carniola. It is fuppofed that this lake communicates with another lake under ground in the mountain Savornic, and fills or empties itfelf according to the fulnefs or emptinefs of that lake; the water of the upper lake running off, and that in vaft quantities, by holes in the bottom. The ducks, which are here always in great numbers, are often carried down along with the water, and forced into the fubterraneous lake to which it retires. In this unnatural habitation, many of thefe creatures undoubtedly perifh, but fome remain alive. Thefe become blind, and lofe all their feathers; and in the next filling of the lake, both they and vaft numbers of fifh are thrown up with the water. At this time they are fat, but make a ftrange appearance in their naked ftate, and are eafily caught, by reafon of their want of fight. In about a fortnight they recover their fight and feathers; and are then of the fize of a common wild-duck, but of a black colour, with a white fpot in their forehead. When opened, on being taken at their firft coming up in their blind ftate, their ftomachs are found full of fmall fifh, and fomewhat refembling weeds. From this it feems that they cannot be abfolutely blind; but that the degree of light to which they have been accuftomed in their fubterraneous habitation, was fufficient to enable them to procure food for themfelves; and their blindnefs, on coming again into open day-light, is no other than that of a man who has been long in the dark, on having in an inftant a large blaze of candles fet under his eyes.

Duck (Stephen), a very extraordinary perfon, who from a threfher became a poet, and was afterwards advanced to the cure of a parifh. He was born about the beginning of this century, and had originally no other teaching than what enabled him to read and write Englifh; and, as arithmetic is generally joined with this degree of learning, he had a fmall fhare of that too. About his 14th year he was taken from fchool, and was afterwards fucceffively engaged in the feveral lower employments of a country life. This lafted for fome years; fo long, that he had almoft forgot all the arithmetic he had learned at fchool. However, he read fometimes, and thought oftener: he had a certain longing after knowledge;

and, when he reflected within himfelf on his want of education, he began to be particularly uneafy that he fhould have forgot any thing of what he had learned, even at the little fchool he had been at. He thought of this fo often, that, at laft, he refolved to try his own ftrength; and, if poffible, to recover his arithmetic again.

He was then about 24 years of age; and confidering the difficulties the poor fellow lay under, an inclination for knowledge muft needs have been very ftrong in him. He was then married, and at fervice: he had little time to fpare: he had no books, and had no money to get any; but he was refolved to go through with it, and accordingly ufed to work more than other day-labourers, by which means he got fome little matter added to his pay. This overplus was at his own difpofal; and with this he bought firft a book of vulgar arithmetic, then one of decimal, and a third of meafuring land: all which, by degrees, he made himfelf a tolerable mafter of, in thofe hours he could fteal from fleep, after the labours of the day. He had, it feems, one dear friend, who joined with him in this literary purfuit; and with whom he ufed to talk and read, when they could fteal a little time for it. This friend had been in a fervice at London for two or three years, and had an inclination to books, as well as Stephen Duck. He had purchafed fome, and brought them down with him into the country; and Stephen had always the ufe of his little library, which in time was increafed to two or three dozen of books.

With thefe helps Stephen grew fomething of a poet, and fomething of a philofopher. He had from his infancy a caft in his mind towards poetry, as appeared from feveral little circumftances; but what gave him a higher tafte of it, than he had been ufed to, was Milton's "Paradife Loft." This he read over twice or thrice with a dictionary, before he could underftand the language of it thoroughly; and this, with a fort of Englifh grammar he had, is faid to have been of the greateft ufe to him. It was his friend that helped him to the "Spectators;" which, as he himfelf owned, improved his underftanding more than any thing. The copies of verfes, fcattered in thofe pieces, helped on his natural bent that way; and made him willing to try whether he could not do fomething like them. He fometimes turned his own thoughts into verfe, while he was at work; and at laft began to venture thofe thoughts a little upon paper. The thing took air; and Stephen, who had before the name of a fcholar among the country people, was faid now to be able to write verfes too. This was mentioned accidentally, about the year 1729, before a gentleman of Oxford, who fent for Stephen, and, after fome talk with him, defired him to write him a letter in verfe. He did fo; and that letter is the epiftle which ftands the laft in his poems, though the firft whole copy of verfes that ever he wrote.

By thefe attempts, one after another, he became known to the clergymen in the neighbourhood; who, upon examining him, found that he had a great deal of merit, made him fome prefents, and encouraged him to go on. At length, fome of his effays falling into the hands of a lady of quality, who attended on the late Queen Caroline, he became known to her majefty, who took him under her protection, and fettled on him a yearly penfion of about 30l. This Duck very gratefully acknowledges, in the dedication of his "Poems" to the Queen.

Duck was afterwards admitted into orders, and preferred to the living of Byfleet in Surrey. He had taken fome pains to mafter the Latin tongue. At Byfleet he continued for many years to make poems and fermons, and was mightily followed by the people as a preacher; till, falling at length into a low-fpirited melancholy way, he flung himfelf into the Thames from a bridge near Reading, and was drowned. This unhappy accident, for he was perfectly lunatic, befel him fome time in June 1756.

DUCKING, plunging in water, a diverfion anciently practifed among the Goths by way of exercife; but among the Celtæ, Franks, and ancient Germans, it was a fort of punifhment for perfons of fcandalous lives. At Marfeilles and Bourbon their men and women of fcandalous life are condemned to the cale, as they call it; that is, to be fhut up naked to the fhift in an iron cage faftened to the yard of a fhallop, and ducked feveral times in the river. The fame was formerly done at Thouloufe to blafphemers.

Ducking, a fort of marine punifhment, ufually performed as follows: The criminal is placed aftride of a fhort thick batten, faftened to the end of a rope, which paffes through a block hanging at one of the yard-arms. Thus fixed, he is hoifted fuddenly up to the yard, and the rope being flackened at once, he is plunged into the fea. This chaftifement is repeated feveral times, conformable to the fentence pronounced and nature of the culprit's offence. This mode of punifhment was chiefly in ufe among the French.

Ducking is alfo a penalty which veteran failors pretend to inflict on thofe who, for the firft time, pafs the tropic of Cancer, the equator, or the ftraits of Gibraltar, in confequence of their refufal or incapacity to pay the ufual fine levied on this occafion.

Ducking-*Stool*. See Castigatory.

DUCKUP, at fea, is a term ufed by the fteer's-man, when the main-fail, fore-fail, or fprit-fail, hinders his feeing to fteer by a land-mark: upon which he calls out, *Duckup the clew-lines of thefe fails*; that is, hale the fails out of the way. Alfo when a fhot is made by a chace-piece, if the clew of the fprit-fail hinders the fight, they call out, *Duckup*, &c.

DUCT, in general, denotes any tube or canal. It is a term much ufed by anatomifts.

DUCTILITY, in phyfics, a property poffeffed by certain folid bodies, which confifts in their yielding to percuffion or preffure, and in receiving different forms without breaking. Some bodies are ductile both when they are hot and when they are cold, and in all circumftances. Such are metals, particularly gold and filver. Other bodies are ductile only when heated to a fufficient degree; fuch as wax, and other fubftances of that kind, and glafs. Other bodies, particularly fome kinds of iron, called by the workmen *red-fhort*, brafs, and fome other metallic mixtures, are ductile only when cold, and brittle when hot. The degrees of heat requifite to produce ductility in bodies of the firft kind, vary according to their different natures. In general, the heat of the body muft be fuch as is fufficient to reduce it to a middle ftate betwixt folidity and perfect fufion. As wax, for inftance, is fufible with a very fmall heat, it may be rendered ductile by a ftill fmaller one; and glafs, which requires a moft violent heat for its perfect fufion, cannot acquire its greateft ductility until it is made perfectly red-hot, and almoft ready to fufe. Laftly, fome bodies are made ductile by the abforption of a fluid. Such are certain earths, particularly clay. When thefe earths have abforbed a fufficient quantity of water to bring them into a middle ftate betwixt folidity and fluidity, that is, to the confiftence of a confiderably firm pafte, they have then acquired their greateft ductility. Water has precifely the fame effect upon them in this refpect that fire has upon the bodies above mentioned.

DUDLEY (Edmund), an eminent lawyer and able ftatefman in the reign of Henry VII. who with Sir Richard Empfon, another lawyer of the fame complexion, affifted in filling that rapacious monarch's coffers by arbitrary profecutions of the people on old penal ftatutes. They were beheaded on the

accession of Henry VIII. to pacify the clamours of the people for justice.

Dudley (John), duke of Northumberland, son of the above, a statesman; memorable in the English history for his unsuccessful attempt to place the crown on the head of his daughter-in-law, lady Jane Grey, who fell a victim to his ambition; was born in 1502, and beheaded in 1553. See (*History of*) England. Ambrose, his eldest son, was a brave general and able statesman under queen Elizabeth; and received the appellation of *the good earl of Warwick*. Henry, the duke's second son, was killed at the siege of St. Quintin. Robert, the third son, a man of bad character, was created earl of Leicester; and was one of queen Elizabeth's favourites. His fourth son was the unfortunate lord Guildford Dudley, whose only crime was his being the husband of lady Jane Grey, for which he was beheaded in 1554.

Dudley (Sir Robert), as he was called in England, and, as he was styled abroad, *earl of Warwick and duke of Northumberland*, was the son of Robert above mentioned, by the lady Douglas Sheffield; and was born at Sheen in Surry in 1573, where he was carefully concealed, to prevent the queen's knowledge of the earl's engagements with his mother. He studied at Oxford; when his father dying, left him the bulk of his estate. He was at this time one of the finest gentlemen in England; and having a particular turn to navigation, fitted out a small squadron at his own expence, with which he sailed to the river Oroonoque, and took and destroyed nine sail of Spanish ships. In 1595 he attended the earl of Essex, and the lord high admiral of England, in their expedition against the Spaniards; when, for his gallant behaviour at the taking of Cadiz, he received the honour of knighthood. He now endeavoured to prove the legitimacy of his birth, in order to be intitled to his hereditary honours. But being overpowered by the interest of the countess dowager of Leicester, he applied for a license to travel; and, being well received at the court of Florence, resolved to continue there, notwithstanding his receiving a letter of recall; on which his whole estate was seized by king James I. and vested in the crown. He discovered at the court of Cosmo II. great duke of Tuscany, those great abilities for which he had been admired in England, and was at length made chamberlain to his serene highness's consort. He there contrived several methods of improving shipping; introduced new manufactures; and by other services obtained so high a reputation, that at the desire of the archduchess, the emperor Ferdinand, in 1620, created him a duke of the holy Roman empire. He afterwards drained a vast tract of morass between Pisa and the sea; and raised Leghorn, which was then a mean, pitiful place, into a large and beautiful town, improving the haven by a mole, which rendered it both safe and commodious; and having engaged his highness to declare it a free port, he, by his influence and correspondence, drew many English merchants to settle and set up houses there, which was of very great service to his native country, as well as to the Spaniards. He was also the patron of learned men, and held a high place himself in the republic of letters. His most celebrated work is his *Del Arcano del Mare*, in two volumes, folio.

DUEL, a single combat, at a time and place appointed, in consequence of a challenge. This custom came originally from the northern nations, among whom it was usual to decide all their controversies by arms. Both the accuser and accused gave pledges to the judges on their respective behalf; and the custom prevailed so far amongst the Germans, Danes, and Franks, that none were excused from it but women, sick people, cripples, and such as were under 21 years of age or above 60. Even ecclesiastics, priests, and monks, were obliged to find champions to fight in their stead. The punishment of the vanquished was either death, by hanging or beheading; or, mutilation of members, according to the circumstances of the case. Duels were at first admitted not only on criminal occasions, but on some civil ones for the maintenance of rights to estates, and the like: in latter times, however, before they were entirely abolished, they were restrained to these four cases. 1. That the crime should be capital. 2. That it should be certain the crime was perpetrated. 3. The accused must by common fame be supposed guilty. And, 4. The matter not capable of proof by witnesses.

Duel, at present, is used for single combat on some private quarrel; and must be premeditated, otherwise it is called a *rencounter*. If a person is killed in a duel, both the principals and seconds are guilty, whether the seconds engage or not. It is also a very high offence to challenge a person either by word or letter, or to be the messenger of a challenge. See Law. The general practice of duelling, in this last sense, took its rise in the year 1527, at the breaking up of a treaty between the emperor Charles V. and Francis I. The former desired Francis's herald to acquaint his sovereign, that he would henceforth consider him not only as a base violator of public faith, but as a stranger to the honour and integrity becoming a gentleman. Francis, too high-spirited to bear such an imputation, had recourse to an uncommon expedient to vindicate his character. He instantly sent back the herald with a cartel of defiance, in which he gave the emperor the lie in form, challenged him to single combat, requiring him to name the time and place of the encounter, and the weapons with which he chose to fight. Charles, as he was not inferior to his rival in spirit or bravery, readily accepted the challenge; but after several messages concerning the arrangement of all the circumstances relative to the combat, accompanied with mutual reproaches bordering on the most indecent scurrility, all thoughts of this duel, more becoming the heroes of romance than the two greatest monarchs of their age, were entirely laid aside.

The example of two personages so illustrious, drew such general attention, and carried with it so much authority, that it had considerable influence in introducing an important change in manners all over Europe. Duels, as has already been observed, had been long permitted by the laws of all the European nations; and, forming a part of their jurisprudence, were authorised by the magistrate on many occasions, as the most proper method of terminating questions with regard to property, or of deciding in those which regarded crimes. But single combats being considered as solemn appeals to the omniscience and justice of the Supreme Being, they were allowed only in public causes, according to the prescription of law, and carried on in a judicial form. Men accustomed to this manner of decision in courts of justice, were naturally led to apply it to personal and private quarrels. Duels, which at first could be appointed by the civil judge alone, were fought without the interposition of his authority, and in cases to which the laws did not extend. The transaction between Charles and Francis strongly countenanced this practice. Upon every affront or injury which seemed to touch his honour, a gentleman thought himself entitled to draw his sword, and to call on his adversary to make reparation. Such an opinion, introduced among men of fierce courage, of high spirit, and of rude manners, where offence was often given, and revenge was always prompt, produced most fatal consequences. Much of the best blood in christendom was shed; many useful lives were lost; and, at some periods, war itself hath hardly been more destructive than these contests of honour. So powerful, however, is the dominion of fashion, that neither the terror of penal laws, nor reverence for religion, have been able entirely to abolish a practice unknown among the ancients, and not justifiable by any principle of reason; though at the same time

we muſt aſcribe to it, in ſome degree, the extraordinary gentleneſs and complaiſance of modern manners, and that reſpectful attention of one man to another, which at preſent render the ſocial intercourſes of life far more agreeable and decent than among the moſt civilized nations of antiquity.

Public opinion is not eaſily controlled by civil inſtitutions; for which reaſon it may be queſtioned whether any regulations can be contrived of ſufficient force to ſuppreſs or change the rule of honour which ſtigmatizes all ſcruples about duelling with the reproach of cowardice. The inadequate redreſs which the law of the land affords for thoſe injuries which chiefly affect a man in his ſenſibility and reputation, tempts many to redreſs themſelves: and proſecutions for ſuch offences, by the trifling damages that are recovered, ſerve only to make the ſufferer ridiculous. For this, however, more ought to be found. Perhaps for the army, where the point of honour is cultivated with exquiſite attention and refinement, there might be eſtabliſhed a Court of Honour, with a power of awarding thoſe ſubmiſſions and acknowledgments which it is generally the object of a challenge to obtain; and it might grow into a faſhion with perſons of rank of all profeſſions to refer their quarrels to the ſame tribunal.

In fact, as the law now ſtands, duelling can ſeldom be overtaken by legal puniſhment. The challenge, appointment, and other previous circumſtances, which indicate the intention with which the combatants met, being ſuppreſſed, nothing appears to a court of juſtice but the actual rencounter; and if a perſon be ſlain when actually fighting with his adverſary, the law deems his death nothing more than manſlaughter.

DUERO, or Duro, a large river, which, riſing in Old Caſtile in Spain, runs from eaſt to weſt, croſſes the province of Leon, and after dividing Portugal from Spain by a ſoutherly courſe, turns weſtward, croſſes Portugal, and falls into the Atlantic Ocean at Porto Port.

DUGDALE (Sir William), an eminent Engliſh hiſtorian, antiquarian, and herald, born in Warwickſhire in 1605. He was introduced into the herald's office by Sir Chriſtopher Hatton; and aſcended gradually through all the degrees, until he became garter principal king at arms. His chief work is the *Monaſticon Anglicanum*, in three vols. folio; containing the charters and deſcriptions of all the Engliſh monaſteries, adorned with engravings: in the former part of which work he was aſſiſted by Mr. Roger Dodſworth. Nor are his Antiquities of Warwickſhire leſs eſteemed. He wrote likewiſe, among other things of leſs note, the Hiſtory of St. Paul's Cathedral; a Hiſtory of Embanking and Draining; a Baronage of England; and completed the ſecond volume of Sir Henry Spelman's Councils, with a ſecond part of his Gloſſary. He died in 1686. His ſon, Sir John, was Norroy king at arms, and publiſhed a Catalogue of Engliſh Nobility. His daughter, Elizabeth, married the famous Elias Aſhmole.

DUILLIA lex, was enacted by M. Duillius, a tribune, in the year of Rome 304. It made it a capital crime to leave the Roman people without its tribunes, or to create any new magiſtrate without a ſufficient cauſe. Another in 392, to regulate what intereſt ought to be paid for money lent.

DUILLIUS nepos (C.), a Roman conſul, the firſt who obtained a victory over the naval power of Carthage in the year of Rome 492. He took fifty of the enemy's ſhips, and was honoured with a naval triumph, the firſt that ever appeared at Rome. The ſenate rewarded his valour by permitting him to have muſic playing and torches lighted at the public expence every day while he was at ſupper. There were ſome medals ſtruck in commemoration of this victory; and there exiſts a column at Rome which was erected on the occaſion.

DUKE, Dux, a ſovereign prince, without the title or quality of king. Such are the Duke of Lorrain, of Holſtein, Savoy, of Parma, &c. The word is borrowed from the modern Greeks, who call *doucas* what the Latins call *dux*. There are alſo two ſovereigns who bear the title of *grand-duke*; as the grand-duke of Tuſcany, and the grand duke of Muſcovy, now called the *czar* or emperor of Ruſſia. The title of *great duke* belongs to the apparent heir of Ruſſia; and the title of *arch-duke* is given to all the ſons of the houſe of Auſtria, as alſo that of *arch-ducheſs* to all the daughters.

Duke, *Dux*, is alſo a title of honour or nobility, the next below princes. The dukedom, or dignity of duke, is a Roman dignity, denominated *a ducendo*, "leading" or "commanding." Accordingly the firſt dukes, *duces*, were the *ductores exercituum*, "commanders of armies." Under the late emperors, the governors of provinces in war-time were intitled *duces*. In after times the ſame denomination was alſo given to the governors of provinces in time of peace. The firſt governor under the name of *duke*, was a duke of the Marchia Rhætica, or Griſons, whereof mention is made in Caſſiodorus; and there were afterwards thirteen dukes in the eaſtern empire, and twelve in the weſtern. The Goths and Vandals, upon their over-running the provinces of the weſtern empire, aboliſhed the Roman dignities wherever they ſettled. But the Franks, &c. to pleaſe the Gauls, who had long been uſed to that form of government, made it a point of politics not to change any thing therein: and accordingly they divided all Gaul into duchies and counties: and gave the names ſometimes of dukes, and ſometimes of counts, *comites*, to the governors thereof.

In England, during the time of the Saxons, Camden obſerves, that the officers and commanders of armies were called dukes, *duces*, after the ancient Roman manner, without any addition. After the Conqueror came in, the title lay dormant till the reign of Edward III. who created his ſon Edward, firſt called the *Black Prince*, duke of Cornwall; which hath ever ſince been the peculiar inheritance of the king's eldeſt ſon during the life of his father; ſo that he is *dux natus, non-creatus*. After whom there were more made, in ſuch manner as that their titles deſcended to their poſterity. They were created with much ſolemnity, *per cincturam gladii, cappæque, & circuli aurei in capite impoſitionem*. However, in the reign of Queen Elizabeth, A. D. 1572, the whole order became utterly extinct; but it was revived about 50 years afterwards by her ſucceſſor, in the perſon of George Villiers duke of Buckingham.

Though the French retained the names and form of the ducal government, yet under their ſecond race of kings there were ſcarcely any dukes: but all the great lords were called *counts*, *peers*, or *barons*; excepting, however, the dukes of Burgundy and Aquitain; and the duke of France, which was a dignity Hugh Capet himſelf held, correſponding to the modern dignity of maire de palais, or the king's lieutenant. By the weakneſs of the kings, the dukes or governors ſometimes made themſelves ſovereigns of the provinces truſted to their adminiſtration. This change happened chiefly about the time of Hugh Capet; when the great lords began to diſmember the kingdom, ſo that that prince found more competitors among them than ſubjects. It was even with a great deal of difficulty they could be brought to own him their ſuperior, or to hold of him by faith and homage. By degrees, what with force, and what by marriages, theſe provinces, both duchies and counties, which had been rent from the crown, were again united to it. But the title *duke* was no longer given to the governors of provinces. From that time duke became a mere title of dignity, annexed to a perſon and his heirs male, without giving him any domain, territory, or juriſdiction over the place whereof he was duke. All the advantages thereof now conſiſt in the name, and the precedence it gives.

The dukes of our days retain nothing of their ancient ſplendour but the coronet on their eſcutcheon, which is the only

mark of their departed fovereignty. They are created by patent, cincture of the fword, mantle of ftate, impofition of a cape, and coronet of gold on the head, and a verge of gold in their hand. The eldeft fons of dukes are by the courtefy of England ftyled *marquiffes*, though they are ufually diftinguifhed by their father's fecond title, whether it be that of marquis or earl; and the younger fons *lords*, with the addition of their chriftian name, as Lord James, Lord Thomas, &c. and they take place of vifcounts, though not fo privileged by the laws of the land. A duke has the title of *grace*; and being written to, he is ftyled, in the herald's language, *moft high, potent, and noble prince*. Dukes of the blood-royal are ftyled *moft high, moft mighty, and illuftrious princes*.

Duke, among Hebrew grammarians, is an appellation given to a fpecies of accents anfwering to our comma. See Accent.

Duke-*Duke*, a quality given in Spain to a grandee of the houfe of Sylva, on account of his having feveral duchies from the uniting of two confiderable houfes in his perfon. Don Roderigo de Sylva, eldeft fon of Don Ruy Gomez Sylva, and heir of his duchies and principalities, married the eldeft daughter of the Duke de l'Infantado; in virtue of which marriage, the prefent Duke de Paftrana, who is defcended therefrom, and is grandfon of Don Roderigo de Sylva, has added to his other great titles that of duke-duke, to diftinguifh himfelf from the other dukes; fome whereof may enjoy feveral duchies, but none fo confiderable ones, nor the titles of fuch eminent families.

DULCIFYING, in chemiftry, is the fweetening any matter impregnated with falts, by frequently wafhing it in pure water.

DULL, in the manege. The marks of a dull horfe, called by the French *marquis de ladre*, are white fpots round the eye and on the tip of the nofe, upon any general colour whatfoever. Though the vulgar take thefe fpots for figns of ftupidity, it is certain they are great marks of the goodnefs of a horfe; and the horfes that have them are very fenfible and quick upon the fpur.

DULLART (Heiman), a Dutch painter and poet. He was a pupil to Rembrandt, for whofe works the few he left are often miftaken. He died in 1684.

DUMBARTON. See Dunbarton.

DUMBNESS, the privation of the faculty of fpeech. The moft general, and frequently the fole caufe of dumbnefs, is the want of the fenfe of hearing; language being originally acquired by imitating articulate founds. From this fource of intelligence, deaf people are entirely excluded: they cannot acquire articulate founds by the ear: unlefs, therefore, articulation be communicated to them by fome other medium, thefe unhappy people muft for ever be deprived of the ufe of language; and as language is the principal fource of knowledge, whoever has the misfortune to want the fenfe of hearing, muft remain in a ftate little fuperior to that of the brute creation. Of late years, however, it has been fhown, that although deaf people cannot learn to fpeak or read by the direction of the ear, there are other fources of imitation, by which the fame effect may be produced. The organs of hearing and of fpeech have little or no connection. Perfons deprived of the former generally poffefs the latter in fuch perfection, that nothing further is neceffary, in order to make them articulate, than to teach them how to ufe thefe organs. This indeed is no eafy tafk; but the regular feminaries kept near the metropolis, by Mr. Braidwood and Mr. Telfair, in which the inftruction of deaf and dumb perfons is fuccefsfully conducted, fhow that it is certainly practicable. The former began with a fingle pupil in 1764; and fince that period has taught great numbers to fpeak fo as to be underftood, to read, to write, to underftand figures, the principles of religion and morality, &c.

The firft thing attempted in the practice of his method is, to teach the pupil to pronounce the fimple founds of the vowels and confonants. He pronounces the found of the letter *a* very flowly, pointing out the figure of it upon paper at the fame time; and makes his pupil obferve the motion of his mouth and throat. He then puts his finger into the pupil's mouth, depreffes or elevates the tongue, and makes him keep the parts in that pofition; then he lays hold of the outfide of the throat, and applies fuch a kind of preffure as fhall indicate to the pupil a certain neceffary action to be performed by the mufcles. All the while he is pronouncing *a*, the pupil is anxioufly imitating him, but at firft feems not to underftand what he would have him to do. In this manner he proceeds, till the pupil has learned to pronounce the founds of the letters. He goes on in the fame manner to join a vowel and a confonant, till at length the pupil is enabled both to utter diftinct words, and to read.

The pupils inftructed in thefe academies are taught not only the mere *pronunciation*, but alfo to underftand the *meaning* of what they read. Of this Mr. Pennant gives a remarkable inftance in a young lady of about 13, who had been fome time under the care of Mr. Braidwood. "She readily apprehended (fays he) all I faid, and returned me anfwers with the utmoft facility. She read; fhe wrote well. Her reading was not by rote. She could clothe the fame thoughts in a new fet of words, and never vary from the original fenfe. I have forgot the book fhe took up, or the fentences fhe made a new verfion of: but the effect was as follows:

"*Original paffage*. Lord Bacon has divided the whole of human knowledge into hiftory, poetry, and philofophy; which are referred to the three powers of the mind, memory, imagination, and reafon.

"*Verfion*. A nobleman has parted the total or all of man's ftudy or underftanding into—An account of the life, manners, religion or cuftoms of any people or country; verfe or metre; moral or natural knowledge: which are pointed to the three faculties of the foul or fpirit; the faculty of remembering what is paft, thought or conception, and right judgment."

A new and different method, equally laborious and fuccefsful, we underftand, is practifed by the Abbe de l'Epée of Berlin, who, it is faid, begins his inftructions not by endeavouring to form the organs of fpeech to articulate founds, but by communicating ideas to the mind by means of figns and characters: to effect this, he writes the names of things; and, by a regular fyftem of figns, eftablifhes a connection between thefe words and the ideas to be excited by them. After he has thus furnifhed his pupils with ideas, and a medium of communication, he teaches them to articulate and pronounce, and renders them not only grammarians but logicians. In this manner he has enabled one of his pupils to deliver a Latin oration in public, and another to defend a thefis againft the objections of one of his fellow-pupils in a fcholaftic difputation; in which the arguments of each were communicated to the other, but whether by figns or in writing is not faid; for it does not appear that the Abbé teaches his pupils to difcern what is fpoken, by obferving the motion of the organs of fpeech, which thofe inftructed by other teachers do very readily.

There is perhaps no word, fays the Abbe, more difficult to explain by figns than the verb *croire*, "to believe." To do this, he writes the verb with its fignifications in the following manner:

Je crois { *Je dis oui par l'efprit, Je penfe que oui.*
Je dis oui par le coeur, J'aime à penfer que oui.
Je dis oui par la bouche.
Je ne vois pas des yeux.

After teaching thefe four fignifications, which he does by as many figns, he connects them with the verb, and adds other

ſigns to expreſs the number, perſon, tenſe, and mood, in which it is uſed. If to the four ſigns correſponding with the lines above mentioned, be added that of a ſubſtantive, the pupil will write the word *foi*, "faith;" but, if a ſign, indicating a participle uſed ſubſtantively, be adjoined, he will expreſs *la croyance*, "belief;" to make him write *croyable*, "credible," the four ſigns of the verb muſt be accompanied with one that indicates an adjective terminating in *able*; all theſe ſigns are rapidly made, and may be immediately comprehended.

M. Linguet, a member of the Royal Academy, having aſſerted that perſons thus inſtructed could be conſidered as little more than automata, the Abbé invited him to be preſent at his leſſons, and expreſſed his aſtoniſhment that M. Linguet ſhould be ſo prejudiced in favour of the medium by which he had received the firſt rudiments of knowledge, as to conclude that they could not be imparted by any other: deſiring him, at the ſame time, to reflect, that the connection between ideas and the articulate ſounds, by which they are excited in the mind, is not leſs arbitrary than that between theſe ideas and the written characters which are made to repreſent them to the eye. M. Linguet complied with the invitation; and the Abbé having deſired him to fix on ſome abſtract term which he would by ſigns communicate to his pupils, he choſe the word *unintelligibility*; which, to his aſtoniſhment, was almoſt inſtantly written by one of them. The Abbé informed him, that to communicate this word he had uſed five ſigns, which, though ſcarcely perceivable to him, were immediately and diſtinctly apprehended by his ſcholars: the firſt of theſe ſigns indicated an internal action; the ſecond repreſented the act of a mind that reads internally, or, in other words, comprehends what is propoſed to it; a third ſignified that ſuch a diſpoſition is poſſible; theſe, taken together, form the word *intelligible*: a fourth ſign transforms the adjective into the ſubſtantive; and a fifth, expreſſing negation, completes the word required. M. Linguet afterwards propoſed this queſtion, *What do you underſtand by metaphyſical ideas?* which being committed to writing, a young lady immediately anſwered on paper in the following terms: "I underſtand the ideas of things which are independent of our ſenſes, which are beyond the reach of our ſenſes, which make no impreſſion on our ſenſes, which cannot be perceived by our ſenſes." On reading this, we cannot help exclaiming with the poet, *Labor omnia vincit improbus!* a maxim by none more forcibly illuſtrated than by the Abbé de l'Epée.

Periodical DUMBNESS. In the German Ephemerides is an account of an innkeeper's ſon affected with a periodical dumbneſs, which had continued for 15 years. The loſs of ſpeech was at firſt inſtantaneous, and continued only a few minutes: but the duration of it began to lengthen every day; ſo that it ſoon amounted to half an hour, two hours, three hours, and at laſt to 23 hours, yet without any order. At laſt the return of ſpeech kept ſo conſtant and regular an order, that, for 14 years together, he could not ſpeak except from noon, during the ſpace of one entire hour, to the preciſe moment of one o'clock. Every time he loſt his ſpeech, he felt a ſenſe of ſomething riſing from his ſtomach to his throat, but in other reſpects was in good health. Both his internal and external ſenſes alſo continued ſound: he heard always perfectly well, and anſwered the queſtions propoſed to him by geſtures or in writing. The account ſtates, that all ſuſpicion of impoſture was removed by his keeping exactly the ſame hour, though he had no acceſs to any inſtruments by which time can be meaſured.

DUMFERMLINE, a borough of Scotland, in Fifeſhire. It is a conſiderable manufacturing town, and has a good trade in linen goods, particularly diapers. It is remarkable for its royal palace, the birth-place of Charles I. and of the princeſs Elizabeth, mother of the princeſs Sophia, great-great-grandmother of his preſent Majeſty. Adjoining to this was a magnificent abbey, part of the remains of which now ſerve for a pariſh-church. In this place were buried Malcolm and his queen, and ſeveral kings of Scotland. It is 15 miles N. W. of Edinburgh. Lon. 3. 27. W. Lat. 56. 5. N.

DUMFRIES-SHIRE, a county of Scotland, bounded on the N. by the ſhires of Lanark and Peebles, on the E. by thoſe of Selkirk and Roxburgh, on the S. by Solway Frith, and on the W. by the counties of Kirkcudbright and Ayr. It is 50 miles long, and its greateſt breadth is 30. See ANNANDALE and NITHSDALE.

DUMFRIES, the capital of a county of the ſame name, in Scotland, ſeated between two hills, on the river Nith. It is a royal borough, and a regular well-built town. Dumfries is eight miles N. of Solway Frith, and 30 W. N. W. of Carliſle. Lon. 3. 29. W. Lat. 55. 12. N.

DUMONT (Francis), a Frenchman; compiler of a general collection of treaties of commerce, alliance, and peace, between the powers of Europe. This collection, with Barbeyrac's, containing the treaties B. C. makes 16 vols. folio, very uſeful for hiſtorical writers. Dumont retired to Holland in the year 1720. The time of his death cannot with any certainty be aſcertained.

DUMOSÆ, from *dumus*, a buſh, an order of plants in the *Fragmenta methodi naturalis* of Linnæus, containing the following *genera*, viz. *Viburnum*, *Tinus*, *Opulus*, *Sambucus*, *Rondeletia*, *Bellonia*, *Caſſine*, *Ilex*, *Tomax*, &c.

DUN, or BURGH, the name of an ancient ſpecies of buildings, of a circular form, common in the Orkney and Shetland iſlands, the Hebrides, and northern parts of Scotland. See Plate 78. The latter term points out the founders, who at the ſame time beſtowed on them their natal name of *borg*, "a defence or caſtle," a Sueo Gothic word; and the Highlanders univerſally apply to theſe places the Celtic name *dun*, ſignifying a hill defended by a tower, which plainly points out their uſe. They are confined to the countries once ſubject to the crown of Norway. With few exceptions, they are built within ſight of the ſea, and one or more within ſight of the other; ſo that on a ſignal by fire, by flag, or by trumpet, they could give notice of approaching danger, and yield a mutual ſuccour. In the Shetland and Orkney iſlands, they are moſt frequently called *wart* or *wardhills*, which ſhows that they were garriſoned. They had their wardmadher, or watchman, a ſort of ſentinel, who ſtood on the top, and challenged all who came in ſight. The gackman was an officer of the ſame kind, who not only was on the watch againſt ſurpriſe, but was to give notice if he ſaw any ſhips in diſtreſs. He was allowed a large horn of generous liquor, which he had always by him, to keep up his ſpirits. Along the Orkney and Shetland ſhores, they almoſt form a chain; and by that means not only kept the natives in ſubjection, but were ſituated commodiouſly for covering the landing of their countrymen, who were perpetually roving on piratical expeditions. Theſe towers were even made uſe of as ſtate-priſons; for we learn from Torfæus, that after Sueno had ſurpriſed Paul, count of Caithneſs, he carried him into Sutherland, and confined him there in a Norwegian tower. Out of our own kingdom, no buildings ſimilar to theſe are to be found, except in Scandinavia. On the mountain Swalberg in Norway is one; the Stir-biſkop, at Upſal in Sweden, is another; and at Umſeborg, in the ſame kingdom, there is a third.

Theſe towers vary in their inner ſtructure; but externally are univerſally the ſame; yet ſome have an addition of ſtrength on the outſide. The burgh of Culſwick in Shetland, notwithſtanding it is built on the top of a hill, is ſurrounded with a dry ditch 13 feet broad; that of Snaburgh in Unſt, has both a wet and a dry ditch; the firſt cut, with great labour.

through the live rock. The burgh of Moura is furrounded by a wall, now reduced to a heap of ftones; and the infide is cylindrical, not taper, as ufual with others. The burgh of Hogfcter, upon an ifle in a loch of the fame name, has alfo its addition of a wall; a peculiarity in a caufeway, to join it to the main land, and a fingular internal ftructure. Numbers of little burghs, with fingle cells, are fcattered about thefe iflands, in the neighbourhood of the greater; and which probably were built by the poorer fort of people, in order to enjoy their protection. A multitude of places in thefe iflands have the addition of burgh to their names, notwithftanding there is not a veftige of a tower near them; the materials having long fince been carried away, and applied to various ufes.

DUNALD-MILL-HOLE, five miles from Lancafter, a great natural curiofity, being a cave at the foot of a mountain, into which a large brook runs, after it has driven a mill near the entrance. It continues its courfe about two miles under ground, and then appears at Carnford, a village in the road to Kendal. The entrance is a rugged paffage from the mill, that defcends about ten yards perpendicular, through chinks in the rocks, and clumps of trees. Some of the vaults are fo high, that they refemble the roof of a church; and in other parts fo low, that you muft creep on your hands and feet to pafs by. The water dropping from the rocks has an awful and pleafing found.

DUNBAR, a royal borough of Scotland, in Haddingtonfhire, feated near the German ocean, where there is a good harbour, which was formerly defended by a caftle built on a rock, whofe ruins are ftill remaining. It is a well-built town, and has an extenfive fifh trade. Under the rock, on which the caftle ftands, are two natural arches, through which the tide flows. Between the harbour and the caftle, is a ftratum of vaft bafaltic columns of red grit ftone. Dunbar is remarkable for the defeat of John Baliol's army by earl Warrenne, in 1296, and for a victory gained here by Cromwell over the Scots in 1650. It is 25 miles E. of Edinburgh. Lon. 2. 34. W. Lat. 56. 0. N.

DUNBARTON, the chief town of Lenox or Dunbartonfhire in Scotland, fituated in W. long. 4. 32. N. lat. 56. 30. It is remarkable for nothing but its caftle, which is a fteep rock, rifing up in two points, and every where inacceffible, except by a very narrow paffage or entry, fortified with a ftrong wall or rampart. It is a royal borough; and formerly gave title of Earl to a branch of the family of Douglas.

DUNCANNON, a fort in the county of Wexford, and province of Leinfter, in Ireland, feated on the river Rofs. It commands the river, infomuch that no fhip can pafs to Waterford or Rofs without its permiffion. Here are barracks for three companies of foot. W. long. 6. 30. N. lat. 52. 10.

DUNCARDS, Dunkers, or *Tunkers*. See Tunkers.

DUNCOMBE (William), younger fon of John Duncombe, Efq. of Stocks in Hertfordfhire, in 1722 publifhed a tranflation of Racine's Athalia; which was well received by the public, and has gone through three editions. In 1724 he was editor of the works of Mr. Needler; in 1735, of the poems of his deceafed brother-in-law, Mr. Hughes, 2 vols. 12mo; in 1737, of the mifcellanies of his younger brother Mr. Jabez Hughes, for the benefit of his widow, in one volume 8vo; and in 1745, of the works of the Rev. Mr. Samuel Say, in one volume 4to. In 1726 he married the only fifter of John Hughes, Efq. whom he long furvived. In 1734 his tragedy of Lucius Junius Brutus was acted at Drury-lane theatre. It was publifhed in 1735, and again in 1747. The works of Horace, in Englifh verfe, by feveral hands, were publifhed by him in two vols. 8vo, with notes, &c. in 1757. A fecond edition, in four vols. 12mo, with many imitations, was publifhed in 1762. In 1763 he collected and republifhed "Seven fermons by archbifhop Herring, on public occafions, with a biographical preface." He died February 26, 1769, aged 80.

DUNDALK, a town of Ireland, in the county of Louth, about 40 miles from Dublin. It is a large, ancient, and thriving town, with a wide ftreet, near a mile long, and a very fine market-houfe, near the entrance from Dublin. In the reign of Edward II. it was a royal city, and the laft we read of where a monarch of all Ireland was actually crowned and refided. It was formerly very ftrong, and had many towers and fmall caftles in it. It is very advantageoufly fituated for a moft extenfive inland trade, and the port is very fafe for fhipping. The bay has good moorings at all times, in from four to upwards of eight fathoms water, with very good land-marks, either for bringing up to, or making the harbour; and in croffing the bar at high water or ordinary neap-tides, there is from 15 to 18 feet water. The only cambric manufacture in Ireland is carried on in this town.

DUNDEE, a royal borough of Scotland, in the fhire of Angus. It is a large and flourifhing town, with an excellent harbour. The new church and the town-houfe are elegant ftructures. The lofty Gothic fquare tower, in the middle of the town, is part of a magnificent confecrated edifice, built in the 12th century. The chief manufactures of Dundee are glafs, ofnaburghs or coarfe linen, fail-cloth, cordage, coloured and white thread, buckram, tanned leather, fhoes, and hats. There is alfo a fugar-houfe here, and the inhabitants are computed at 16,000. Dundee is feated on the N. fide of the frith of Tay, 14 miles N. W. of St. Andrew's. Lon. 2. 55. W. Lat. 56. 30. N. Dundee is the birth-place of the celebrated and learned Hector Boethius, whofe Hiftory of Scotland has been long in much reputation with many. It, with Perth, Forfar, St. Andrew's, and Cupar, returns one member to the Britifh parliament.

DUNFERMLINE. See Dumfermline.

DUNG, in hufbandry. See Husbandry.

Dung-*Bird*. See Upupa.

Dung *Meers*, in hufbandry, places where foils and dungs are mixed and digefted together. Thefe are a kind of pits, prepared at the bottom with ftone and clay, that they may hold water, or the moifture of the dung; and ought to be fo fituated, that the finks and drips of the houfes and barns may run into them. Into thefe pits they caft refufe, fodder, litter, dung, weeds, &c. where they lie and rot together, till the farmer have occafion for them.

Dung *Worms*, a fpecies of fly-worms of a fhort and fomewhat flat body, found in great plenty among cow-dung in the months of September and October.

DUNGANNON, the chief town of the county of Tyrone, in the province of Ulfter in Ireland. It is feated on a hill, and is a place of fome ftrength. 11 miles N. N. W. of Armagh. Lon. 6. 39. W. Lat. 54. 38. N.

DUNGARVON, a town of Ireland, in the county of Waterford. It ftands on a bay of the fame name, has a commodious harbour for fhips, and is a walled town with a caftle. W. long. 7. 55. N. lat. 51. 57.

DUNIPACE. See the article Carron.

DUNKELD, a town of Scotland, in the fhire of Perth, fituated amid vaft rocks, partly naked, and partly wooded, under which the Tay rolls in its majeftic ftream. Its romantic fituation, and the benefit of drinking goats whey, render this place the refort of much genteel company in the fummer feafon. Dunkeld is the market town of the Highlands on that fide, and carries on a manufacture of linen. The duke of Athol has a fine feat here, in a beautiful valley, fcreened by the Grampian mountains. The ruins of a cathedral, almoft

concealed by wood, ſtand near the houſe. Part of this ancient ſtructure is now the pariſh church. Dunkeld is 12 miles N. of Perth. Lon. 3. 36. W. Lat. 56. 35. N.

DUNKERS, Duncards, or *Tunkers*. See Tunkers.

DUNKIRK, a conſiderable town of France, in the department of the North and late French Flanders. It was taken from the Spaniards by the Engliſh and French in 1658, and put into the hands of the Engliſh, but ſold to the French by Charles II. in 1662. Lewis XIV. ſoon made it one of the moſt reſpectable and beſt fortified ports in the kingdom. But all theſe vaſt and expenſive works were demoliſhed, and the baſins filled up, in conſequence of the treaty of Utrecht in 1713. The French afterward reſumed the works; but they were ordered to be demoliſhed by the peace of 1763, when it was ſtipulated that an Engliſh commiſſary ſhould reſide at Dunkirk, in order to ſee that the terms of the treaty were ſtrictly adhered to. But, by the peace of 1783, the Engliſh commiſſary was withdrawn, and the French were left to reſume the works. The Engliſh laid ſiege to this place, in 1793, but were obliged, by a ſuperior army, to abandon it. It is 22 miles S. W. of Oſtend. Lon. 2. 28. E. Lat. 51. 2. N.

DUNSE, a market-town of Scotland, in the ſhire of Mers, ſituated in W. lon. 2. 15. N. lat. 55. 42.

DUN-LE-ROI, a ſmall town of France, in the department of Cher and late province of Berry, 20 miles S. of Bourges. Lon. 2. 29. E. Lat. 46. 45. N.

DUNMOW, Great, a town of Eſſex, with a market on Saturday. It has a manufactory of bays, and is 13 miles N. of Chelmsford, and 40 N. E. of London. Lon. 0. 24. E. Lat. 51. 54. N.

DUNMOW, Little, a village in Eſſex, adjoining to Great Dunmow. It had once a priory; and is ſtill famous for the cuſtom inſtituted in the reign of Henry III. by Robert de Fitzwalter, and now the tenure of the manor; namely, that whatever married couple will go to the priory, and ſwear, kneeling upon two ſharp-pointed ſtones in the church, that they had not quarrelled, nor repented of their marriage, within a year and a day after it took place, ſhall receive from the lord of the manor a flitch of bacon. Some old records mention ſeveral that have claimed and received it. It has been actually received ſo lately as ſince the year 1750, by a weaver and his wife, of Coggieſhal, in Eſſex. It has been *demanded* more recently ſtill; but the ceremony being attended with a very great expence to the lord of the manor, the demand is now evaded.

DUNS (John), commonly called Duns Scotus, was a celebrated theologian of the order of St. Francis, and born in England, at Dunſtance in Northumberland. He was ſent to Merton-Hall in Oxford, and choſen fellow of it. Then he went to Paris, and joined himſelf to the ſociety of the Franciſcans; where he diſtinguiſhed himſelf ſo much by the acuteneſs of his parts, and eſpecially by his manner of diſputing, that he acquired the name of "The Subtil Doctor." He affected to maintain opinions contrary to thoſe of Thomas Aquinas, which produced two parties in the ſchools, the Thomiſts and the Scotiſts. He was a writer of prodigious ſubtilty; and, like all ſubtil writers, refined upon every ſubject he handled, till it had no meaning at all left in it. The beſt edition of his works is that of Lyons, printed in 1639, in ten volumes folio. They are now waſte paper. Some have ſaid, that Duns Scotus was the firſt who taught, in the univerſity of Paris, "the immaculate conception of the bleſſed Virgin:" but this is not true. He went afterwards to Cologne, where he died in 1308. Paul Jovius and others have told a terrible ſtory relating to the manner of his death. They ſay, that, falling down of an apoplexy, he was immediately interred as dead; but that, coming afterwards to his ſenſes, he languiſhed in a moſt miſerable manner in his coffin, beating his head and hands againſt its ſides, till he died in good earneſt.

DUNSTABLE, a town of Bedfordſhire, with a market on Wedneſday. It is ſeated on a hill, on a dry chalky ground. It has four ſtreets, which regard the four cardinal points. The church is the remainder of a priory, and oppoſite to it is a farmhouſe, once a royal palace. Dunſtable is famous for the elegant baſkets, &c. made of ſtraw, which are even an article of exportation. It is 17 miles S. of Bedford, and 34 N. W. of London. Lon. 0. 29. W. Lat. 51. 59. N.

DUNSTAFFNAGE, a venerable caſtle of Scotland, in the ſhire of Argyle, formerly a royal palace, and afterward the ſeat of the lord of the iſles. It lies near Loch Etive.

DUNSTAN, a famous ſaint, and archbiſhop of Canterbury; of whoſe ſingular conteſts with the devil the monkiſh hiſtorians give us a very ridiculous account. Among other curious things ſaid of this good prelate, it is aſſerted that he retired to a little cell built againſt the church-wall of Glaſtonbury, where he ſlept, ſtudied, prayed, meditated, and ſometimes amuſed himſelf with forging uſeful things in braſs and iron. One evening, as he was working very buſily at his forge, the devil, putting on the appearance of a man, thruſt his head in at the window of his cell, and aſked him to make ſomething or other for him. Dunſtan was ſo intent upon his work that he made no anſwer; on which the devil began to ſwear and talk obſcenely, which betrayed the lurking fiend. The holy blackſmith, putting up a ſecret ejaculation, pulled his tongs, which were red-hot, out of the fire, ſeized the devil with them by the noſe, and ſqueezed him with all his ſtrength; which made his infernal majeſty roar and ſcold at ſuch a rate, that he awakened and terrified all the people for many miles around. Thus far the legend. Ridiculous as were theſe fictions, they ſerved, in thoſe times of ignorance, to procure Dunſtan a reputation which has been confirmed by the authority of ſeveral ſucceeding hiſtorians. It appears that this extraordinary perſon died A. D. 988, in the 64th year of his age, after having held the biſhopric of London, together with the archbiſhopric of Canterbury, about 27 years. As this prelate was the great reſtorer and promoter of the monaſtic inſtitutions, the grateful monks, who were almoſt the only hiſtorians of thoſe dark ages, have loaded him with the moſt extravagant praiſes, and repreſented him as the greateſt wonder-worker and higheſt favourite of heaven that ever lived.

DUNUM, a Celtic term, denoting a hill or eminence, and which often concurs to form the names of towns, to ſignify their high ſituation, places of ſtrength or citadels, hills or eminences, being adapted to ſuch ſtructures. See Dun.

DUO, in muſic, a ſong or compoſition, to be performed in two parts only, one ſung, the other played on an inſtrument, or by two voices. *Duo* is alſo when two voices ſing different parts, as accompanied with a third, which is a thorough baſs. It is ſeldom that uniſons and octaves are uſed in duos, except at the beginning and end.

DUODECIMA, in muſic, is the twelfth or the fifth doubled.

DUODENUM. See Anatomy, p. 189.

DUPIN (Lewis Ellis), a learned doctor of the Sorbonne, and one of the greateſt critics of his time, eſpecially in eccleſiaſtical matters, was born at Paris in 1657. When he publiſhed the firſt volume of his *Bibliotheque Univerſelle des Auteurs Eccleſiaſtiques*, in 1686, the liberty with which he treated ſome eccleſiaſtical writers gave ſuch offence, that M. de Harlay, archbiſhop of Paris, obliged Dupin to retract many propoſitions, and ſuppreſſed the work. He was nevertheleſs ſuffered to continue it, by altering the title from *Bibliotheque Univerſelle*

to *Bibliotheque Nouvelle*. This great undertaking, continued in ſeveral ſucceſſive volumes, though ſufficient to occupy the life of an ordinary man, did not hinder M. Dupin from obliging the world with ſeveral other works. He was a man of prodigious reading; and had an eaſy happy way of writing, with an uncommon talent for analyſing the works of an author; which makes his Eccleſiaſtical Bibliotheque ſo valuable. M. Dupin was profeſſor of philoſophy in the royal college; but was baniſhed ſome time from the chair to Chatellerault, on account of the famous *Cas de Conſcience*; but was reſtored, and died in 1719.

DUPLE, among mathematicians, denotes the ratio of 2 to 1. Thus the ratio of 8 to 4 is duple, or as 2 to 1.

Sub-Duple *Ratio*, is juſt the reverſe of the former, or as 1 to 2. Such is 4 to 8, or 6 to 12.

DUPLICATE, among lawyers, denotes a copy of any deed, writing, or account. It is alſo uſed for the ſecond letters-patent, granted by the lord chancellor in a caſe wherein he had before done the ſame. Alſo a ſecond letter written and ſent to the ſame party and purpoſe as a former, for fear of the firſt's miſcarrying, is called a *duplicate*.

Duplicate *Proportion* or *Ratio*. See Ratio.

DUPLICATION, in general, ſignifies the doubling of any thing, or multiplying of it by 2: alſo the folding of any thing back again on itſelf.

DUPLICATURE, among anatomiſts, a term uſed to denote the folds of any membrane or veſſel: thus we ſay, the *duplicatures of the inteſtines*, *peritonæum*, &c.

DUPONDIUS, in antiquity, a weight of two pounds, or a money of the value of two aſſes. See As. As the *as* at firſt weighed a juſt pondo or libra, the dupondius then weighed two; and hence the name. And though the weight of the *as* was afterwards diminiſhed, and of conſequence that of the dupondius alſo, yet they ſtill retained the denomination. See Pound and Libra.

DUPPA (Brian), a learned Engliſh biſhop, born in 1589 at Lewiſham in Kent, of which place his father was then vicar. In 1634 he was inſtituted chancellor of the church at Sarum, and ſoon after made chaplain to Charles I. He was appointed tutor to Charles prince of Wales, and his brother James duke of York; was made biſhop of Chicheſter; and in 1641 tranſlated to Saliſbury, though the confuſions that followed deprived him of all benefit from his promotion. Charles I. held him in high eſteem, and he is ſaid to have aſſiſted the king in compoſing the *Eikon Baſilike*. On the Reſtoration he was made biſhop of Wincheſter, and lord high almoner; but died in 1662. He bequeathed large ſums to charitable purpoſes: and publiſhed a few ſermons, with other religious pieces.

DURANDUS (William), born at Puimoiſſon in Provence, in the 13th century, was one of the moſt knowing lawyers of his time. Pope Martin made him one of his nuncios, and then biſhop of Mende and Languedoc. His *Speculum Juris* gave him the name of *Speculator*; his ſecond piece was *Rationale divinorum officiorum*, containing eight books. He wrote ſeveral others.

DURANTA, in botany; a genus of the angioſpermia order, belonging to the didynamia claſs of plants; and in the natural method ranking under the 40th order, *Perſonatæ*. The calyx is quinquefid, ſuperior; the berry tetraſpermous; the ſeeds bilocular.

DURATION, an idea we get by attending to the fleeting and perpetual periſhing parts of ſucceſſion. See Metaphysics.

Duration, as marked by certain periods and meaſures, is what we moſt properly call *time*. See Time.

Duration *of Action*, according to Ariſtotle, is confined to a natural day in tragedy; but the epopea, according to the ſame critic, has no fixed time. See Poetry.

DURER (Albert), deſcended of an Hungarian family, and born at Nuremberg in 1471, was one of the beſt engravers and painters of his age. He was at the ſame time a man of letters and a philoſopher; and he was an intimate friend of Eraſmus, who reviſed ſome of the pieces which he publiſhed. He was a man of buſineſs alſo, and for many years the leading magiſtrate of Nuremberg. Though not the inventor, he was one of the firſt improvers of the art of engraving; and he bethought himſelf of working alſo in wood, for expedition, having an inexhauſtible fund of deſigns. In many of thoſe prints which he executed on copper, the engraving is elegant to a great degree. His *Hell-Scene* particularly, which was engraved in the year 1513, is as highly finiſhed a print as ever was engraved, and as happily executed. In his wooden prints too we are ſurpriſed to ſee ſo much meaning in ſo early a maſter; the heads ſo well marked, and every part ſo well executed. This artiſt ſeems to have underſtood the principles of deſign. His compoſition, too, is often pleaſing; and his drawing generally good. But he knows very little of the management of light; and ſtill leſs of grace: and yet his ideas are purer and more elegant than we could have ſuppoſed from the awkward archetypes which his country and education afforded. In a word, he was certainly a man of a very extenſive genius; and, as Vaſari remarks, would have been an extraordinary artiſt, if he had had an Italian inſtead of a German education. His prints are very numerous. They were much admired in his own life-time, and eagerly bought up; which put his wife, who was a teaſing woman, upon urging him to ſpend more time upon engraving than he was inclined to do. He was rich; and choſe rather to practiſe his art as an amuſement than as a buſineſs. He died in the year 1527.

DURESSE, hardship, in law, is where a perſon is kept in priſon or reſtrained of his liberty, contrary to order of law; or is threatened to be killed, maimed, or beaten. In which caſe, if a perſon ſo in priſon, or in fear of ſuch threats, make any ſpecialty or obligation, by reaſon of ſuch impriſonment or threats, ſuch deed is void in law; and in an action brought on ſuch ſpecialty, the party may plead that it was brought by dureſſe.

D'URFEY (Thomas), an eminent Engliſh ſatiriſt and ſongſter, whoſe name though as well known as that of any writer extant, yet there are very few particulars of his life to be collected. He was born in Devonſhire; but when, where, or of what family, are all uncertain. He was bred to the law, which he forſook for the more agreeable employment of writing plays and ſongs; and the latter he had ſo happy a talent both of writing and ſinging, that he received many favours from perſons of quality on that account. Even crowned heads did not diſdain his company. The writer of the Guardian, No. 67. tells us, he remembered to have ſeen Charles II. leaning on Tom D'Urfey's ſhoulder more than once, humming over a ſong with him. This indeed was not extraordinary in ſo merry a monarch; but even the phlegmatic king William could relax his muſcles on hearing him ſing. He was certainly by all accounts a cheerful, honeſt, good-natured man; but as this character does not include prudence, D'Urfey grew poor as he grew old; and prevailing on the managers of the playhouſe to act his comedy of the *Plotting Siſters* for his benefit, Mr. Addiſon wrote the abovementioned paper in the Guardian, with another, No. 82. repreſenting him in a good-humoured light, to procure him a full houſe. He died very old, in 1723.

DURHAM, a county of England, commonly called the biſhopric of Durham, bounded on the N. by Northumberland, from which it is ſeparated on the N. E. by the river Tyne; on the E. by the German Ocean; on the S. and S. W. by Yorkſhire and the river Tees; and on the W. by Weſtmorland and Cumberland. It extends 37 miles from N. to S.

and 47 from E. to W. It is ſituated in the dioceſe of its own name, and contains one city, ſeven market-towns, and 113 pariſhes, but ſends only four members to parliament. The air is wholeſome, and though very ſharp in the weſtern parts, is milder toward the ſea, whoſe warm vapours mitigate the ſeverity of the winter ſeaſons. The ſoil is very various; the weſtern ſide being mountainous and barren, while the eaſtern and ſouthern particularly reſemble the S. of England, and conſiſt of beautiful meadows, rich paſtures, woods, and corn-fields. Immenſe quantities of coal, lead, and iron, are found in the bowels of the earth. The principal rivers are the Were, Tees, Tyne, and Derwent.

Durham, the capital of the biſhopric of Durham, with a market on Saturday. It is a biſhop's ſee, and a conſiderable place, irregularly built on a beautiful winding of the Were, whoſe banks are covered with woods, and edged with lofty crags. Its cathedral is a large and magnificent edifice. The buildings of the city, in general, are old. It has two ſtone bridges over the Were, is ſurrounded by a wall, and has a caſtle, now the biſhop's palace, ſeated on the higheſt part of the hill. It contains ſix pariſh churches, beſide the cathedral, and is well inhabited. Durham has a manufactory of ſhalloons, tammies, and calamancoes. Around it are grown large quantities of the beſt muſtard. Nevil's Croſs, near this city, was erected in memory of the great victory obtained by queen Philippa, in 1346, over David Bruce, king of Scotland, who was taken priſoner in this battle. Durham ſends two members to parliament; is 14 miles S. of Newcaſtle, and 257 N. by W. of London. Lon. 1. 27. W. Lat. 54. 50. N.

The city conſiſts of three manors; the biſhop's manor containing the city liberties and the bailey, held of him by the ſervice of caſtle-guard: the manor of the dean and chapter, conſiſting of the Elvet's croſs gate, ſouth-gate ſtreet; and the manor of Gilligate, formerly belonging to the diſſolved hoſpital of Kepyar in this neighbourhood, but granted by Edward VI. to John Cockburn, lord of Ormiſtoun, and late in the poſſeſſion of John Tempeſt, Eſq.

The biſhopric of Durham is deemed the richeſt biſhopric in the kingdom; and the prebends are frequently ſtyled the Golden Prebends of Durham. The dioceſe contains the whole counties of Durham and Northumberland, except the juriſdiction of Hexham in the latter. It hath alſo one pariſh in the county of Cumberland: making in the whole 135 pariſhes, whereof 87 are impropriate. The ſee is valued in the king's books at L. 2821 : 1 : 5¼, but is computed to be worth annually L. 8700. The clergy's tenths amount to L. 385 : 5 : 6½. It has two archdeacons, viz. of Durham and Northumberland. This ſee hath given to the church of Rome eight ſaints and one cardinal; and to the Engliſh nation one lord chief juſtice, five lord chancellors, three lord treaſurers, one principal ſecretary of ſtate, one chancellor to the univerſity of Oxford, and two maſters of the rolls.

DURIO, in botany; a genus of the polyandria order, belonging to the polyadelphia claſs of plants. The calyx is a monophyllous perianthium; the corolla has five petals growing to the calyx; the ſtamina are conjoined in five bodies; the germ is roundiſh; the ſtyle briſtly, the length of the ſtamina. The fruit is a roundiſh apple every where muricated; the ſeeds have a mucous orilla.

DUROBRIVÆ, or *Durocobrivæ*, a town of the Trinobante, in Britain; whoſe ruins are ſituated between Flamſtead and Redburn, in Hertfordſhire.

DUROBRIVIS, 25 miles to the weſt of Durovernum, or Canterbury; from which it appears to be Rocheſter town, confirmed by the charter of foundation of the church, in which it is called *Durobrevis*.

DUROIA, in botany; a genus of the monogynia order, belonging to the hexandria claſs of plants. The calyx above is cylindrical and lobed; the border ſix-parted; there are no filaments; the fruit a hiſpid apple.

DUROTRIGES, an ancient Britiſh nation, ſeated in that part of the country which is now called *Dorſetſhire*. Their name is derived from the two Britiſh words *Dur* "water," and *Trigo* "to dwell;" and it is no leſs evident that they got their name from the ſituation of their country, which lies along the ſea-coaſt. It is not very certain whether the Durotriges formed an independent ſtate under a prince of their own, or were united with their neighbours the Danmonii; as they were reduced by Veſpaſian under the dominion of the Romans, at the ſame time, and with the ſame eaſe, and never revolted. The peaceable diſpoſition of the inhabitants was probably the reaſon that the Romans had ſo few towns, forts, and garriſons, in this pleaſant country. Dorcheſter, its preſent capital, ſeems to have been a Roman city of ſome conſideration, though our antiquaries are not agreed about its Roman name. It is moſt probable that it was the Durnovaria in the 12th Iter of Antoninus. Many Roman coins have been found at Dorcheſter; the military way, called *Jeening-Street*, paſſed through it; and ſome veſtiges of the ancient ſtone wall with which it was ſurrounded, and of the amphitheatre with which it was adorned, are ſtill viſible. The country of the Durotriges was included in the Roman province called *Flavia Cæſarienſis*, and governed by the preſident of that province, as long as the Romans kept any footing in theſe parts.

DURY (John), in latin Duræus, a divine of Scotland, who laboured with great zeal to re-unite the Lutherans and Calviniſts. His ſtrong inclination for this great work, and his ſanguine hopes of ſucceſs in it, induced him to let his ſuperiors know, that he could employ his talents better by travelling through the world, than if he was confined to the care of one flock. They agreed to his propoſals, and permitted him to go from place to place, to negotiate an accommodation between the Proteſtant churches. He obtained likewiſe the approbation and recommendation of the archbiſhop of Canterbury; and was aſſiſted by the biſhop of Kilmore, and alſo by Dr. Joſeph Hall, biſhop of Exeter, as he acknowledges in the preface to his "Prodromus." He began by publiſhing his plan of a re-union in 1634; and the ſame year appeared at a famous aſſembly of the Evangelics in Germany at Frankfort. The ſame year alſo the churches of Tranſylvania ſent him their advice and counſel. Afterwards he negotiated with the divines of Sweden and Denmark: he turned himſelf every way; he conſulted the univerſities; he communicated their anſwers, and was not deterred by the unſucceſsfulneſs of his pains, even in 1661. He appeared at that time as much poſſeſſed as ever with hopes of ſucceeding; and, going for Germany, deſired of the divines of Utrecht an authentic teſtimony of their good intentions, after having informed them of the ſtate in which he had left the affair with the king of Great-Britain and the elector of Brandenburg; and of what had paſſed at the court of Heſſe, and the meaſures which were actually taken at Geneva, Heidelberg, and Metz. He deſired to have this teſtimonial of the divines of Utrecht, in order to ſhew it to the Germans: he obtained it, and annexed it to the end of a Latin work, which he publiſhed this year at Amſterdam, October 1, 1661.

Being at Frankfort in April 1662, he declared to ſome gentlemen at Metz, that he longed extremely to ſee monſieur Ferri. He reſolved at length to go to Metz, but he met with two difficulties: the firſt was, that he muſt conſent to dreſs after the French faſhion, like a countryman; the ſecond, to have his great white and ſquare beard ſhaved. He got theſe difficulties over, and went: and, upon his arrival, monſieur Ferri was ſo ſurpriſed, ſo overjoyed, and ſo very eager to ſalute

this good doctor and fellow-labourer immediately, that he forgot to tie the ſtrings of his breeches, and went out half dreſſed. They conferred much; and their ſubject was a coalition of religions. However, in 1674, Dury began to be much diſcouraged; nor had he any longer hopes of ſerving the church, by the methods he had hitherto taken. He had therefore recourſe to another expedient, as a ſure means of reuniting not only Lutherans and Calviniſts, but all Chriſtians; and this was, by labouring a new explication of the Apocalypſe. Accordingly he publiſhed at Francfort a little treatiſe in French, in 1674, intitled, "Of underſtanding the Apocalypſe by itſelf, as all the Holy Scriptures ought reaſonably to be underſtood." He enjoyed then a quiet retreat in the country of Heſſe: where Hedwige Sophia, princeſs of Heſſe, who had the regency of the country, had aſſigned him a very commodious quarter, with a table well furniſhed, and had given him free poſtage for his letters. It is not known in what year he died. He was an honeſt man, full of zeal and piety, but became at laſt ſomewhat fanatical. The letter which he wrote to Peter du Moulin, "concerning the ſtate of the churches of England, Scotland, and Ireland, under Cromwell," was printed with ſome other pieces at London in 1658, in 12mo. by the care of Lewis du Moulin; and is curious.

DUSSELDORP, a city of Weſtphalia in Germany, and capital of the duchy of Berg. It is ſituated at the conflux of the river Duſſel with the Rhine, in E. long. 6. 20. N. lat. 51. 15.

DUTY, in general, denotes any thing that one is obliged to perform. For Duty, in a moral ſenſe, ſee Moral *Philoſophy*.

Duty, in polity and commerce, ſignifies the impoſt laid on merchandizes, at importation or exportation, commonly called the duties of cuſtoms; alſo the taxes of exciſe, ſtamp-duties, &c. See Customs, Excise, &c. The principle on which all duties and cuſtoms ſhould be laid on foreign merchandizes which are imported into theſe kingdoms, are ſuch as tend to cement a mutual friendſhip and traffic between one nation and another; and therefore due care ſhould be taken in the laying of them, that they may anſwer ſo good an end, and be reciprocal in both countries: they ſhould be ſo laid as to make the exports of this nation at leaſt equal to our imports from thoſe nations wherewith we trade, ſo that a balance in money ſhould not be iſſued out of Great Britain, to pay for the goods and merchandizes of other countries; to the end that no greater number of our landholders and manufacturers ſhould be deprived of their revenues ariſing from the product of the lands, and the labour of the people, by foreign importations, than are maintained by exportations to ſuch countries. Theſe are the national principles on which all our treaties of commerce with other countries ought to be grounded.

Duty, in the military art, is the exerciſe of thoſe functions that belong to a ſoldier: with this diſtinction, that mounting guard and the like, where there is no enemy directly to be engaged, is called duty; but their marching to meet and fight an enemy is called going on ſervice.

DUUMVIRATE, the office or dignity of the duumviri. The duumvirate laſted till the year of Rome 388, when it was changed into a decemvirate.

DUUMVIRI, in Roman antiquity, a general appellation given to magiſtrates, commiſſioners, and officers, where two were joined together in the ſame functions.

Duumviri *Capitales* were the judges in criminal cauſes: from their ſentence it was lawful to appeal to the people, who only had the power of condemning a citizen to death. Theſe judges were taken from the body of the decuriones; they had great power and authority, were members of the public council, and had two lictors to walk before them.

Duumviri *Municipales*, were two magiſtrates in ſome cities of the empire, anſwering to what the conſuls were at Rome: they were choſen out of the body of the decuriones; their office laſted commonly five years, upon which account they were frequently termed *quinquinales magiſtratus*. Their juriſdiction was of great extent: they had officers who walked before them, carrying a ſmall ſwitch in their hands; and ſome of them aſſumed the privilege of having lictors, carrying axes and the faſces, or bundles of rods, before them.

Duumviri *Navales*, were the commiſſaries of the fleet, firſt created at the requeſt of M. Decius, tribune of the people, in the time of the war with the Samnites. The duty of their office conſiſted in giving orders for the fitting of ſhips, and giving their commiſſions to the marine officers, &c.

Duumviri *Sacrorum*, were magiſtrates created by Tarquinius Superbus, for the performance of the ſacrifices, and keeping of the Sibyls books. They were choſen from among the patricians, and held their office for life: they were exempted from ſerving in the wars, and from the offices impoſed on the other citizens, and without them the oracles of the Sibyls could not be conſulted.

DUYVELAND, or Diveland, one of the iſlands of Zealand, in the United Provinces, lying eaſtward of Schonen, from which it is only ſeparated by a narrow channel.

DWAL, in heraldry, the herb nightſhade, uſed by ſuch as blazon with flowers and herbs, inſtead of metals and colours, for ſable or black.

DWARF, in general, an appellation given to things greatly inferior in ſize to that which is uſual in their ſeveral kinds: thus there are dwarfs of the human ſpecies, dwarf-dogs, dwarf-trees, &c. The Romans were paſſionately fond of dwarfs, whom they called *nani* or *nanæ*, inſomuch that they often uſed artificial methods to prevent the growth of boys deſigned for dwarfs, by incloſing them in boxes, or by the uſe of tight bandages. Auguſtus's niece, Julia, was extremely fond of a dwarf called *Sonopas*, who was only two feet and an hand-breadth high. We have many other accounts of human dwarfs, but moſt of them deformed in ſome way or other beſides the ſmallneſs of their ſize. Many relations alſo concerning dwarfs we muſt neceſſarily look upon to be fabulous, as well as thoſe concerning giants. The following hiſtory, however, which we have reaſon to look upon as authentic, is too remarkable not to be acceptable to the generality of our readers.

Jeffery Hudſon, the famous Engliſh dwarf, was born at Oakham in Rutlandſhire in 1619; and about the age of ſeven or eight, being then but 18 inches high, was retained in the ſervice of the duke of Buckingham, who reſided at Burleigh on the Hill. Soon after the marriage of Charles I. the king and queen being entertained at Burleigh, little Jeffery was ſerved up to table in a cold pye, and preſented by the ducheſs to the queen, who kept him as her dwarf. From 7 years of age till 30 he never grew taller; but after 30 he ſhot up to three feet nine inches, and there fixed. Jeffery became a conſiderable part of the entertainment of the court. Sir William Davenant wrote a poem called *Jeffreidos*, on a battle between him and a turkey-cock; and in 1638 was publiſhed a very ſmall book, called the *New Year's Gift*, preſented at court by the lady Parvula to the lord Minimus (commonly called *Little Jeffery*) her majeſty's ſervant, &c. written by Microphilus, with a little print of Jeffery prefixed. Before this period, Jeffery was ſent to France to fetch a midwife for the queen; and on his return, brought many rich preſents to the queen from her mother Mary de Medicis, but was taken by the Dunkirkers. Jeffery, thus made of conſequence, grew to think himſelf really ſo. He had borne with little temper the teaſing of the courtiers and domeſtics, and had many ſquabbles with the king's gigantic porter. At laſt, being provoked by Mr.

Crofts, a young gentleman of family, a challenge enſued: and Mr. Crofts coming to the rendezvous armed only with a ſquirt, the little creature was ſo enraged, that a real duel enſued; and the appointment being on horſeback with piſtols, to put them more on a level, Jeffery, with the firſt fire, ſhot his antagoniſt dead. This happened in France, whither he had attended his miſtreſs in the troubles. He was again taken priſoner by a Turkiſh rover, and ſold into Barbary. He probably did not remain long in ſlavery: for at the beginning of the civil war, he was made a captain in the royal army; and in 1644 attended the queen to France, where he remained till the Reſtoration. At laſt, upon ſuſpicion of his being privy to the Popiſh plot, he was taken up in 1682, and confined in the Gatehouſe, Weſtminſter, where he ended his life, in the 63d year of his age.

In the Memoirs of the Royal Academy of Sciences, a relation is given by the Count de Treſſau, of a dwarf called *Bebe*, kept by the late Staniſlaus king of Poland, and who died in 1764 at the age of 23, when he meaſured only 33 inches. At the time of his birth, he meaſured only between eight and nine inches. Diminutive as were his dimenſions, his reaſoning faculties were not leſs ſcanty; appearing indeed not to have been ſuperior to thoſe of a well-taught pointer. But that the ſize and ſtrength of the intellectual powers are not affected by the diminutiveneſs or tenuity of the corporeal organs, is evident from a ſtill more ſtriking inſtance of littleneſs, given us by the ſame nobleman, in the perſon of Monſieur Borulawſki, a Poliſh gentleman, whom he ſaw at Luneville, who has ſince been at Paris and London, and who at the age of 22 meaſured only 28 inches. This miniature of a man, conſidering him only as to his bodily dimenſions, was a giant with regard to his mental powers and attainments. He is deſcribed by the count as poſſeſſing all the graces of wit, united with a ſound judgment and an excellent memory; ſo that we may with juſtice ſay of M. Borulawſki, in the words of Seneca, and nearly in the order in which he has uſed them, "*Poſſe ingenium fortiſſimum ac beatiſſimum ſub quolibet corpuſculo latere.*"

DWINA, the name of two large rivers; one of which riſes in Lithuania, and, dividing Livonia from Courland, falls into the Baltic Sea a little below Riga: the other gives name to the province of Dwina in Ruſſia, diſcharging itſelf into the White Sea a little below Archangel.

DYE, in architecture, any ſquare body, as the trunk or notched part of a pedeſtal: or it is the middle of the pedeſtal, or that part included between the baſe and the corniche; ſo called becauſe it is often made in the form of a cube or dye.— See Architecture.

DYER, a perſon who profeſſes the art of dyeing cloth or other ſubſtances of different colours. See Dyeing.

Dyer (Sir James), an eminent Engliſh lawyer, chief judge of the court of common pleas in the reign of Queen Elizabeth. He died in 1581; and about 20 years after was publiſhed his large collection of Reports, which have been highly eſteemed for their ſuccinctneſs and ſolidity. He alſo left other writings behind him relative to his profeſſion.

Dyer (John), an Engliſh poet, was born in 1700, the ſecond ſon of Robert Dyer, of Aberglaſney in Caermarthenſhire, a ſolicitor of great capacity and note. He paſſed through Weſtminſter ſchool under the care of Dr. Freind, and was then called home to be inſtructed in his father's profeſſion. His genius, however, led him a different way: for, beſides his early taſte for poetry, having a paſſion no leſs ſtrong for the arts of deſign, he determined to make painting his profeſſion. With this view, having ſtudied a while under his maſter, he became, as he tells his friend, an itinerant painter, and wandered about South Wales and the parts adjacent; and about 1727 printed "Grongar Hill." Being, probably, unſatisfied with his own proficiency, he made the tour of Italy; and ſpent whole days in the country about Rome and Florence, ſketching thoſe pictureſque proſpects with facility and ſpirit. On his return to England, he publiſhed the "Ruins of Rome," 1740; and being rather ſerious, and his conduct and behaviour always irreproachable, he was ordained by the biſhop of Lincoln; and had a law degree conferred on him.

About the ſame time he married a lady of Coleſhill, named Enſor; "whoſe grandmother," ſays he, "was a Shakſpeare, deſcended from a brother of every body's Shakſpeare." His firſt patron, Mr. Harper, gave him, in 1741, Calthorp in Leiceſterſhire, of eighty pounds a year, on which he lived ten years; and, in April 1757, exchanged it for Belchford in Lincolnſhire, of ſeventy-five, which was given him by lord-chancellor Hardwicke, on the recommendation of a friend to Virtue and the Muſes. In 1752, Sir John Heathcote gave him Coningſby, of one hundred and forty pounds a year; and in 1756, when he was LL.B. without any ſolicitation of his own, obtained for him from the chancellor, Kirby on Bane, of one hundred and ten. In 1757 he publiſhed "The Fleece," his greateſt poetical work. He did not indeed long out-live that publication, nor long enjoy the increaſe of his preferments; for a conſumptive diſorder, with which he had long ſtruggled, carried him off at length in 1758. Mrs. Dyer, on her huſband's deceaſe, retired to her friends in Caernarvonſhire. In 1756 they had four children living, three girls and a boy. Of theſe, Sarah died ſingle. The ſon, a youth of the moſt amiable diſpoſition, died in London, as he was preparing to ſet out on a tour to Italy, in April 1782, at the age of 32.

DYERS-*Weed*, in botany. See Reseda.

D Y E I N G

IS the art of developing and extracting the coloured particles of any ſubſtance whatever, and of uniting and fixing them afterwards upon cloths, ſtuffs, or any other matters, ſo as apparently to conſtitute but one body.

The object of this art therefore conſiſts in depriving one body of its colouring principle, in order to fix it upon another in a durable manner; and the ſeries of manipulations which are neceſſary to produce this effect, conſtitutes the art itſelf.

OF THE ANTIQUITY OF THE ART OF DYEING.

THE origin of the art of dyeing, or of imparting to different materials employed for the fabrication of garments and furniture, thoſe beautiful colours which are afforded by many articles of the vegetable, animal, and mineral kingdoms, appears to have been of high antiquity. As moſt of theſe materials are, of themſelves, either of dark and diſagreeable colours, or elſe devoid of all colour, it is probable that, even in the very

earlieſt ages, the love of ornament, which is natural to mankind, would induce them to ſtain their veſtments with various colouring ingredients, eſpecially with vegetable juices. But the means of imparting *permanent* dyes to cloth, and affixing to its fibres ſuch colouring materials, as could not eaſily be waſhed out by water, or be obliterated or greatly changed by the action of air, or of certain ſaline ſubſtances, to which they are liable to be expoſed, and which are neceſſary to render them clean when ſoiled, was an art which required the knowledge of principles not within the reach of untutored men, and only to be obtained by gradual inveſtigation, and by the lapſe of a conſiderable portion of time.

According to Pliny, the Egyptians had diſcovered a mode of dyeing, ſomewhat reſembling that which we uſe for colouring printed linens; the ſtuffs, probably after having been impregnated with different mordants, were immerſed in vats, where they received various colours. And Mr. Delaval is of opinion, that they were poſſeſſed not only of the art of dyeing, but even of that of printing on cloths.

The Phœnicians ſeem to have a ſtrong claim to the invention of this art, and they held a decided pre-eminence in it for many ages: their purple and ſcarlet cloths were ſought after by every civilized nation; and the city of Tyre, enriched by its commerce, increaſed to an amazing extent. But her career was ſtopped by the vanity and folly of the eaſtern emperors; under whoſe dominion this opulent city had unfortunately fallen. Deſirous of monopoliſing the wearing of the beautiful cloths of Tyre, theſe miſjudging tyrants iſſued moſt ſevere edicts, prohibiting any one from appearing in the Tyrian blue, purple, or ſcarlet, except themſelves, and their great officers of ſtate. To this injudicious reſtriction is to be attributed the deſtruction of the Tyrian dyes. For under the impolitic reſtraint impoſed on the conſumption of the Phœnician cloths, the manufacturers and dyers were no longer able to carry on their trade; it grew languid, ſickened, and expired: and, with the trade, the art itſelf alſo periſhed.

Among the Greeks the knowledge of dyeing muſt have been very imperfect, and little aſſiſted by ſcience; for the art of dyeing linen appears not to have been known in Greece before Alexander's invaſion of India, where, according to Pliny, they dyed the ſails of his veſſels of different colours. The Greeks ſeem to have borrowed this art from the Indians.

This laſt country ſeems to have been the nurſery of the arts and ſciences, which were afterwards ſpread and perfected among other nations. Accidents which had a tendency to improve the art, could not fail to be multiplied rapidly, in a country rich in natural productions, which requires little labour for the ſupport of its inhabitants, and the population of which was favoured by the bounty of nature, and the ſimplicity of manners, till it was oppoſed by the tyranny of ſucceeding conquerors. But religious prejudices, and the unalterable diviſion in caſts, ſoon put ſhackles upon induſtry; the arts became ſtationary; and it would ſeem that the knowledge of dyeing cotton in that country (for ſilk was then unknown, or at leaſt very ſcarce) was as far advanced in the time of Alexander, as it is at the preſent period.

The very beautiful colours which are obſervable in ſome Indian linens, would lead one to ſuppoſe that the art of dyeing had there attained a high degree of perfection; but we find by the deſcription which Beaulieu, at the requeſt of Dufay, gave of ſome operations performed under his own eye, that the Indian proceſſes are ſo complicated, tedious, and imperfect, that they would be impracticable in any other country, on account of the great difference in the price which is paid for labour.

It is unqueſtionably true, that European induſtry has far ſurpaſſed them in correctneſs of deſign, variety of ſhade, and facility of execution; and if we are inferior to them with reſpect to the livelineſs of two or three colours, it is only to be attributed to the ſuperior quality of ſome of their dyes, or perhaps to the length and multiplicity of their operations and proceſſes.

In our own country, however, the art of dyeing had made no conſiderable progreſs till about the beginning of the laſt century. Before that period our cloths were ſent to Holland, to be dreſſed and dyed. This, however, was probably practiſed only in the caſe of particular colours. The dyeing of woollen and ſilken goods has indeed long ſince attained a conſiderable degree of excellence; but the manufactures of cotton, owing to the ſmall attraction of that ſubſtance for colouring matters have been very deficient in this point. Till within theſe few years, the colours employed in the dyeing of fuſtians and cotton velvets were few; and, even at this day, many of them are fugitive. But it muſt be allowed that great improvements have been made within theſe few years; from the application of chemical principles, and by a diligent inveſtigation of the nature of colouring ſubſtances. There is however ſtill much room for the improvement of the art, but this can only be effected by the practical dyer acquiring chemical knowledge. While the grounds on which the different operations ſhould proceed are ill-underſtood, many errors muſt ariſe, many needleſs materials muſt be employed, and much expence, which might otherwiſe be ſpared, muſt neceſſarily be incurred.

PART I.

Sect. I. *Of the Theory of Dyeing.*

IT is not the buſineſs of this treatiſe to examine the different theories which have been advanced concerning the nature of colours; but it may be neceſſary, before we proceed to deduce a general theory of dyeing, to make a few obſervations on the common properties of colouring ſubſtances.

Of the Properties of Colouring Subſtances.—In explaining the cauſe of colour, and the nature of colouring particles, two great inconveniences have ariſen; firſt, from an attempt to illuſtrate the action which the particles of colouring ſubſtances have on the rays of light, in conſequence of their denſity and thickneſs, without having any means of aſcertaining this, and without any regard to the attractions which reſult from their chemical compoſition; ſecondly, in comparing the colouring particles to mucilages and reſins, from ſome very faint reſemblances; and in attempting to explain their colouring properties by conjectures, formed reſpecting their component parts, while theſe properties ought rather to be aſcertained by direct experiment, than explained by an imaginary compoſition. It was alſo departing from true theory, to aſcribe to laws purely mechanical, the adheſion of the colouring particles to the ſubſtances dyed, the action of the mordants, the difference between the true or durable, and the falſe or fading dyes. Hellot, who has written an excellent treatiſe on dyeing, ſeems to have been completely wrong on this ſubject; and Macquer, who was amongſt the firſt who entertained juſt notions reſpecting chemical attractions, ſeems to have been led aſtray by his ideas. It appears, however, that Dufay had before

obferved, that the colouring particles were naturally difpofed to adhere more or lefs firmly to the filaments which receive them; and had very juftly remarked, that without this difpofition, ftuffs would never affume any colour, but that of the bath, and would always divide the colouring particles equally with it; whereas the liquor of the bath fometimes becomes as limpid as water, giving off all the colouring particles to the ftuff; which (fays he) feems to indicate that the ingredients have lefs attraction for the water, than for the particles of the wool. But Bergman feems to have been the firft who referred the phenomena of dyeing entirely to chemical principles. Having dyed fome wool and fome filk in a folution of indigo, in very dilute fulphuric acid, he explains the effects he obferved in the operation, by attributing them to the precipitation occafioned by the blue particles having a ftronger attraction for the particles of the wool and filk, than for thofe of the acidulated water: he remarks, that this attraction of the wool is fo ftrong, as to deprive the liquor entirely of the colouring particles; but that the weaker attraction of the filk can only diminifh the proportion of thefe particles in the bath: and he fhews, that both the durability of the colour, and the degree of intenfity it is capable of acquiring, depend on thefe different attractions. This is, in fact, the true light in which the phenomena of dyeing fhould be viewed; they are real chemical phenomena, which ought to be analyfed in the fame way as all thofe dependant on the actions which bodies exert, in confequence of their peculiar nature. It is evident that the colouring particles of bodies poffefs chemical properties, that diftinguifh them from all other fubftances; and that they have attractions peculiar to themfelves, by means of which they unite with acids, alkalis, metallic oxides, or calces, and fome earths, principally alumine or pure clay. They frequently precipitate oxides and alumine, from the acids which held them in folution; at other times they unite with the falts and form fupracompounds, or compounds of more than two ingredients, which combine with the wool, filk, cotton, or linen. And with thefe, their union is rendered much more clofe by means of alumine or a metallic oxide, than it would be without their intervention. It may be remarked, that the difference in the attractions of the colouring particles for wool, filk, and cotton, is fometimes fo great, that they will not unite with one of thefe fubftances, while they combine very readily with another: thus cotton receives no colour in a bath which dyes wool fcarlet. Dufay got a piece of ftuff made, the warp of which was wool and the woof cotton, which went through the procefs of fulling, that he might be certain that the wool and the cotton received exactly the fame preparation; but the wool took the fcarlet dye, and the cotton remained white. It is this difference of attraction which renders it neceffary to vary the preparation, and the procefs, according to the nature of the fubftance which is intended to be dyed of a particular colour. And thefe fame confiderations ought to determine the means to be purfued for the improvement of the art of dyeing. It is highly proper to endeavour to afcertain, what are the conftituent principles of the colouring particles. And in this inquiry, the moft effential circumftances are, to determine the affinities of a colouring fubftance, firft, with the fubftances which may be employed as menftrua; fecondly, with thofe which may by their combinations modify the colour, increafe its brilliancy, and help to ftrengthen its union with the ftuff to be dyed; thirdly, with the different agents which may change the colour, and principally with the external agents—air and light.

It is proper to take notice, that the qualities of the uncombined colouring particles are modified when they unite with a fubftance; and if this compound unites with a ftuff, it undergoes new modifications. Thus the properties of the colouring particles of cochineal are modified, by being combined with the oxide of tin, and thofe of the fubftance refulting from this combination, are again modified by their union with the wool or filk; fo that the knowledge we may acquire by the examination of colouring fubftances in their feparate ftates, can only inform us refpecting the preparations that may be made of them: that which we acquire refpecting their combinations with fubftances which ferve to fix them, or to increafe their beauty, may inform us what proceffes in dyeing ought to be preferred or tried; but it is only by direct experiment made with the different fubftances employed in dyeing, that we can confirm our conjectures and properly eftablifh the proceffes.

The preceding facts and obfervations fhew, that the changes produced by acids and alkalis on many vegetable colours, fuch as the chemifts often employ, in order to difcover the nature of different fubftances, are owing to the combinations which take place between thefe colouring particles and the acids and alkalis. The compounds refulting from thefe combinations, may be compared to neutral falts, which poffefs qualities different from thofe of their component parts, but in which one of thefe parts may be in excefs, and its qualities confequently be predominant. This ftate of combination is obfervable between the colouring particles of cochineal and acidulous tartrite of potafh, or cream of tartar; by evaporating flowly a folution of this falt in a decoction of cochineal, cryftals are formed, which retain a fine ruby colour, much more bright and intenfe than that of the liquor which formed them. It is well known alfo, that there are fome acids, particularly the nitric, which, after having combined with the colouring particles, change the colour which they at firft produced, make it yellow, and deftroy it. They then act by means of one of their principles, the oxigene, or vital air. Blue colours are not the only ones which become red by the addition of acids, and green by that of alkalis; moft red colours, as that of the rofe, for inftance, are heightened by acids, and made green by alkalis; and fome green colours, fuch as that of the green decoction of burdock, according to the experiments of Mr. Nofe, and the green juice of buckthorn, as is evident from the trials of Mr. Becker, are reddened by acids. This property, which is common to moft of the ordinary colours of vegetables, feems to prove, that there is a great analogy between their colouring particles; and it is not without foundation, that Linnæus fuppofed that the red in vegetables was owing to an acid, and indicated its prefence; but there are alfo many vegetables which contain acid in a difengaged ftate, without their poffeffing a red colour. It is therefore evident, that the colouring particles have attractions for acids, alkalis, earths, and metallic oxides, which conftitute a part of their chemical properties; and in confequence of which, their colours are more or lefs varied: therefore thefe particles form, with the ftuff on which they are fixed, a compound which retains only fome of their original properties: they are alfo modified by their union with alumine, or pure clay, metallic oxides, and fome other fubftances, as are alfo thofe new compounds, when they are further combined with the ftuff: all thefe modifications are analogous to what is obferved in other chemical combinations.

Of Mordants.—Mordant is a term that appears to have been firft introduced by the French dyers; who apprehended that the intention of paffing the fubftances which were to be dyed, through certain faline liquors, the nature of which they did not underftand, was to corrode fomething that oppofed the entrance of the colouring principle, and to enlarge the pores of the fubftances. It is a title which is applied to thofe fubftances which ferve as intermedia between the colouring particles and the ftuff to be dyed, either for the purpofe of facilitating or of modifying their combination. *Bafis* would feem

to be a more appropriate term. Mordants deserve the greatest attention; as by their means colours are varied, brightened, made to strike, and rendered more durable.

It is here necessary to examine the nature of the action of the principal bases or mordants, and to endeavour to determine how their attractions serve to unite the colouring particles with the stuff, and how they affect the qualities of the colours. A basis or mordant is not always a simple agent, for new combinations are sometimes formed by the ingredients that compose it; so that the substances employed are not the immediate agents, but the compounds which they have formed. Sometimes the mordant is fixed with the colouring particles, and sometimes the stuff is impregnated with it; on other occasions, both these modes are united; and we may dye successively with liquors containing different substances, the last of which only can act on the particles with which the stuff is impregnated. The art of printing linen affords many processes, in which it is easy to observe the effects of mordants: therefore, to elucidate this subject, it may be necessary to mention a few examples. The basis employed for linens intended to receive different shades of red, is prepared by dissolving in eight pounds of hot water, three pounds of alum, and one pound of acetite of lead, or sugar of lead, to which two ounces of pot-ash, and afterwards two ounces of powdered chalk are added. The alum is decomposed by the acetite of lead, because the oxide or calx of lead combines with the sulphuric or vitriolic acid, and forms an insoluble salt which is precipitated; the base of the alum, alumine, or *argillaceous earth*, at the same time combines with the acetous acid, or vinegar, and produces an acetite of alumine; the chalk and pot-ash answer the purpose of saturating the excess of acid. One of the advantages which result from the formation of the acetite of alumine is, that the alumine is retained in it by a much weaker attraction than in the alum, so that it more easily quits its menstruum, to combine with the stuff and the colouring particles. And another advantage is, that the acid liquor from which the alumine is separated, has much less action on the colour when it consists of the acetous, that when it consists of a stronger acid, such as the sulphuric. In short, the acetite of alumine not having the property of crystallizing, the mordant, which is thickened with starch or gum to prepare it for being applied to the block on which the design is engraved, does not curdle as it would if it contained alum capable of crystallizing. By attending to the operation performed upon a piece of linen cloth, we find that when it has been impregnated by the mordant, in the manner determined by the design, it is put into a bath of madder; the whole of the cloth becomes coloured, but the tinge is deeper in these parts which have received the mordant; there the colouring particles have combined with the alumine and the cotton, so that a triple compound has been formed, and the acetous acid separated from its basis is carried off in the bath. It is obvious that the colouring particles combined with the alumine and the stuff, are much more difficultly affected by external agents, than when they are in a separate state, or combined only with the stuff, without any intermediate bond of union: and it is on this property that the operations, to which the cloth is afterwards subjected, are founded: after it has been maddered, it is boiled with bran, and spread upon the grass; and these operations are alternately repeated until the ground becomes white. The colouring particles which have not united with the alumine, are altered in their composition, dissolved, and separated, while those that have combined with it remain, and are preserved, without alteration; and thus, the design alone remains coloured. It seems that this destruction of the colouring particles by exposure on the grass, and boiling with bran, is accomplished in the same manner as that of the colouring particles of flax, and admits of the same explanation. The only difference consists in substituting bran for alkalis, because they would dissolve a part of the colouring matter which is fixed by the alumine, and would change its colour; instead of which, the bran, having a much weaker action on this substance, affects only the colouring particles, which, by the action of the air, have been disposed more easily to solution. If, however, instead of the mordant which has been mentioned, a solution of iron be employed, the same phenomena take place; the colouring particles decompose the solution of iron, and form a triple compound with the stuff; but, instead of red, we get from the madder brown colours of different shades, down even to black; and, by uniting these two mordants, alum and iron, we have mixed colours, inclining to red on the one hand, and to black on the other, such as mordoré and puce colour. Other colours are also procured by substituting dyers weed for madder, and by means of these two colouring substances, indigo, and the two mordants above mentioned, we obtain most of the different shades that are observable in stuffs which are printed.

It is found that the substances which compose a mordant are sometimes incapable of decomposing each other solely by their own attractions; but the attraction of the stuff for one of their constituent parts, brings about a decomposition and new combinations, and sometimes this effect is not produced or completed without the aid of the attraction of the colouring particles. This appears to be the case in the mixture of alum and tartar, one of the most common mordants employed in the dyeing of wool. Mr. Berthollet having dissolved equal weights of alum and of tartar, the latter salt by this mixture acquired a greater degree of solubility than it naturally possesses; but, by evaporation and a second crystallization, the alum and the tartar were separated, so that they had not decomposed each other. On boiling for an hour, half an ounce of alum with an ounce of wool, a precipitate was formed, which, when washed carefully, seemed to consist chiefly of small filaments of wool incrusted with earth. To this the above chemist added sulphuric acid, and evaporated it to dryness, dissolved it, and obtained crystals of alum; some carbonic particles separated from it. He also evaporated the liquor in which the wool had been boiled, but obtained from it only a few grains of alum; the remainder would not crystallize. He redissolved it, and precipitated the alumine by an alkali; the precipitate was of a slate colour, it grew black upon a red-hot coal, and emitted alkaline vapours. From this experiment it is evident that the wool had decomposed the alum; that a part of the alumine had combined with its most detached filaments, which were least retained by the force of aggregation; that a part of its animal substance had been dissolved, and precipitated by the alkali, from the triple combination which it had formed. He made the same experiment with half an ounce of alum and two drams of tartar; no precipitation took place: he obtained by evaporation a small portion of the tartar, and some very irregular crystals of alum; the rest would not crystallize: this, on being diluted with water, and precipitated by pot-ash, gave by evaporation a salt which burned like tartar. The wool which had been boiled with the alum felt harsh, but the other had preserved its softness. The first had acquired from the madder a more dull though lighter tint, but the colour of the latter was more full and bright.

It seems obvious in these experiments, first, that the wool had begun a decomposition of the alum, that it had united with a part of the alumine, and that even the part of the alum which retained its alumine had dissolved some of the animal matter: secondly, that the tartar and alum, which cannot decompose each other solely by their own attractions, become capable of acting on each other, when their attractions are assisted by that of the wool: thirdly, that the tartar appears principally useful for moderating the too power fulaction of the alum upon the wool, whereby it is injured; for tartar is not used in the aluming of silk and thread, which have less action

on the alum than wool has. As the decompoſition of alum by the tartar and wool takes place in conſequence of attractions which nearly balance each other, and the proceſs muſt therefore go on ſlowly, we ſee why it is uſeful to keep the ſtuff impregnated with alum and tartar for ſome days in a moiſt place, as is generally recommended. The final effect of aluming, in whatever manner performed, and whatever chemical changes may have taken place in it, conſiſts in the combination of alumine with the ſtuff: this union has probably been imperfect, and the acids only partially ſeparated, but becomes complete when the cloth has been boiled with the madder, as we have ſeen in the caſe of printed ſtuffs. But an acid or an alkali may form a ſupracompound with the ſtuff, the colouring matter, and the alumine; for there are ſome colours which are changed by an acid, and reſtored by alkalis, or by calcareous earths, which take the acid from them, or vice verſa: but this ſupracompoſition does not take place with reſpect to thoſe colours which are eſteemed durable, being unchangeable by alkalis or acids, which are not ſtrong enough to deſtroy their compoſition. The attraction of alumine for animal ſubſtances, is not however merely indicated by uncertain appearances, nor ſuppoſed for the purpoſe of being employed in explanations, but is proved by direct experiment. The chemiſt juſt mentioned united them together, by mixing an animal ſubſtance with a ſolution of alum; a double exchange took place, the alkali entered into combination with the acid of the alum, and the alumine, combined with the animal ſubſtance, was precipitated. He alſo proved the attraction of alumine for animal ſubſtances by another experiment; having mixed a ſolution of glue with a ſolution of alum, he precipitated the alumine by an alkali, and the glue with which it had combined fell down along with it. This compound has the appearance of a ſemi-tranſparent jelly, and grows dry with difficulty. Thus we have alſo ſeen in the preceding experiments, that the alkali precipitated the alumine combined with the animal ſubſtance, from the uncryſtallizable reſidue of the alum which had been boiled with the wool. The attraction of alumine for moſt colouring ſubſtances, may alſo be ſhewn by direct experiment. If a ſolution of a colouring ſubſtance be mixed with a ſolution of alum, a precipitation ſometimes takes place; but if to the liquor we add an alkali, which decompoſes the alum, and ſeparates the alumine, the colouring particles are then precipitated, combined with the alumine, and the liquor remains clear: this compound has got the name of *Lake*. In this experiment, too much alkali muſt not be added, becauſe alkalis are capable of diſſolving lakes in general. No direct experiment has however yet ſhewn, that alumine attracts any vegetable ſubſtance except the colouring particles; its attraction for them ſeems much weaker than that which it has for animal ſubſtances; hence the acetite of alumine, as has been already obſerved, is a better baſis or mordant for cotton and linen than alum is, and upon this depend the different means employed to increaſe the fixity of the colouring particles of madder in the dyeing of theſe ſubſtances. The oxides or calces of metals have ſo great an attraction for many colouring ſubſtances, that they quit the acids in which they were diſſolved, and are precipitated in combination with them. And, on the other hand, all metallic oxides have the property of uniting with animal ſubſtances; and theſe different compounds may be formed by mixing an alkali ſaturated with an animal ſubſtance, with metallic ſolutions. It is not ſurpriſing, therefore, that metallic oxides ſhould ſerve as a bond of union between the colouring particles and animal ſubſtances; but, beſides the attraction of the oxides for the colouring particles, and for animal ſubſtances, their ſolutions in acids poſſeſs qualities which render them more or leſs fit to act as mordants: thus, thoſe oxides which eaſily part with their acids, ſuch as that of tin, are capable of combining with animal ſubſtances, without the aid of colouring particles; it is ſufficient to impregnate the wool or the ſilk with a ſolution of tin, although they be afterwards carefully waſhed, which is not the caſe with other metallic ſolutions. Some metallic ſubſtances afford, in combination, only a white and colourleſs baſis; and ſome, by the admixture of their own colour, modify that which is proper to the colouring particles; but in many metallic oxides, the colour varies according to the proportion of oxigene or vital air they contain, and the proportion of this is eaſily liable to change. Upon theſe circumſtances their properties in dyeing chiefly depend. The attraction of metallic oxides for ſubſtances of vegetable origin, ſeems much weaker than that which they have for animal ſubſtances, and we are even ignorant whether they be capable of contracting a real union with them or not: metallic ſolutions are therefore ill fitted to ſerve as mordants for colours in cotton or linen, except iron, the oxide of which unites firmly with vegetable ſubſtances, as is ſhewn by iron moulds, which are owing to a real combination of this oxide or calx.

Whenever the colouring particles have precipitated a metallic oxide from its menſtruum, the ſupernatant liquor contains the diſengaged acid, which is commonly capable of diſſolving a portion of the compound of colouring ſubſtance and oxide, ſo that the liquor remains coloured; but ſometimes the whole of the colouring particles are precipitated, when the proportions have been accurately adjuſted: this precipitation is facilitated, and rendered more complete, by the preſence of the ſtuff, which aſſiſts, by the tendency it has to unite with the compound of oxide and colouring particles. Uncombined metallic oxides have alſo a very evident action on many colouring ſubſtances when boiled with them, and modify their colour; the oxide of tin in particular, increaſes the brightneſs and fixity of many.

It is obvious that the compounds of oxides and colouring ſubſtances muſt be ſimilar to many other chemical compounds, which are inſoluble, when the principles of which they are formed are properly proportioned; but which are capable of being ſuperſaturated by an exceſs of one of the principles, and thence of becoming ſoluble. Thus a metallic oxide united with a colouring ſubſtance in exceſs, will produce a liquor, the colour of which will be modified by the oxide, whereas, when the colouring matter is not in exceſs, the compound will be inſoluble, or nearly ſo; theſe effects are very evident in the combination of iron with the aſtringent principle. Neutral ſalts, ſuch as nitre, and particularly muriate of ſoda, or common ſalt, act as baſes or mordants, and modify colours; but it is difficult to aſcertain the manner in which they act. Mr. Berthollet has found, that the muriate of ſoda was contained in ſubſtance, in the precipitates produced by ſome ſpecies of colouring particles, and that theſe precipitates retained a conſiderable degree of ſolubility; it would ſeem, that a ſmall part of the ſalt becomes fixed with the colouring particles and the ſtuff. Salts with calcareous baſes alſo modify colours; but as theſe modifications are nearly ſimilar to thoſe which would be produced by the addition of a ſmall quantity of lime, it is probable that they are decompoſed, and that a little of the lime enters into combination with the colouring particles and the ſtuff. By attention to what has been juſt now obſerved, we ſhall eaſily diſcern what combinations are formed by the agency of the different reactives employed in the analyſis of colouring ſubſtances; but we muſt not forget, that the mordants and the colouring particles have a mutual action on each other, which may change their properties. It is already evident, that by varying the baſes or mordants, we may multiply prodigiouſly the ſhades obtained from a colouring ſubſtance; to vary their mode of application even, may be ſufficient: thus we ſhall have different effects, by impregnating the ſtuff with the mordant, or by mixing

the mordant with the bath; by applying heat, or uſing exſiccation; for we operate upon three elective attractions; that of the colouring particles, that of the ſtuffs, and that of the principles of the mordant; and many circumſtances may cauſe variations in the reſult of theſe attractions; circumſtances which merit further explanation. Exſiccation favours the union of the ſubſtances which have an attraction for the ſtuff, and the decompoſitions which may reſult from that union; becauſe the water which held theſe ſubſtances in ſolution, by its attraction, oppoſed the action of the ſtuff; but the exſiccation ſhould be ſlow, in order that the ſubſtances may not be ſeparated before their mutual attractions have produced their effect. Hence it is obvious, how the repeated exſiccations employed in ſome proceſſes produce their effect.

It is alſo evident that the greater or leſs diſpoſition of the ſtuff to unite with the colouring particles, muſt frequently occaſion conſiderable differences in the mode of employing the mordant: thus, when this diſpoſition is ſtrong, the mordant may be mixed with the colouring ſubſtance; the compound then formed, unites with the ſtuff immediately: but if it be weak, the compound formed by the colouring particles, and the ſubſtance employed as an intermedium, may ſeparate, and be precipitated, before it can be attached to the ſtuff. To prevent this inconvenience, we muſt begin by attaching to the ſtuff the ſubſtance which is to ſerve as the medium of union between it and the colouring particles. But in order to judge of the effects of mordants, and of the moſt advantageous manner of employing them, we muſt pay attention, firſt, to the combinations which may be produced, either by the action of the ſubſtances which compoſe them, or by that of the colouring particles and the ſtuff; ſecondly, to the circumſtances which may concur in bringing about theſe combinations more or leſs quickly, or in rendering them more or leſs complete; thirdly, to the action that the liquor in which the ſtuff is immerſed may have, either on its colour or texture; and in order to foreſee what that action may be, it is neceſſary to know the proportions of the principles which enter into the compoſition of the mordant, and what will be left in an uncombined ſtate in the fluids. Baſes or mordants are not however obtained from the claſs of ſalts alone; vegetable and animal ſubſtances ſerve this purpoſe for each other under certain circumſtances: thus, in the proceſs for Adrianople red, the cotton ought to be impregnated, or rather combined with an animal ſubſtance; and thus, the aſtringent principle is often employed as a medium of union between colouring particles and ſtuffs of different kinds.

Of the Action of different Subſtances on Colours.—Hitherto the colouring particles have been conſidered only as ſubſtances capable of forming different combinations, by which their properties are modified; but they may be altered in their compoſition, either by other external agents, or by the ſubſtances with which they unite. It is proper to begin with an examination of the changes produced by external agents, becauſe they are more eaſily aſcertained. It is well known that the ſtability of a colour conſiſts in its power of reſiſting the action of vegetable acids, alkalis, ſoap, and more eſpecially that of the air and light; but this power varies exceedingly, according to the nature of the colour and the ſpecies of the ſtuff; for the ſame durability is not required in the colours of ſilk as in thoſe of wool. There is not much obſcurity in the action of water, acids, alkalis, or ſoap; it is a ſolution brought about by theſe agents; and it appears that a ſmall quantity of acid, or of alkali, ſometimes unites with the compound which gives the colour; becauſe the colour is not deſtroyed, but only changed, and may be reſtored by taking away this acid, as for example, by means of chalk and ammoniac or volatile alkali.

But this is not the caſe with reſpect to the action of air and light. Scheele has obſerved, that the oxigenated muriatic acid or dephlogiſticated marine acid rendered vegetable colours yellow, and he attributed that effect to the property it had of taking up the phlogiſton which entered into their compoſition. Mr. Berthollet has ſhewn that the properties of the oxigenated muriatic acid were owing to the combination of its oxigene or vital air, with the ſubſtances expoſed to its action; that it commonly rendered the colouring particles yellow; but that, by a continuance of its action, it deſtroyed their colour; without determining in what this action conſiſted: and Mr. Fourcroy has ſince made ſeveral obſervations on the action of oxigene on the colouring particles, which throw a great deal of light on the nature of the changes they undergo, chiefly when watery ſolutions of them are left expoſed to the air, or have been ſubjected to a boiling heat; he obſerved, that in conſequence of the action of the air, vegetable decoctions formed pellicles, which loſt their ſolubility, and underwent ſucceſſive changes of colour; he marked the gradations of colour thus produced, and concluded from his obſervations, that oxigene entered into the compoſition of the colouring particles; that when it combined with them, their ſhade was changed; and that the more they received, the more fixed did their colour become; and that the beſt method of obtaining permanent unchangeable colours for painting, was to chooſe ſuch as had been expoſed to the action of the oxigenated muriatic acid. In conſidering the effects of air on colours, it is neceſſary to make a diſtinction between thoſe produced by metallic oxides, and thoſe produced by the colouring particles. Mr. Berthollet thinks that the modifications of the former are entirely owing to different proportions of oxigene, but from obſervation he has been led to form a different opinion reſpecting the modifications of the latter. He obſerved, that the oxigenated muriatic acid exhibited different phenomena with the colouring particles; that ſometimes it diſcharged their colour, and rendered them white; that moſt frequently it changed them to a yellow, fawn, or root coloured, brown, or black, according to the intenſity of its action; and that, when their colour appeared only diſcharged or rendered white, heat, or a length of time, was capable of rendering them yellow. He compared the effect produced by the oxigenated muriatic acid, when the particles are rendered yellow, fawn coloured, or brown, with the effect of a ſlight degree of combuſtion, and ſhewed that they were the ſame; that they were owing to the deſtruction of the hydrogene, which combining with the oxigene, more eaſily, and at a lower temperature than charcoal does, leaves it predominant, ſo that the natural colour of charcoal is more or leſs blended with that which before exiſted. This effect becomes very evident, when ſugar, indigo, or the infuſion of the gall-nut, or of ſumach, are expoſed to the action of oxigenated muriatic gas, or dephlogiſticated marine acid air; the ſugar and the indigo aſſume a deep colour, and afford indiſputable marks of a ſlight combuſtion; the infuſion of the gall-nut, and that of ſumach, let fall a black precipitate, which is not far from being pure charcoal or carbone. Theſe appearances are analogous to theſe which are obſerved in the diſtillation of organized ſubſtances; in proportion as the hydrogene is extricated in the form of oil, or of gas, the ſubſtance grows yellow, and at length there remains only a black coal. If the hydrogene be expelled from an oil by heat, it grows brown evidently in the ſame way.

This ingenious chemiſt had alſo found by other experiments made on alcohol and ether, that the oxigene united to the marine acid, had the property of combining with the hydrogene, which abounds in theſe ſubſtances, and of thereby forming water. He therefore ſuppoſes that when the oxigenated marine acid renders a colour yellow, fawn coloured, or brown, the effect proceeds from the colouring matter having undergone a ſlight combuſtion, by which more or leſs of its hydrogene has been converted into water; and that the charcoal thus,

rendered predominant, has communicated its own colour. The art of bleaching linen by means of the oxigene of the atmosphere, of the dew, and of the oxigenated marine acid, he also supposes to depend on this change of the colouring matter. The colouring particles of the flax are rendered soluble in the alkaline lixivia, the action of which ought to alternate with that of the oxigene. These colouring particles may be afterwards precipitated from the alkali, and by evaporation and drying become black, and prove the truth of this theory, both by the colour they have acquired, and by the quantity of charcoal which they yield by analysing them. But the alkaline solution of the colouring matter of linen, which is of a dark brown colour, loses its colour almost entirely, by the addition of a certain quantity of oxigenated muriatic acid; and the same effect is observable in many other substances, which have assumed a colour originating from a beginning combustion. A piece of linen, which appears white, may grow yellow in the course of time, particularly if exposed to a certain degree of heat, if the oxigenated parts have not been removed by a sufficiently strong lixivium; in the same manner, the green parts of vegetables are rendered white by the oxigenated muriatic acid, but grow yellow when boiled.

It is evident from these facts that oxigene is capable of whitening, or rendering paler, the colouring matters with which it unites, perhaps by having produced the effects of a slight combustion upon them; or possibly these effects take place only afterwards in a gradual manner, but more rapidly, when the whole is exposed to a certain degree of heat. It is extremely probable that in all cases a part of the oxigene unites with the colouring matter, without being combined with the hydrogene in particular, and that it is in this way that oxigene acts in rendering the colouring matter of flax more easily soluble in alkalis.

In many other cases oxigene has evidently an influence on the changes which take place in the colouring particles of vegetables: these particles are formed chiefly in the leaves, flowers, and inner bark of trees; by degrees they undergo a slight combustion, either from the action of the atmospheric air which surrounds them, or from that of the air which is carried by a particular set of vessels into the internal parts of vegetables.

From these observations Mr. Berthollet supposes we may explain how the air acts upon colouring matters, of an animal, or vegetable nature; it first combines with them, renders them weaker and paler, and by degrees occasions a slight combustion, by means of which the hydrogene which entered into their composition is destroyed; they change to a yellow, red, or fawn colour; their attraction for the stuff seems to diminish; they separate from it, and are carried off by water: all these effects vary, and take place more or less readily, and more or less completely, according to the nature of the colouring particles; or rather, from the nature of the properties which they possess, in the state of combination into which they have gone. The alterations which occur in the colours produced by the union of the coloring particles with metallic oxides, are effects compounded of the change which takes place in the colouring particles, and of that which is undergone by the metallic oxide or calx.

The distinction of colours is considerably accelerated by the light of the sun; it ought therefore, if this theory be well founded, to favour the combination of oxigene, and the combustion thereby induced. Mr. Sennebier, who has given many interesting observations on the effects of light on different substances, and particularly on their colours, attributes these effects to a direct combination of light with the substances. And the effects of light on the colour of wood, have long ago been noticed; it preserves its natural appearance while kept in the dark, but when exposed to the light, it becomes yellow, brown, or of other shades. The ingenious gentleman just mentioned has remarked the varieties which occur in this particular, in different kinds of wood, and has found that the changes are proportioned to the brightness of the light, and that they take place even under water, but that wetted wood underwent these changes less quickly than that which was dry; that several folds of ribband were required to defend the wood completely, that a single leaf of black paper was sufficient, but that when paper of any other colour was substituted, the change was not prevented; a single covering of white paper was insufficient, but two intercepted the action of the rays of light. He has also extended his experiments to a great number of vegetable substances, in a manner that may serve to illustrate different phenomena of vegetation. If a well-made solution of the green parts of vegetables in alcohol, which has a fine green colour, be exposed to the light of the sun, it very soon acquires an olive hue, and loses its colour in a few minutes. If the light be weak, the effect is much more slow; and in perfect darkness, the colour remains without alteration, or, if any change does take place, it requires a great length of time. The same philosopher also asserts that an alkali restores the green colour; but that if the change of colour in the liquor has been completed, the alkali has no effect. No change of colour takes place in azotic gas, or phlogisticated air, nor in a bottle which is exactly full. A bottle half full of this green solution was inverted over mercury, by Mr. Berthollet, and exposed to the light of the sun; when the colour was discharged, the mercury was found to have risen in the bottle, and consequently vital air had been absorbed, the oxigene having united with the colouring matter. The precipitate which Mr. Sennebier mentions was not evident; the liquor had continued transparent, and retained a slight yellow tinge. On evaporating this liquor, its colour was immediately rendered darker, and became brown; the residuum was black, and in the state of carbone. Light therefore acts by favouring the absorption of oxigene, and the combustion of the colouring matter; at first, the marks of combustion are not evident; the liquor retains only a slight yellow tinge; but by the assistance of heat, the combustion is completed, the liquor becomes brown, and leaves a black residuum. If the vessel which holds the liquor contains no oxigenous gas, the light has no effect on the colouring matter; azotic gas in this situation does not suffer any diminution. The observation, that ribbands, or a single leaf of white paper, do not prevent the action of light, deserves attention, as it shews that light can pass through coverings which appear to be opake, and exert its force at some way within. Beccaria and Sennebier have compared the effects of light on ribbands of various colours; but the differences they have observed, are rather to be attributed to the nature of the colouring matters, than to the colours; for a ribband dyed with brasil wood will lose its colour much sooner than one dyed with cochineal, though the shade should be exactly the same in each of them.

Light, though it greatly accelerates the combustion of colouring matter, and seems even necessary to its destruction in some cases, in others is not required. It was found, by putting some plants into a dark place, in contact with vital air, that that air was absorbed by some of them; and also, that the rose suffers a change, and becomes of a deeper hue, when it is not in contact with vital air, probably because it contains a little oxigene, the combination of which then becomes more intimate. But many flowers, when in azotic gas, retain their colour in perfection. The tincture of turnsole, when put in contact with vital air over mercury, both in the dark, and exposed to the light of the sun; the former continued unchanged for a considerable length of time, and the vital air had suffered no diminution; the other lost much of its colour, became red, and the air was in a great measure absorbed, and a small quantity of carbonic acid was produced, which undoubtedly had

occasioned the alteration of colour from blue to red. From this we may be enabled to form an idea of some of the changes of colour, produced by a particular disposition of the component principles of vegetable substances, when, by their combination with oxigene, they undergo the effects of a slight combustion, which may generate an acid, as in the leaves in autumn, which grow red before they become yellow, and in the streaks which are seen in flowers, the vegetation of which is becoming weak. It is therefore evident that light promotes the absorption of oxigene by the colouring matter, and that thence arises a combustion, the common effect of which is the predominance of carbonic particles; and to the same cause is also to be ascribed the injury which stuffs themselves are found to suffer from the action of light, as has been observed by Dufay.

There is here however an apparent contradiction. The action of the sun's light produces colours in vegetables; it extricates oxigene from the nitric and oxigenated muriatic acids, from some metallic oxides, and from plants in a state of vegetation: in these instances, its action seems to be the reverse of combustion; but when it contributes to the destruction of colour, it serves to fix oxigene, and produces a kind of combustion. In like manner, phosphorus is not affected by the oxigenated muriatic acid, even assisted by heat, while in the dark; but when exposed to the action of light, it is changed into the phosphoric acid. But Mr. Berthollet seems to be unacquainted with the circumstances, and the attractions, which determine sometimes the production of one effect, sometimes that of the other, but both of them are equally demonstrated. They seem to bear a resemblance to double elective attractions. It is very well known that calcareous earth yields the sulphuric acid to pot-ash, but yet that calcareous earth is capable of expelling the pot-ash, by means of a double elective attraction; and besides there are in nature a great many phenomena of the same kind.

It is therefore evident that colouring substances resist the action of the air more or less according as they are more or less disposed to unite with oxigene, and thereby to suffer more or less quickly a smaller or greater degree of combustion. Light favours this effect, which in many cases is not produced without its assistance; but the colouring matter, in its separate state, is much more prone to this combustion, than when united to a substance, such as alumine, which may either defend it by its own power of resisting combustion, or by attracting it strongly, weaken its action on other substances, which is the chief effect of mordants; and finally, this last compound acquires still greater durability, when it is capable of combining intimately with the stuff upon which it is deposited. Thus the colouring matter of cochineal dissolves easily in water, and its colour is quickly changed by the air; but when united to the oxide of tin, it becomes much brighter, and almost insoluble in water, though it is still easily affected by the air, and by oxigenated muriatic acid; it resists the action of these better, however, when it has formed a triple compound with a woollen stuff. But still it must not be inferred from the above observations, that all yellow colours are owing to the carbonic part of the colouring substance; very different compounds are capable of producing the same colour; thus, indigo is very different from the blue of our flowers, from that of oxide of copper, and from that of prussian blue. Mr. Berthollet does not even suppose, that oxigene may not unite in a small proportion with some colouring substances, without weakening their colour, or changing it to yellow. It will hereafter appear that indigo becomes green by uniting with an alkali, with lime or a metallic oxide; but that it resumes its colour, and quits these substances, when it recovers a small portion of the oxigene which it had lost. The liquor of the *whelk*, employed to dye purple, is naturally yellowish; but when exposed to the air, and more especially to the sun, it quickly passes through various shades, and at length assumes the exquisite purple colour. It may then be considered as a general fact, that colours become brighter by their union with a small portion of oxigene; for this reason, it is found necessary to air stuffs when they come out of the bath, and sometimes even to take them out of it from time to time expressly for this purpose; but the quantity of oxigene which, thus becoming fixed, contributes to the brightness of the colour, is very inconsiderable in some cases, and the deterioration soon begins. But the action of the air affects not only the colouring matter and the stuff, but also metallic oxides, when they are employed as intermedia; because the oxides, which have at first been deprived of a part of their oxigene by the colouring particles, may absorb it again. Those then, the colour of which varies according to their proportion of oxigene, have thereby an influence in changes of colour. It is undoubtedly to this cause that the change observable in the blue given to wool, by sulphate of copper, or blue vitriol, and logwood, is to be attributed. This blue soon becomes green by the action of the air: now it is well known, that copper which has a blue colour, when combined with a small proportion of oxigene, assumes a green one by its union with a larger quantity. The change which the colouring particles undergo, may indeed contribute to this effect; but the colouring particles of the logwood, which have themselves a dark colour, should rather become brown by combustion, than grow yellow, which would be necessary in order to produce a green with the blue. It has been observed, that colouring particles in a state of combination were less disposed to be changed by the action of the air, than in an uncombined state. This is generally the case, but there are some exceptions; an alkali for instance produces a contrary effect. A matrass being half filled with an infusion of cochineal, and exposed to the light, over mercury; a similar matrass contained an infusion of cochineal made with a little tartar; and in a third, a small quantity of alkali had been added to the infusion. The second matrass appeared least altered in the same space of time, and in it the absorption had been least considerable. In the third, the colour of the liquor became first brown, and was then discharged; and the absorption of air, though inconsiderable, was greater than in the two others. On being evaporated, it assumed a brown colour, and left a residuum of a yellowish brown colour.

Similar experiments having been made on different colouring substances, the alkali was found to darken their colour, which grew more and more brown, and to promote the absorption of air. Madder appeared to be the only exception to this rule: its colour, which became darker at first, stood better than that of the infusion made without alkali. The general effect of alkalis on the colouring particles is consonant to that which it produces on many other substances, such as sulphur; it favours the absorption of air, because it has a strong attraction for the substance which is the result of that absorption. From this effect of alkalis, a fact which has been observed by Becker may be explained; which is, that a vegetable infusion rendered green by an alkali, becomes gradually yellow, if left exposed to the air, and that when the yellow is completely formed, acids cannot restore the original colour: but that this is not the case, when a vegetable colour, reddened by means of an acid, has been kept in like manner for some time. Those instances in which acids have been employed, which act by giving off their oxigene in a way that will be noticed hereafter, must be excepted, for in these there is an extinction of the colour.

Of the Yellow Colour of Animal Substances produced by the Ni-

tric and Oxigenated Muriatic Acids.—The action of these acids upon animal substances has such a connexion with the preceding subject, that it is necessary to notice it in this place. It having been observed by Mr. Brunwiser that wood assumed different colours by exposure to the air, he endeavoured to ascertain whence those colours arose, and to produce them artificially: he remarked, that by moistening the surface of wood with nitric acid, particularly that of young wood not yet quite dry, it assumed a yellow colour; and that, by performing the same operation with the muriatic and sulphuric acids, it assumed a violet colour, which he supposes to be formed from a blue and a red. From these observations it is concluded, that, as all colours are produced by a mixture of yellow, blue, and red, all those which are observed in the leaves, fruits, and flowers, are owing to the colouring particles which exist in the wood, and are there disguised by an alkali; that the mineral acids, by taking up this alkali, set the colouring particles at liberty, and that the fixed air, by penetrating the leaves, fruits, and flowers, produce naturally the same effect, by combining with the alkali which kept them disguised. The author has endeavoured to apply his experiments, and pretended discovery, to the arts. Having moistened pieces of wood with nitric acid, he poured water upon them, filtered the liquor, and employed it to dye stuffs of wool, silk, and goats hair, of a durable yellow, which, in his opinion, is produced by the yellow colouring particles contained in the wood, and extracted, or disengaged by the action of the acid. It is mentioned by De la Folie that, having immersed a skein of white silk in nitric acid, or aqua fortis of the strength it is generally met with in commerce, the silk in three or four minutes assumed a fine jonquille yellow. He washed it several times in water, that it might not be affected by any adhering acid; the colour sustained several trials to which he submitted it, and the silk preserved its lustre unimpaired. If it be dipped into an alkaline solution, a fine orange colour is the result. Mr. Gmelin observes, that he has given a fine brimstone colour to silk, by keeping it for the space of a day in cold nitric acid, or some hours only, when the acid was warm. Boiling with soap and water diminished the brightness of this colour; and it was changed to a fine lemon colour, by being kept for twelve hours in an alkaline solution; but when the solution was employed hot, a fine gold colour was produced. The different solutions of metals in nitric acid communicated a more or less deep yellow to silk, as did also the solution of alumine in the same acid; but those of calcareous earth and magnesia had no effect whatever. De la Folie has found that a solution of tin mixed with a solution of gold, gives a purple, which fixes on silk: Mr. Gmelin however obtained in this way only common yellow; and he has shewn that the different yellows, which Mr. Struve had asserted were obtained by different metallic solutions, depend solely on the acid they contain. There is however a solitary exception in the case of mercury, by the solution of which a copper colour is given to silk. Bergman seems to have been acquainted with this process; for, in his notes on Scheffer's treatise, he has observed that common aqua fortis gives wool and silk a clear, beautiful, and durable yellow, in three or four minutes; that they ought to be washed immediately, and that the more the acid is *dephlogisticated*, the greater is the effect which results.

Mr. Berthollet also found that the oxigenated muriatic acid had the property of tingeing animal substances yellow; but that it does not give them nearly so deep a colour as the nitric acid, and it weakens them much more than that acid when properly diluted; so that the nitric acid is far preferable for the different purposes of art. In fine it therefore appears that the nitric acid diluted with a certain quantity of water gives silk a yellow colour, which is more or less deep according to the concentration of the acid, its temperature, and the time of immersion; that the silk must be carefully washed as soon as taken out of the acid: that this colour possesses considerable brightness; and that it may be made deep without sensibly weakening the silk; which may render the process really useful. The colour may also be modified by the use of alkalis. It is found that the solutions of calcareous earth and magnesia produce no effect upon silk, because they do not contain an excess of acid; but that the solutions of alumine and of all metallic substances, on the contrary, produce a more or less deep yellow, because they all contain more or less excess of acid, which acts upon the silk, like uncombined acid. It seems also to have been the acid alone that dyed the animal substances yellow, in the experiments of Mr. Brunwiser, and not the matter extracted from the wood, as he has supposed. Nor is the yellow colour in these cases owing to iron, as De la Folie supposed; for the purest nitric acid, which contains no iron, produces it, as well as that, in which the presence of that metal may be supposed to exist. Silk, when put into concentrated nitric acid, quickly assumes a deep yellow colour, loses its cohesion, and is dissolved; during this solution, the azote, or phlogisticated air, which enters into the composition of animal substances, is extricated, with a long continued effervescence: if heat be applied, it expels much nitrous gas, and the liquor immediately acquires a deep colour and grows brown. At this time, the oxigene of the nitric acid certainly combines with the hydrogene which abounds in animal substances, forming the oil which is obtained from them by distillation, and which renders them so inflammable. When the acid begins to act, and to render the silk yellow, the same effect should also begin to take place. It is therefore supposed by Mr. Berthollet, that the yellow colour arises from a commencement of combustion; but that this combustion, being very slight, does not sensibly weaken the silk: if however the acid be a little too strong, or the immersion too long continued, or if the whole of it be not carried off by careful washing, the silk immediately becomes weak, and is *burnt*. It is therefore evident why, as Bergman observed, the nitric acid which he called dephlogisticated, is preferable in this operation to that which is saturated with nitrous gas; for, in the former, the proportion of oxigene being greater, it is thence better fitted for producing the effects of combustion, than it becomes in the state of nitrous acid. The same explanation ought to apply to the action of the oxigenated muriatic acid on animal substances; it differs however in some essential circumstances, a few of which are not easily explained.

It has been found that silk receives a yellow colour when the oxigenated muriatic acid is employed, that is, much lighter than when the nitric acid is made use of: the sulphureous acid discharges it in a great degree, but has no effect on the yellow produced by the dilute nitric acid. The oxigenated muriatic acid has, however, a much stronger action on the silk; it soon weakens, and even dissolves it; and if it be left for some time in this fluid, the yellow which at first appeared grows lighter, in conformity to what has already been remarked, that oxigene, by being accumulated, is capable of disguising the yellow colour occasioned by the combustion which it had originally induced. Mr. Berthollet has endeavoured to explain the effects which sulphureous acid produces on colours, by the facility with which it gives off its oxigene, and has compared them to those of the oxigenated muriatic acid; but although it be true that oxigene adheres much more weakly to the sulphureous than to the sulphuric acid, he does not believe that that explanation is founded in truth.

From the observation of De la Folie, it appears that roses whitened by the vapour of burning sulphur become green in an alkaline lixivium, and red in acids; and Mr. Berthollet

has himfelf obferved, that the fulphureous acid reddened the tincture of turnfole, which has a very fading colour, but that it acted only like other acids on infufions of fuftic, brazil-wood, and logwood: and further, that filk which has been expofed to the vapour of fulphur, exhaled the fmell of fulphureous acid, when moiftened with fulphuric acid, although it could not be perceived before that odour exifted. He therefore fuppofes, that the fulphureous acid commonly unites with the colouring particles, and with the filk, without giving off its oxigene to them, and confequently without producing any combuftion; that the product of that combination fometimes lofes its colour entirely, which is probably owing to the femi-elaftic ftate of the oxigene; but fometimes combuftion may, and even commonly fhould take place by degrees, fo that the colouring particles, which have been difguifed for fome time, ought ultimately to leave a yellow colour.

Of the Gall-Nut and Aftringents in general.—Thefe fubftances deferve particular attention, not only from their great ufe in dyeing, but as poffeffing a property that is common to a great many vegetables. Our ideas refpecting this property of vegetables have been extremely vague; fome flight refemblance in tafte has frequently been the only circumftance attended to, and, under the name of aftringents, alum, and many vegetables of very different properties have been confounded together in the arts as well as in medicine. Moft frequently every fubftance which renders a folution of iron black, has been confidered as aftringent; it is fuppofed that this effect is owing to one identical principle exifting in all the fubftances which produce it, and the title aftringent or acerb has been beftowed on that principle, and it is at prefent confidered as a particular acid, to which the name of gallic acid has been given, from galls, in which it has been found to be predominant. The gall-nut is an excrefcence found on the young branches of the oak, and which is produced by the puncture of an infect. Different kinds of the gall-nut are met with, fome inclining to white, yellow, green, brown, or red; others are afh-coloured or blackifh: they alfo differ greatly in magnitude, and are either round or irregular, heavy or light, fmooth or covered with protuberances: thofe which are fmall, blackifh, knotted, and heavy, are the beft; and are known by the name of Aleppo galls. Thefe aftringent fubftances are almoft totally foluble in water by long ebullition. Sixteen drams afforded Neumann fourteen of extract; from the remaining two drams, only four grains could be extracted by means of alcohol. And the fame quantity treated firft with alcohol, and then with water, afforded twelve drams and two fcruples of fpirituous extract, and four fcruples of watery extract; the refiduum weighed half a fcruple more than in the preceding experiment. In the fpirituous extract the tafte is more ftrong and difagreeable than in the watery extract. Many other very interefting obfervations have been made on aftringent fubftances, as may be feen by confulting the writings of Scheele, Monnet, and Berthollet. From thofe of the laft chemift it appears to be proved, that it is not the gallic acid which communicates the aftringent property to the fubftances that poffefs it; that the acid itfelf poffeffes that property, in a degree inferior to other aftringents; and that fumach, treated like the galls in the manner of Scheele, affords no gallic acid, though it poffefs a high degree of aftringency: walnut peels, treated in the fame way, do not afford any. The property which the infufion of common galls has, of reddening certain vegetable colours, appears to proceed only from the gallic acid; fince the infufions of fumach, or of floe bark, which very readily produce a black precipitate, that of walnut-tree bark, or of quinquina, did not exhibit this property; and thence it is evident that the gallic acid does not exift in white galls. For the infufion of thefe, though it depofit a copious fediment on expofure to the air, it is not the gallic acid.

It is evident that if the aftringent property was owing to an individual principle, which was always the fame, diftributed in different vegetables, the precipitates obtained by their means, from a folution of iron, would conftantly form the fame compounds, and exhibit the fame appearances and properties; but it is quite different: the precipitate produced by galls is of a blackifh blue, that by logwood has a different fhade of blue; that by oak is of a fawn colour, or blackifh brown; that by quinquina, a blackifh green; they fall down with different attendant circumftances, and when fixed on ftuffs are difcharged by alum and tartar, fome much more eafily than others: and probably, by multiplying experiments, many other remarkable differences may be difcovered in the properties of thefe different precipitates. Aftringents then form with iron different fpecies of compounds, and confequently do not derive their properties from one individual principle found in different vegetables; but there muft be a property common to different fubftances, to enable them to act in an uniform manner on folutions of iron, and to produce precipitates which are more or lefs black, and appear of the fame nature when not examined with a proper degree of attention.

It is neceffary to obferve, that the metallic oxides which unite with the colouring particles, modify their colours; but fome metallic oxides, and particularly that of iron, have colours which vary according to the quantity of oxigene they contain. Iron, when united with only a fmall quantity of oxigene, has a black colour, and forms what is called *martial ethiops*. If any fubftance, by uniting with the oxide of iron, had the property of taking from it a part of the oxigene which it has when precipitated from its folution in an acid, this would be fufficient to give it a black colour; and if the peculiar colour of this fubftance was not predominant, or was of itfelf inclining to black, the compound formed would have a black colour: thus nitrous gas or air, either uncombined or weakly attached to the nitrous acid, renders folutions of iron black, and even precipitates the metal, by depriving it of a portion of its oxigene. By acting in the fame manner, it alfo happens that ammoniac is capable of producing a black precipitate with the folutions of iron; in this cafe the hydrogene of the ammoniac forms water, by combining with the oxigene that is difengaged from the oxide or calx of the iron. As galls are found to precipitate gold and filver from their folutions, by reducing them to their metallic ftate; they therefore have the property of feparating the oxigene from thofe metals, to which it adheres but flightly, and from others, that portion which is retained in the weakeft degree. Any infufion of galls, of itfelf, readily affumes a deep brown colour by expofure to the air; though it is found to abforb but a fmall quantity of vital air. The infufion of fumach, and that of moft other vegetable fubftances, particularly woods and barks, alfo acquire a dark colour by expofure to the air; fo that when acting upon the oxide of iron, by feparating a part of its oxigene, an aftringent ought itfelf to acquire a darker colour, by which the black fhould be affifted. It is evident in what manner various fubftances, which have in other refpects different properties, may produce black with folutions of iron. Among thefe fubftances there are fome which are real colouring particles, and employed as fuch in dyeing; for example, logwood, and even moft kinds of colouring particles, form brown or blackifh precipitates with iron. Sometimes the aftringent effect is not inftantaneous, but produced by degrees, and the colour of the precipitate is at firft light; it grows deeper gradually, being darkened in proportion as the iron lofes its oxigene. This is obfervable in the infufion of fuftic, which produces, with the folution of iron, a yellow precipitate, that grows

brown by degrees, and becomes black after a confiderable length of time.

But though the property of precipitating folutions of iron black, does not indicate the prefence of the fame individual principle in the fubftances which poffefs it, there can be no inconvenience in calling it by the name of aftringent-principle, provided by that term is conveyed only a property which is common to a great number of fubftances, and which they may have in various proportions.

It has been found, that the aftringent principle precipitates iron from almoft all acids; and that the acids of phofphorus and arfenic only have a ftronger attraction than it has for iron; and the phofphoric acid was known to have the property of feparating iron from the fulphuric acid: but all acids except the acetous, and probably fome other vegetable acids which have not been tried, rediffolve the precipitate, and make the colour difappear, until they are faturated with an alkali. It is not furprifing that the aftringent principle can unite with metallic oxides without having the qualities of an acid; for animal fubftances, oils, even alkalis, and lime, have this property. It is well known that it is the precipitate compofed of iron and the aftringent principle, which, by remaining fufpended in the liquor, forms ink.

But, notwithftanding chemifts have confidered the aftringent principle as always the fame, experience had taught us, that all aftringent fubftances were not equally proper for producing a beautiful and durable black; it is of importance to determine which of them may be employed with the greateft fuccefs: it is however very difficult to make comparative experiments on this fubject with perfect accuracy, becaufe fome fubftances require much longer boiling than others to extract their aftringency; becaufe a difference in their coarfenefs or finenefs, when fubjected to ebullition, is fufficient to produce differences in the refults; and becaufe the colouring particles have a greater or lefs difpofition to combine with the ftuff, according to the proportion of fulphate of iron or green vitriol that has been made ufe of. It is alfo neceffary to remark, that folutions of iron in different acids may produce differences in the refults, according to the ftate of oxigenation of the iron in them, according as the proportion of that metal is greater or lefs, and according to the ftrong or weak action, which the different acids, when difengaged, are capable of exerting on the newly formed compound. And, in the dyeing of a ftuff, confiderable alterations may arife from its greater or lefs attraction for the colouring particles.

It has been remarked by Doctor Lewis, that a decoction of logwood employed, inftead of fimple water, for the infufion of galls, increafed the beauty of ink without rendering it paler; that fumach, floe tree, or pomegranate bark, pomegranate flowers, biftort, or tormentil root, and oak bark were not fo powerful as galls. In his experiments on dyeing, he found that fumach, oak bark, or the faw-duft of that wood, could not fupply the place of galls, unlefs they were employed in much larger proportions.

A great many experiments have been made by Mr. Beunie, with a view to determine the beft procefs for giving cotton a durable black. He firft tried what folution of iron gave the fineft black to galled cotton; he afterwards combined different folutions, and examined the durability of the blacks which he produced; and made the fame experiments on galled cotton, with other metals and femimetals; he employed in like manner a great number of aftringents, and tried with them cotton which had received different preparations. He found that out of twenty-one fpecies of aftringents, compared with galls; oak faw-duft, the galls of the country, and yellow myrobolans, were the only fubftances which produced a fine black, but which was ftill neither fo fine, nor fo durable, as that obtained by means of the common gall. He has alfo fhewn, that the oak faw-duft is preferable to the bark, which is employed by the dyers of thread. This, from its being cheaper, may probably be fubftituted with advantage.

The following are the refults of the experiments of Lavoifier, Vandermonde, Fourcroy, and Berthollet, which were made on different aftringents; fuch for inftance as galls, oak bark, rafpings of heart of oak, of the external part of oak, of logwood, and fumach, for the purpofe of forming a comparifon of their qualities.

In order to afcertain the portion of aftringent principle contained in thefe different fubftances, they took two ounces of each feparately, which they boiled half an hour in three pounds of water; after the firft water they added a fecond, which underwent a fimilar ebullition, and continued thefe operations until the fubftances appeared exhaufted: they then mixed together the decoctions that had been fucceffively obtained. A tranfparent folution of fulphate of iron or green vitriol, in which the proportions of water and fulphate had been exactly determined, was made ufe of. They firft eftimated the quantity of the aftringent principle, by the quantity of fulphate which each liquor could decompofe, and afterwards by the weight of the black precipitate which was formed. In order to ftop precifely at the point of faturation, they proceeded very flowly in the precipitation, and towards the end added the folution of fulphate only drop by drop, and ceafed at the moment when the laft added quantity no longer augmented the intenfity of the black colour. When the liquor is too opake to allow its fhade of colour to be diftinguifhed, a fmall quantity of it is largely diluted with water, and, by adding to this a little of the folution of fulphate of iron at the end of a glafs tube, it is difcovered whether or not the point of faturation has been attained: if we then wifh to get the precipitate which is formed, the whole muft be diluted with water in a very copious manner. And this operation is deferving of attention, as being an eafy and accurate mode for manufacturers to determine the proper proportions of aftringents, and folutions of iron. In order to faturate the decoction of two ounces of galls, three drams and fixty-one grains of fulphate of iron were required; the precipitate weighed feven drams, twenty-four grains, when carefully collected and dried.

The colour of the decoction of oak bark is a deep yellow; a very fmall portion of fulphate of iron gives it a dirty reddifh colour, and a larger one changes it to a deep brown. The quantity of fulphate required to faturate the decoction of two ounces of this bark, was eighteen grains. The precipitate collected and dried, formed coarfer and more compact grains, and weighed twenty-two grains; the inner bark of the oak afforded very nearly the fame refult. But the decoction of the rafpings of the heart of oak required for its faturation one dram twenty-four grains, and the precipitate weighed one dram twenty-four grains; the decoction of the external wood of the oak produced very little precipitate. The decoction of fumach acquired a reddifh violet colour when a fmall quantity of the fulphate of iron was added. The quantity required for its faturation was two drams eighteen grains. The precipitate exactly refembled that afforded by the galls. And the decoction of logwood became of a fapphire blue colour, by the addition of fulphate of iron: if the point of faturation be exceeded, the blue becomes greenifh and dirty. The exact quantity required for faturation was found to be one dram forty-eight grains, and the weight of the precipitate was two drams twelve grains. The different precipitations made by means of oak take place readily; that by logwood, a little more difficultly, but ftill more eafily than that which is effected by means of galls.

It was next afcertained by trials made with cloth, that the

quantity of aſtringent ſubſtances required to give a black colour of equal intenſity, to an equal weight of the ſame cloth, was proportional to the quantities of aſtringent principle, which had been already eſtimated in each kind from the foregoing experiments; but the black obtained by means of the different parts of the oak does not reſiſt *proofs* or teſts of colour nearly ſo well as that which is produced by means of galls. It ſeems that logwood alone is not capable of producing ſo intenſe a black as galls or oak; nor does the colour which it produces ſtand the teſt of proofs ſo well as that produced by means of galls.

It may be neceſſary, after having examined the aſtringent principle with reſpect to its affinities with ſolutions of iron, to conſider it in regard to its property of combining with vegetable and animal ſubſtances, but particularly the latter. Silk acquires by galling, which is an operation that conſiſts in macerating a ſtuff in a decoction of ſome aſtringent ſubſtance, a weight which cannot be taken from it, or diminiſhed beyond a certain degree, by repeated waſhing; after which operation, the ſtuff when put into a ſolution of iron is dyed black, becauſe the aſtringent principle, decompoſing the ſulphate of iron, forms a triple compound with the oxide of iron and the ſtuff which is dyed. A ſtuff that is galled is likewiſe capable of combining with other colouring particles, the colours of which thereby acquire fixity, if they do not naturally poſſeſs it; ſo that the aſtringent communicates its durability to the triple compound, or perhaps the more complex one which is formed; but by this union the colour generally becomes of a deeper ſhade. It is found that the aſtringent principle, by combining with animal ſubſtances, renders them incapable of corruption, and tends to render their texture more compact; and in this the art of tanning conſiſts.

It has been found that an ounce of galls diſtilled with a ſtrong heat, yielded three drams of charcoal; an ounce of ſugar, two drams twelve grains; an ounce of the colouring particles of flax, two drams twenty-four grains; an ounce of dry plum-tree, one dram forty-eight grains; an ounce of dry walnut-tree, alſo one dram forty-eight grains; ſo that galls yield almoſt double as much charcoal as hard and dry wood. From theſe obſervations, Mr. Berthollet is led to conſider the abundance of charcoal as the eſſential characteriſtic of the aſtringent principle; the hydrogene, which it contains only in ſmall quantity, is however very much diſpoſed partially to combine with oxigene: hence it is that when an infuſion of galls is left in contact with vital air, a ſmall quantity of the air only is abſorbed, and yet the colour of the infuſion becomes much deeper; for in conformity with the theory already laid down, the charcoal readily becomes predominant in conſequence of the ſlight combuſtion, and the colour is rendered deeper and made brown.

Subſtances which contain much charcoal, and can undergo only a ſlight degree of combuſtion, ought to poſſeſs conſiderable durability, becauſe charcoal does not combine with oxigene in the ordinary temperature of the air, unleſs its union be aſſiſted by other attractions, and becauſe ſlight variations of temperature produce no change in the dimenſions of charcoal; but, on the contrary, ſubſtances which contain much hydrogene, and in which the particles of the hydrogene are in a ſtate of diviſion, ought to be eaſily decompoſed, by the combination of the hydrogene with azote or oxigene. The diſunion of their parts ought to take place from ſmall variations of temperature, becauſe hydrogene is dilatable by heat, which the carbonaceous particles are not. When therefore the aſtringent principle is combined with an animal ſubſtance, it communicates to it the properties which it derives from the charcoal; the animal ſubſtance becomes leſs liable to change from ſlight variations of temperature; inſtead of growing putrid, it ſuffers a ſlight degree of combuſtion, by the action of the air; for the proceſs of tanning probably could not go on in a perfectly cloſe veſſel: the effect of this combuſtion is the conſtriction of the parts, which alſo afterwards aſſiſts as a cauſe of preſervation. On examining the analyſes that have been made of indigo, which may be looked upon as the colouring matter leaſt liable to change of any we are acquainted with, it will be found that this ſubſtance leaves, in diſtillation, a greater proportion of charcoal than even galls themſelves. Mr. Berthollet ſuppoſes that it is alſo to this abundance of charcoal that the durability of the colour of indigo is to be attributed, and that the proportion of this principle is the chief cauſe of the difference obſerved in the durability of colours; but the force of adheſion may alſo have great influence, for a principle which combines intimately with another ſubſtance, ought to form with it a more permanent compound, than one which has only a ſlight diſpoſition to unite with it; now the aſtringent principle poſſeſſes a very ſtrong diſpoſition to form intimate combinations, eſpecially with animal ſubſtances. Upon the ſame principles may be explained the fixity communicated to colouring particles by alumine, and by thoſe metallic oxides which are not liable to contain different proportions of oxigene, ſuch as the oxide of tin, and ſome others.

The different colouring ſubſtances which are capable of uniting with metallic oxides, have an action upon them, which is analogous to that of aſtringents in a conſiderable degree. And thus the oxides are deprived of more or leſs of their oxigene, according to the force with which they retain it, the ſtrength of attraction with which the colouring particles tend to combine with them, the proportions in which they meet with each other, and the greater or leſs diſpoſition of the colouring particles towards combuſtion. The colouring particles alſo ſuffer a change in their conſtitution, from theſe circumſtances: thus, the ſolutions of iron render brown all the colours into which oxide of iron can enter, although it has only a green or yellow colour in the ſtate in which it is held in ſolution by acids, and this effect goes on increaſing to a certain degree; but the alteration of the colouring particles may afterwards be carried ſo far as to ſpoil their colour, and to diminiſh their tendency to combination; the oxide of iron is then brought back to the yellow colour, by the oxigene which it attracts, and is capable of retaining. The action of metallic oxides and the colouring particles on each other, explains the changes obſerved in ſolutions of the colouring particles, when mixed with metallic ſolutions. The effect is gradual, as has been ſhewn with reſpect to fuſtic. It ſometimes happens that the mixture does not even grow turbid immediately, but loſes its tranſparency by degrees; the precipitation begins; the ſediment is formed, and its colour grows gradually deeper. In producing theſe effects, light has ſometimes a conſiderable ſhare.

From the whole of what has been hitherto advanced, the following concluſions may be drawn: That metallic colours ſhould be diſtinguiſhed from thoſe which are peculiar to ſubſtances of the vegetable and animal kind: that the colours of metals are modified and changed by oxidation, and by the proportion of oxigene with which they are combined; and that vegetable and animal ſubſtances may themſelves poſſeſs a peculiar colour, which varies in the different ſtates through which they paſs, or they may owe their colours to tingeing particles, either combined, or ſimply mixed with them. Theſe are the particles which are extracted from different ſubſtances, and which undergo different preparations, in order to render them proper for the various purpoſes of the dye. And the colouring particles poſſeſs chemical properties which diſtinguiſh them from all other ſubſtances: the attractions which they have for acids, alkalis, earths, metallic oxides, oxigene, wool, ſilk, cotton, and linen, form the principal of theſe properties. In proportion to the attraction which the colouring particles have

for wool, silk, cotton, and linen, they unite more or less readily, and more or less intimately with each of these substances; and thence arises the first cause of variation in the processes employed, according to the nature of the stuff and of the colouring substance employed. And by the attraction which the colouring particles have for alumine and metallic oxides, they form compounds with these substances, in which their colour is more or less modified, becomes more fixed, and more difficultly affected by external agents than before. This compound, being formed of principles which have separately the power of uniting with vegetable substances, and more especially with animal substances, preserves this property, and forms a triple compound with the stuff; and the colour, which has been again modified by the formation of this triple union, acquires a greater degree of fixity, and of indestructibility, when exposed to the action of external agents.

It frequently happens that the colouring particles have so great an attraction for alumine and metallic oxides, that they separate them from acids which held them in solution, and fall down with them; but the attraction of the stuff is sometimes necessary, in order that this separation may take place. The oxides of metals, which combine with the colouring particles, modify their colours, not only by their own, but also by acting upon their composition by means of their oxigene. The change which the colouring particles thereby suffer, is similar to that occasioned by the air, which injures every colour in a greater or less degree. In the two different principles which constitute the air of the atmosphere, it is only the vital air or oxigenous gas that acts upon the colouring particles: it combines with them, weakening their colour, and rendering it paler; but presently its action is principally exerted on the hydrogene which enters into their composition, and it then forms water. This effect ought to be considered as a true combustion, whereby the charcoal which enters into the composition of the colouring particles becomes predominant, and the colour commonly changes to yellow, fawn colour, or brown; or the injured part, by uniting with what remains of the original colour, causes other appearances of a different kind. The combustion of the colouring particles is increased by light, and which frequently cannot take place without its aid; it is in this way that it contributes to the destruction of colours. Heat promotes it also, but less powerfully than light, provided its intensity be not very great. The effects of the nitric acid, the oxigenated muriatic acid, and even the sulphuric acid, when they make the colour of the substances upon which they act pass to a yellow, and even to black, are to be attributed to a combustion of a similar nature.

It is possible, however, that the effects of combustion may be concealed, by the oxigene combining with the colouring particles, without the hydrogene being acted upon by it in a particular manner. But colours are more or less durable, or more or less fixed, in proportion to the greater or less disposition of the colouring particles to suffer this combustion, and to permit it to proceed to a greater or less degree. There are some substances also capable of acting on the colour of stuffs, by a superiority of attraction, or by a solvent power; and in this consists the action of acids, alkalis, and soap. A small quantity of these agents, however, may sometimes form supracompounds with the stuff, and its colour may be altered in that way. The oxides of metals produce in the colouring particles, with which they unite, a degree of combustion proportioned to the quantity of oxigene which these particles can take from them. Therefore the colours which the compounds of metallic oxides and colouring particles assume, are the product of the colour peculiar to the colouring particles, and of that peculiar to the metallic oxide; but the colouring particles and metallic oxides must be considered in that state to which they have been reduced by the diminution of oxigene in the oxide, and the diminution of hydrogene in the particles that produce the colour. It consequently follows from this, that the metallic oxides, to which the oxigene is only slightly attached, are not fit to serve as connecting media for the colouring particles, because they produce in them too great a degree of combustion; instances of this kind are the oxides of silver, gold, and mercury:—that the oxides which undergo considerable alterations of colour, by giving off more or less of their oxigene, are also bad intermedia, particularly for light shades, because they produce changeable colours; examples of this kind are the oxides of copper, of lead, and of bismuth:—that the oxides which strongly retain their oxigene, and undergo very little change of colour by the loss of a portion of it, are the most suited to answer this purpose; such is particularly the oxide of tin, which quits its menstruum easily, which has a strong attraction for the colouring particles, and which affords them a basis which is very white, and proper for giving a brightness to their shades, without altering them by the admixture of another colour. The oxide of zinc is possessed of some of these properties in a considerable degree.

But in order to account for the colours, which proceed from the union of the colouring particles with the basis which a mordant gives them, it is necessary to attend to the proportion in which the colouring particles unite to that basis: thus, the solution of tin, which produces a very copious precipitate with a solution of colouring particles, and which thereby proves that the oxide of tin enters in a large proportion into the precipitate, has a much greater influence on the colour of the precipitate, by the whiteness of its basis, than the solution of zinc, or that of alum, which generally produce much less copious precipitates. The precipitates produced by these two last substances retain very nearly the natural tint which the colouring particles afforded. It is therefore necessary to distinguish, in the action of mordants, the combinations that may take place by their means, between the colouring particles, the stuff, and the intermedium; the proportions of the colouring substance and intermedium, the modifications of colour, which may arise from the mixture of the colour of the colouring particles, and of that of the basis to which they are united; and finally, the changes which the colouring particles may suffer, from the combustion that may be produced by the substance that is employed as an intermedium. It is evident also that astringents do not derive their characteristic property from an acid, or from any other individual principle which is always the same, but from the property which they possess, of uniting with the oxide of iron, of reducing it to the state of a black oxide, and of acquiring themselves a dark colour, by the combustion they thereby experience. Galls, which are to be considered as the type of astringents, readily undergo a slight combustion, which gives them a deep brown colour; but this combustion, which requires but a small quantity of oxigene, soon ceases, without their properties being in any degree injured. But galls owe their stability to the large proportion of charcoal they contain; and as they have the property of combining with some vegetable substances, with several colouring matters, and particularly with animal substances, they serve as intermedia for them, and impart to them that stability which they possess in so very high a degree.

On the ingenious theory which has been advanced above, Doctor Bancroft, an able writer on the subject of Dyeing, has made some observations which it may not be improper to notice. It seems to be his opinion, that Mr. Berthollet, in ascribing the decays of vegetable and animal colouring matters in general to effects or changes similar to those of *combustion*, has gone much further than is warrantable by facts. It cannot, he thinks, be his intention that we should apply the term of combustion to alterations which result from a simple addition of oxigene, to

colouring matters, without a deſtruction or ſeparation of any of their component parts; though a great many of the decays and extinctions of theſe colours evidently ariſe only from ſuch ſimple additions of oxigene. The nitric, ſulphuric, and other acids containing oxigene, have the power not only of weakening, but of extinguiſhing, for a time, the colours of many tingent matters; not however by any effect which can properly be denominated a combuſtion, but rather by a change in their ſeveral affinities or attractions for particular rays of light in preference to other rays; but none of their parts being deſtroyed, or carried away, the addition of an alkali, or of calcareous carbonate, will generally undo ſuch alteration, and reſtore the original colour, by decompoſing and neutralizing the acid or oxigene which had cauſed the alteration. Of this hundreds of inſtances might be given, it being the caſe of almoſt all vegetable or animal colouring matters: it will however be ſufficient to mention, what moſt people have ſeen, that ink, dropped into a glaſs of diluted nitric, vitriolic, or other acid, will loſe its colour, and that it may be again reſtored by adding a ſuitable portion of vegetable or foſſil alkali; and that this may be done ſeveral times with the ſame ink, and therefore the change, or loſs of colour, could not have been the effect of combuſtion. If however this ink had been fixed by dyeing in the ſubſtance either of wool, ſilk, linen, or cotton, and the ſubſtance ſo dyed had been dipped into a glaſs of diluted acid, as before mentioned, a conſiderable part of the colouring matter would have been diſlodged, and ſeparated from the dyed ſubſtance, by its affinity with the oxigene or acid; and though no combuſtion had taken place, the colour ſo ſeparated and loſt could not be again reſtored without a ſecond dyeing: and this loſs of colour would be ſimilar to what frequently happens to colours from expoſure to ſun and air, by which they are gradually weakened, many of them without any other change of tint than the ſimple diminution of their original body, or quantity of colouring matter; and this continuing in the more fugitive colours, particularly that of turmeric, the cloth is ſoon left as white as before it had been dyed, without any thing like combuſtion having ever taken place in it, or in the matter with which it was dyed. It may alſo be preſumed, he thinks, that colours are not generally impaired by any thing like combuſtion, from this fact—that there are but few of them which the common muriatic acid does not injure as much as either the nitric or the ſulphuric; and as there can be no combuſtion without oxigene, and as the common muriatic acid either contains none, or what it does contain is confeſſedly combined with it, by an affinity too powerful to be overcome by any known ſubſtance or means, it neceſſarily follows that the oxigene (if it contain any) cannot be liberated ſo as to act in the way of combuſtion upon any other matter; and therefore, when the common muriatic acid changes or deſtroys the colours in queſtion, it changes or deſtroys the affinities upon which they depend, by producing effects different from thoſe of combuſtion; and as the changes which it produces on colours are in moſt caſes ſimilar to thoſe produced by the nitric, ſulphuric, and other acids known to contain oxigene, it ſeems reaſonable to conclude that theſe alſo act upon colours, by producing other effects than thoſe of combuſtion.

Mr. Sennebier expoſed a great variety of woods to the action of the ſun and air, and found all their colours very ſoon affected. The white woods were generally made brown, and the red and violet changed either to yellow or black. Guaiacum was rendered green; the oak and the cedar were whitened, as were the brown woods generally; effects which certainly do not reſemble thoſe of combuſtion, any more than the bleaching of wax and tallow by expoſure to the air. It is therefore evident, as the Doctor ſuppoſes, that the colour of each particular ſubſtance depends on its peculiar conſtitution, producing in it a particular affinity or attraction for certain rays of light, and a diſpoſition to reflect or tranſmit certain other rays; and in this reſpect it may doubtleſs ſuffer very conſiderable changes from the action or combination of oxigene, without any effects ſimilar to thoſe of combuſtion. And indeed the changes of colour which ariſe from the acceſs of vital or atmoſpheric air, ſeldom reſemble thoſe which the mere predominance of blackneſs, which is the ſuppoſed natural colour of carbone or charcoal, would produce; though this may have been the caſe with the colouring matter of brown or unbleached linen, upon which the experiments of Mr. Berthollet ſeem principally to have been made. But whether the action of vital air, or its baſis, in promoting the decays of colours, ought to be denominated a combuſtion or not, Dr. Bancroft is confident that at leaſt ſome of them are liable to be impaired, not ſo much by an acceſſion of oxigene, as by the loſs of it. The difference of colour in arterial and venal blood has been long ſince noticed, and numerous experiments have lately ſhown that the fine vermilion colour of the former is produced ſolely by vital air, which it is capable of acquiring even through bladders, the coats of blood veſſels, &c. And very recently, Mr. Haſſenfratz ſeems to have proved, that as this fine red colour is gained by a diſſolution of oxigene in the arterial blood, ſo it is loſt, and the dark colour of the venal blood reſtored, by a ſeparation of the oxigene, in conſequence of its forming a new combination with the hydrogene and carbone of the ſame.

It ſeems evident to the Doctor, that the blue colour of indigo abſolutely depends upon a certain portion of oxigene; for he has found that a ſolution of indigo, by loſing its oxigene, may become as pellucid, and, excepting a very ſlight yellowiſh tinge, as colourleſs as water, and afterwards ſpeedily return through all the ſhades of yellow and green to its original deep blue, by expoſure to atmoſpheric or vital air. Similar to this, he remarks, is the fact long ſince obſerved by the abbé Nollet, of the tincture of archil-orchella employed to colour the ſpirit of wine uſed in thermometers, and which after ſome time loſes its colour, but ſoon recovers it again upon being expoſed to atmoſpheric air. And this alſo happens to the infuſion of turnſole, and to ſyrup of violets, which both loſe their colours when ſecluded from air, and regain them when placed in contact with it. He has alſo obſerved various animal and vegetable colours, produced ſolely by the contact of vital or atmoſpheric air; and ſome others, which, when given by dyeing or callico-printing to wool, ſilk, cotton, &c. though unable to ſuſtain a ſingle day's expoſure to the ſun and air without manifeſt injury, were found to receive none from the action of ſtrong nitric or ſulphuric acids, but, on the contrary, were preſerved by being wetted with them, and even with oxigenated muriatic and ſulphuric acids. But the ſame colours, if covered with linſeed oil, were found to decay more quickly from expoſure to the ſun and air, than if uncovered. Theſe colours therefore, he contends, could not owe their decay to the contact or combination of oxigene, becauſe they were not only unhurt, but benefited by its concentrated powers in the nitric, the oxigenated muriatic and ſulphuric acids; and alſo becauſe they were ſooneſt impaired when defended from the acceſs of oxigene, by being covered with linſeed oil. Probably the decays of theſe colours were occaſioned by a loſs of at leaſt ſome part of the oxigene which was neceſſary to their exiſtence, and which the linſeed oil aſſiſted in depriving them of, by the ſtrong affinity which it is known to have with oxigene or vital air.

The Doctor further obſerves, that, in forming ſyſtems, we are apt to draw general concluſions from only a partial knowledge or view of facts. And this even Mr. Berthollet ſeems to have done, not only in aſcribing the decays of vegetable and animal colours, *excluſively* to effects ſimilar to thoſe of combuſtion, but

alſo in repreſenting the oxigenated muriatic acid as an accurate teſt or meaſure for anticipating, in a few minutes, the changes which theſe colours are liable to ſuffer, by long expoſure to the action of ſun and air; for, ſays he, though it doubtleſs is true that the oxigenated muriatic acid, in weakening or deſtroying colours, gives up to them more or leſs of the oxigene which it had received by diſtillation from manganeſe; and that, by this new combination of oxigene, thoſe affinities for particular rays of light, upon which their colours depend, are liable to be deſtroyed; it is nevertheleſs true, that the changes of colour ſo produced are no certain indication of thoſe which the combined influence of light and air will occaſion upon colours in general; there being ſeveral colours which are very ſpeedily deſtroyed by the latter of theſe cauſes, though they reſiſt the ſtrongeſt action of the oxigenated muriatic acid, without ſuffering any degree of injury or hurt. The Doctor adds, that Mr. Berthollet well knows, ſince nobody has contributed more to aſcertain how much the properties of oxigene are diverſified by each particular baſis to which it unites; and that it does not therefore ſeem warrantable to imagine that its action will not be modified by a baſis ſo powerful as that of the common muriatic acid, or that the united properties of both ſhould repreſent or reſemble thoſe of atmoſpheric air upon colours any more than they do in the lungs by reſpiration, where, inſtead of ſupporting life, they would inſtantly put an end to it.

On the whole, Doctor Bancroft is of opinion that, until further diſcoveries ſhall have been made, we are only authoriſed to conclude, that the permanent colours of natural bodies do not depend upon their thickneſſes, ſizes, or the denſities of their ſeveral parts or particles, but upon certain affinities or attractions (chymical or phyſical) by which they are diſpoſed to abſorb and conceal ſome of the rays of light, and to reflect or tranſmit other rays, giving the ſenſations or perceptions of their reſpective colours; that the contact of light greatly contributes towards producing theſe affinities or attractions: but it only does this (as far as we yet know) either by promoting a combination or a ſeparation of the baſis of vital air in the different coloured or colouring ſubſtances. But though moſt of the changes of colour, in permanently coloured bodies, evidently depend on changes in their reſpective portions of oxigene, he is far from thinking that this cauſe operates excluſively in all caſes, or that chemical knowledge is yet far enough advanced to juſtify even an attempt towards a complete hypotheſis reſpecting theſe moſt abſtruſe and moſt intereſting phenomena. The opinions of this author are however, by no means ſatisfactory, ſince they want the ſupport of facts and experiments.

PART II.

OF THE PRACTICE OF DYEING.

IN treating of the practice of the art of dyeing, it will firſt be neceſſary to conſider the proceſſes which are generally employed, and the differences that exiſt between ſeveral of the ſubſtances which are to be dyed; ſuch for inſtance as wool, ſilk, cotton, and linen; and the operations by which theſe different ſubſtances are prepared for taking the dye that is deſigned to be given to them.

Sect. I. *Of the Difference between Vegetable and Animal Subſtances.*

Although it may be difficult to account for many properties which depend upon the compoſition of organized bodies, the knowledge that has been acquired reſpecting the compoſition of vegetable and animal ſubſtances, may afford us ſome light reſpecting the cauſe of the different diſpoſitions of wool, ſilk, cotton, and linen, to unite with the colouring particles, and with the baſes which mordants afford. It is well known that wool and ſilk are animal ſubſtances; and that cotton, flax, and hemp are productions of the vegetable kind. It is now pretty generally known that the compoſition of animal ſubſtances is diſtinguiſhed from that of vegetables by their abounding in a particular principle, *azote*, which, when in its elaſtic form, conſtitutes what is called *phlogiſticated gas*, *phlogiſticated air*, *&c.* which is found only in ſmall quantity in vegetables; ſecondly, by their containing much more hydrogene, or baſe of inflammable air, than is found in the other. It is from theſe two cauſes that the differences obſerved in the diſtillation of animal and vegetable ſubſtances proceed: the former yield a large quantity of ammoniac or volatile alkali, which is compoſed of azote and hydrogene; the latter afford very little, and commonly yield even an acid: the former yield a great deal of oil, the predominant principle in which is hydrogene, which is very volatile and diſpoſed to fly off by a ſmall increaſe of temperature; while the latter ſometimes do not yield it in the leaſt ſenſible quantity. In conſequence of this compoſition, animal ſubſtances, when ſet on fire, produce a bright flame, which breaks out at the beginning, but is ſoon ſtifled, as it were, by the charcoal which is formed, and which has peculiar properties; their combuſtion is accompanied with a penetrating odour, owing to the ammoniac and oil which are produced and eſcape unconſumed: they are liable to putrefaction, in which proceſs ammoniac is produced, as well as in their diſtillation, by a more intimate union of the azote and hydrogene; while vegetable ſubſtances, on the contrary, undergo the vinous or acetous fermentation. It is evident that, as animal ſubſtances contain a conſiderable quantity of principles diſpoſed to aſſume an elaſtic form, they have leſs coheſive force among their particles than vegetables have, and a greater diſpoſition to combine with other ſubſtances; hence they are more liable to be deſtroyed by different agents, and are more diſpoſed to combine with colouring particles. And thus, pure or cauſtic fixed alkalis deſtroy animal ſubſtances, becauſe they combine with them, and are ſaturated by them, loſing their cauſticity. The conſequence of this action of alkalis on animal ſubſtances is, that they cannot bear leys, and that alkalis ſhould be uſed with great caution, in the proceſſes employed for dyeing them; whereas, no danger is to be apprehended from the uſe of alkalis with ſubſtances of the vegetable kind.

It is alſo obvious, that the nitric and ſulphuric acids muſt have conſiderable action on animal ſubſtances; the former decompoſes them, extricates the azote, ſeparates the fatty matter, and forms carbonic acid or fixed air, and oxalic acid or the acid of ſugar, with a part of the hydrogene and a part of the charcoal: the latter extricates the inflammable gas, probably azotic gas, and reduces the other principles to the ſtate of vegetable coal or carbone. It would ſeem that ſilk bears ſome reſemblance to vegetable ſubſtances, from its being leſs diſpoſed to combine with colouring particles, and by reſiſting the action of alkalis and acids more powerfully; which may ariſe either from the ſame principles being more intimately combined in it than in wool, or more probably, from its containing leſs azote and hydrogene: but though the action of alkalis and acids upon ſilk be weaker than upon wool, they ſhould ſtill be employed with great caution, becauſe the brightneſs of colour required

in silk, appears to depend upon the smoothness of its surface, which should on that account be preserved unimpaired, with every possible attention.

It has been found that cotton withstands the action of acids much better than flax or hemp, and that even the nitric acid does not destroy it without great difficulty.

Of Wool.—Both the value of this substance, and its fitness for the different kinds of manufacture, depend upon the length and fineness of its filaments; and it is these qualities which constitute the chief differences in wool. That which has the finest filaments, is reserved for fine cloths. Wool of the finest kind is brought from Spain. But although the long wool is not so fine as the Spanish, and cannot be employed for fine cloths, it is still very useful in forming different cloths.

It is very well known that wool is naturally covered with a kind of grease, called *suint*, which preserves it from moths, as has been remarked by Reaumur, so that it is not scoured until it is about to be dyed, or formed into yarn. With a view to scour wool, it is necessary to put it about a quarter of an hour into a kettle, containing a sufficient quantity of water, mixed with a fourth of putrid urine, heated to such a degree as the hand can just bear, and it must be stirred from time to time with sticks; it is then taken out, put to drain; and then carried in a large basket to a stream of running water, where it is moved about until the grease is entirely separated, and no longer renders the water turbid; it is afterwards taken out, and left to drain. It sometimes loses in this operation more than a fifth of its weight. The scouring should be performed with great care, because the wool is better fitted to receive the dye, by being exact in this operation. For in this process the ammoniac, or volatile alkali, formed in putrid urine, unites with the grease, producing a kind of soap, which water is capable of dissolving. Wool is chiefly dyed in the fleece, or before it is spun, when it is intended to form cloths of mixed colours; or else it is dyed after being spun, and it is then intended principally for tapestry: but it is most generally dyed after having been manufactured into cloth. If wool be dyed in the fleece, its filaments, from being separate, absorb a larger quantity of the colouring particles than when it is spun; for the same reason, woollen yarn takes up more than cloth: but cloths themselves vary considerably in this respect, according to their degree of fineness, or the closeness of their texture; besides the variety in their dimensions, the different qualities of the ingredients employed in dyeing, and a difference of circumstances in the process, prevent us from relying upon the precise quantities we find recommended for the processes described. This is a consideration which ought in all dyes to be attended to. For the generality of colours, wool requires to be prepared by a bath, in which it is boiled with saline substances, principally with alum and tartar; this is called the *bouillon* by the French dyers, which will be accurately described in the different processes: but there are some dyes for which the wool does not require such a preparation; then it must be well washed in warm water, and wrung out, or left to drain. This is a general rule, which should be observed with respect to all the substances we wish to dye, in order that the colour may penetrate them more easily, and be distributed in a more uniform manner.

The operation of felting, and the effects of fulling, have been explained by Mr. Monge, from the external conformation of the wool and hair of animals. His observations on this subject are very curious. In the filaments of wool, or in the hairs of animals, nothing particular is observable by the use of the microscope; yet the surfaces of these bodies are not smooth; they seem to be formed either of small laminæ placed over each other in a slanting direction from the root towards the point, like the scales of fish, which cover each other, from the head of the animal to the tail; or more probably, perhaps, of zones placed one upon another, as we see in the horns of animals of different kinds. When a hair is laid hold of by the root in one hand, and drawn between the fingers of the other, from the root towards the point, scarce any friction or resistance is perceived, and no noise is heard; but if, grasping it by the point, it be passed in the same manner between the fingers of the other hand, from the point towards the root, a resistance is felt which did not take place in the former case, and a tremulous motion is evident to the touch, and a noise may be distinctly heard. It is obvious therefore, that the texture of the surface of hair is not the same from the root towards the point, as it is from the point towards the root; and that a hair, when pressed, must meet with greater resistance in sliding or moving towards the point, than towards the root. When, after having laid hold of a hair between the thumb and fore finger, we rub them against each other, in the longitudinal direction of the hair, it acquires a progressive motion in that direction towards the root. This effect depends neither on the nature of the skin of the finger, nor on its texture; for if the hair be turned, so that the point shall be placed where the root was before, its motion will now be in a direction exactly the contrary.

These observations, though related of human hair, are equally applicable to the filaments of wool, to horse hair, and to that of animals in general. The surface of all these bodies is therefore formed of rigid laminæ, laid upon each other like tiles, from the root to the point. And it is this structure which is the principal cause of the disposition to felting, which the hair of animals generally possesses.

Another operation, which is that of *fulling* woollen stuffs, is so closely connected with felting, that it is necessary to take notice of it in this place. The roughness of the surface of the filaments of wool, and their disposition to acquire a progressive motion towards the root, forms an obstacle to the spinning of wool, and the working it into stuffs; all the filaments must therefore be covered with a coat of oil, which by filling the cavities renders the asperities less sensible, just as a coat of oil renders a fine file still smoother. When the piece of stuff is wrought, it must be freed from that oil, which gives it a disagreeable smell, renders it dirty, and would prevent it from taking the colour we wish to dye it; for this purpose, it is taken to the fulling-mill, where it is beaten with large beetles, in a trough of water, through which some fullers' earth has been diffused. This earth, uniting with the oil, renders it soluble in the water, and both are carried off together, by fresh water brought thither by the machine; and the stuff is found clean scoured, after some length of time.

Scouring, however, is not the only object in fulling; the alternate pressure of the beetles on the stuff, particularly when the scouring is advanced, produces an effect analogous to that of the pressure employed in felting; the filaments of wool which compose a thread of the warp or of the woof, acquire a progressive motion, insinuate themselves into the adjoining threads, then into those which are next, and presently all the threads both of the warp and woof are felted together. By this means the stuff is formed into a clothing of a much warmer kind.

Of Silk.—The fibres of this substance are naturally coated over with a substance which has been considered as a gum or kind of varnish, to which it owes its stiffness and elasticity. Most of that which is commonly met with in Europe, contains besides, a yellow colouring matter. And most of the purposes for which silk is employed, require that it should be deprived not only of its colouring matter, but also of its gum or varnish. Both these purposes are answered by means of soap, and the term scouring is applied to this operation, by which it acquires its suppleness and whiteness. The scouring ought

not to be fo complete for filks which are to be dyed, as for thofe which are intended to remain white; and a difference ought even to be made, according to the colour which the filk is to have given to it. The difference in fcouring chiefly confifts in the quantity of foap employed; thus, for common colours, it is generally thought fufficient to boil the filk for three or four hours, in a folution of twenty pounds of foap for each hundred of filk, taking care to fill up the kettle with water from time to time, that there may be always a fufficient proportion of fluid. The quantity of foap is increafed for thofe filks which are to be dyed blue, and more efpecially for thofe that are to be fcarlet, cherry colour, &c. becaufe for thefe colours the ground muft be whiter than for fuch as are lefs delicate in their nature.

In cafes where filk is to be employed white, it muft undergo three operations. The firft is called by the French *dégommage*; it confifts in keeping the hanks of filk in a folution of thirty pounds of foap to a hundred of filk: this folution ought to be very hot, but not boiling; when that part of the hanks which is immerfed is entirely freed from its gum, which is known by the whitenefs it acquires, the hanks are turned upon the fkein fticks, fo that the part which was not before immerfed may undergo the fame operation. This is called by the workmen *fhaking over*. They are then taken out of the kettle, and wrung out, according as the procefs is finifhed.

To the fecond operation the title of the *cuite* has been given in France. In this operation the filk is put into bags of coarfe cloth, five-and-twenty or thirty pounds in each bag, which is called a boiling bag. A bath of foap is prepared like the former, but with a lefs quantity of foap; in this the bags are boiled for an hour and a half, taking care to keep them conftantly ftirred, that thofe which touch the bottom of the kettle may not have too much heat communicated to them.

In the third operation, which is called by the French dyers *blanchiment*, it is principally intended to give the filk a flight caft, to make the white more pleafing, and from which it derives different names, fuch as china white, filver white, azure white, or thread white. A folution of foap is prepared, the proper ftrength for which is determined by its mode of frothing when agitated; for the china white, which fhould have a flight tinge of red, a fmall quantity of annotta is added, and the filk is fhaken over in it, until it has acquired the defired fhade. To the other whites more or lefs of a blue tinge is given, by adding a little blue to the folution of foap; though fome had been previoufly introduced into the bath called the *cuite*.

But in order to prepare the azure, fine indigo is taken, and after being well wafhed two or three times in moderately warm water, it is ground fine in a mortar, and boiling water poured on it; it is then left to fettle, and the liquor alone is employed, which retains only the moft fubtile parts: this is called azure. A fmall quantity of the liquor of a frefh vat of indigo may alfo be fubftituted for this colour. At Lyons, in France, where they make a beautiful white, no foap is ufed in the third operation; but after the fecond, the filks are wafhed, fumigated with fulphur, and azured with river water. In this method, it is of importance that very clear water be made ufe of. As foon as the filk has become very uniform, and has acquired the defired fhade, it is wrung out and dried afterwards. But the white obtained by thefe means is not yet fufficiently bright, for the filk intended for white ftuffs; it muft therefore be ftill further expofed to the vapour of fulphur. As foap appears to impair the luftre of filk, fubftitutes for it have been propofed. Mr. Rigaut has propofed fubftituting for foap a folution of foda, or carbonate of foda, fo much diluted with water as not to injure the filk; but this has not yet been generally employed. The obfervations of the abbé Collomb refpecting the fcouring of filk by the action of water alone, are highly deferving of attention. Having perceived that a fkein of yellow filk, which he had boiled for about three hours in common water, had loft nearly one eighth of its weight, he repeated the boiling twice, by which he brought the diminution very nearly to one quarter. But filk which has fuffered this lofs of weight, ftill retains a yellow or rather chamois colour, which renders it unfit for white ftuffs, or for fuch as are intended to receive any colour the beauty of which depends on the whitenefs of the ground upon which it is applied; but it takes thofe colours very well which cannot be injured by the tinge it retains; for the black which it received after this, feemed preferable to that which it took when fcoured with foap. A particular advantage is, that the filk remains very firm and ftrong after this operation; for threads of it, compared with fimilar ones fcoured with foap, fupported weights which broke the latter. It is found that eight hours of brifk ebullition are required to diffolve the whole gummy coat of filk, and that it thereby lofes a little more than one fourth of its weight; but the boiling ought to be continued longer when the barometer is low, becaufe the greater the weight of the atmofphere, the higher is the degree of heat at which the ebullition of water takes place. On this account Mr. Collomb was led to try the effect of boiling filk in Papin's digefter; and he found that only one hour and a quarter were required to complete the folution of the gummy coat, although the degree of heat muft have been inferior to that which produced many of thofe effects that have been generally noticed in ufing this digefter. Silk ftuffs prepared by Mr. Collomb's method feemed to have the qualities which he mentions; but it had lefs fupplenefs and foftnefs than filk fcoured in the ufual way. The fubftance feparated from filk by water in thefe operations, was black, brittle, and of a fhining fracture; it afforded by diftillation the ufual products of animal fubftances; it diffolved eafily in warm water, and left very little refiduum on the filter; the folution, which is tranfparent, and of a greenifh yellow colour, did not feem to be fenfibly affected either by acids or alkalis. A folution of alum produced in it a dirty white precipitate; that of copper, a dark brown precipitate; that of fulphate of iron, a brown precipitate; nitro-muriatic folution of tin, or folution of tin in aqua regia, a white precipitate; acetite of lead, a brown precipitate. All thefe precipitates were in fmall quantity, and more or lefs vifcous. A white precipitate was alfo produced by the infufion of galls and fumach.

This fubftance is not diffolved in alcohol even by ebullition, it takes up only a yellow colouring matter; by evaporation, a refiduum of fcales of an amber yellow was afforded by folution. On adding fome drops of muriatic acid to nearly two ounces of alcohol, and boiling it on twenty grains of the filk gum, a folution took place; but, on cooling, this fubftance appeared like jelly. It therefore feems that the fubftance taken from the filk in the fcouring is of an animal nature, and that confequently the foap-fuds ufed in that operation foon become putrid. When feparated from the filk, it is eafily diffolved in water, but not in alcohol. Though not of a vegetable nature, it may with confiderable propriety be called a gum. That part which gives it the yellow colour is foluble in alcohol, and when it is feparated, the gum becomes brown. It is not improbable that this colour is occafioned by the heat to which it is expofed in the boiling, becaufe, when only the yellow colouring part is feparated, the filk is whitened very evidently.

In the procefs which has been propofed by Mr. Collomb, the gum is feparated, and takes with it only fome of the colouring particles; but in the procefs of fcouring by foap, the gum and the yellow colouring particles are both carried off at the fame time.

Mr. Berthollet boiled fome yellow filk in a retort, where, as the vapours did not efcape fo freely as from an open veffel, a

degree of heat muſt have been produced, ſuperior to that of water boiling in the open air. After having been boiled for four hours, the ſilk had loſt one fourth of its weight, but its colour was ſcarcely altered. Another pattern treated in the ſame way, in a quantity of water impregnated with common ſalt, became whiter, but loſt leſs of its weight, though the degree of heat was certainly increaſed by the addition of the ſalt, which reſtrained the evaporation of the water; poſſibly a part of the ſalt had united with the ſilk. By making experiments with other ſalts, we ſhould probably find ſome that might be employed in diſſolving the gum and colouring particles without injuring the ſilk. If ſilk be intended for the manufacture of blonds and gauzes, its natural elaſticity and ſtiffneſs ſhould be preſerved; and it is the white china ſilk that is principally uſed for theſe purpoſes.

It is neceſſary to conſider the preparation of ſilk with alum as one of the general operations in dyeing this ſubſtance; for without aluming, the greateſt part of the colours applied would poſſeſs neither beauty nor durability. It conſiſts in mixing in a tun or vat about forty or fifty pails of water with forty or fifty pounds of roman alum, that has been previouſly diſſolved in warm water; this muſt be carefully ſtirred during the mixture, in order to prevent the alum from being cryſtallized.

The ſilk having been waſhed, beetled, and wrung out with the jack and pin, in order to ſeparate any ſoap it may have retained, it is immerſed in the alum liquor, where it is left for eight or nine hours; after which it is wrung out by hand over the vat, and waſhed by means of a ſtream of water very well. The quantity of liquor which has been mentioned above is ſufficient to prepare one hundred and fifty pounds of ſilk, without the addition of any more alum: but when it begins to grow weak, which thoſe who are in the habit of employing it can eaſily diſtinguiſh by the taſte, twenty or twenty-five pounds of diſſolved alum muſt be added as before, and this addition muſt be repeated until the liquor acquires a diſagreeable ſmell; and then it may be employed in the preparation of ſtuffs intended for darker colours, ſuch as browns and marones, until the whole of its ſtrength be gone. It muſt be obſerved, that the preparation of ſilk with alum is always made in the cold, becauſe when the liquor is employed hot, the luſtre of the ſilk is liable to be impaired in ſome degree.

Of Cotton.—This ſubſtance is the down or wool contained in the pods of a tree or ſhrub which grows in warm climates; and is ſeparated from the ſeeds, which it covers, by a kind of mill or machine employed for that purpoſe.

The circumſtances in which cottons differ are principally in the length of their filaments, their fineneſs, their ſtrength, and the colour. This ſubſtance has different ſhades, from a deep yellow to a white; the darkeſt coloured comes from Siam and Bengal, and is often made into ſtuffs without changing its natural colour. The moſt beautiful is not always the whiteſt; it is neceſſary to bleach it, by proceſſes ſimilar to thoſe employed in the bleaching of linen. The operations neceſſary however in bleaching cotton, are leſs various, and more expeditious, than thoſe for bleaching linen. Inſtead of theſe operations, oxigenated muriatic acid may be employed; and with the aſſiſtance of time, by this means a more beautiful white, than by the ordinary way of bleaching, may be produced; and the cotton afterwards appears better fitted for the reception of a fine colour in dyeing. Mr. Berthollet has ſucceeded in bleaching the yellow cotton of St. Domingo, which very obſtinately retains this bad colour. But in order that cotton may be diſpoſed to receive the dye, it muſt undergo an operation called ſcouring. Some boil it in four water, but more frequently alkaline ley is uſed; the cotton muſt be boiled in it for two hours, and then wrung out, after which it muſt be rinſed in a ſtream of water, till the water comes off clear, and then be dried very carefully: and the cotton ſtuffs which are to be prepared, muſt be ſoaked for ſome time in water, mixed with at moſt one fiftieth of ſulphuric acid, after which they muſt be carefully waſhed in a ſtream of water, and dried. Mr. Berthollet has obſerved, that the acid which had been uſed in this operation, had taken up a quantity of calcareous earth and iron, which would have injured the colours very much. Aluming and galling are to be conſidered as operations generally employed in the dyeing of cotton and linen: and in the preparation with alum, about four ounces of it are required to each pound of ſtuff; it muſt be diſſolved with the precautions mentioned in the preceding article; and ſome add a ſolution of ſoda in the proportion of one ſixteenth of the alum, others a ſmall quantity of tartar and arſenic. The thread is well impregnated by working it pound by pound in this ſolution; it is then put altogether into a veſſel, and what remains of the liquor is poured upon it: this is left for twenty four hours, and then removed to a ſtream of water, where it is ſuffered to remain for an hour and an half or two hours, in order to extract a part of the alum, and it is then waſhed. It has been found that cotton, by this operation, gains about one fortieth of its own weight.

It is cuſtomary, in the operation of galling, to employ different quantities of galls or other aſtringents, according to the quality of the aſtringents, or the effect that is to be produced. Powdered galls are boiled for about two hours, in a quantity of water proportioned to that of the thread to be galled; the liquor is then ſuffered to cool to a temperature which the hand can ſupport, after which it is divided into a number of equal parts, that the thread may be wrought pound by pound; and what remains after the operation, is poured upon the whole together, as before deſcribed in the proceſs of aluming. It is then left for twenty-four hours, eſpecially when intended for maddering for black, but for other colours twelve or fifteen hours are ſufficient. When this has been performed, it is to be wrung out and dried in a careful manner. In caſes where ſtuffs are galled, which have already received a colour, the operation is to be performed in the cold, in order that the colour may ſuffer no injury. Mr. Berthollet has found that cotton which has been alumed, acquired more weight in the galling than that which had not undergone that proceſs; although alum adheres but in ſmall quantity to cotton, it communicates to it a greater power of combining, both with the aſtringent principle and with the colouring particles of different ſubſtances.

Of Flax.—As this ſubſtance and hemp poſſeſs the ſame properties ſo far as relates to dyeing, it does not ſeem neceſſary to make any diſtinction between them. It is generally known that flax muſt undergo ſeveral preparations before it be in a proper ſtate to receive the dye; the firſt is the watering, by which the fibrous parts of the plant become diſpoſed to ſeparate, ſo as to be rendered fit for ſpinning. The watering is an operation of much conſequence, from its influence on the quality and quantity of the product, and from its deleterious effects on the air. In the operation of watering, a glutinous juice, which holds the green colouring part of the plant in ſolution, and which is the medium of union between its cortical and ligneous parts, undergoes a greater or leſs degree of putrefaction, according to the mode of conducting the operation; this is evident from the extrication of carbonic acid and inflammable gas. This matter ſeems greatly to reſemble the glutinous part that is held diſſolved in the juice that is procured from green plants by preſſure, which is ſeparated along with the colouring particles by a heat approaching to that of ebullition, which becomes putrid, and which affords ammoniac by diſtillation: but though this ſubſtance be held in ſolution in the expreſſed juice of plants, it is probable however that water alone cannot ſufficiently ſeparate it from the

cortical parts; whence it happens, that the hemp which has been watered in too ſtrong a current, is deficient in many reſpects, ſuch as in its ſoftneſs and pliability. But if, on the other hand, the water employed in this operation be ſtagnant and putrid, the hemp acquires a brown colour, but more particularly loſes its firmneſs, and highly noxious vapours are exhaled from it. This proceſs is therefore evidently performed to the greateſt advantage, in watering pits ſituated on the banks of rivers, where the water may be changed often enough to prevent a putrefaction, that would injure the hemp, and be prejudicial to the workmen; yet not ſo often as to hinder the degree of putrefaction which is neceſſary, in order to render the water capable of diſſolving the glutinous ſubſtance.

In order to prepare flax for the dye, it muſt alſo be ſubjected to the operations of ſcouring, aluming, and galling, in the manner that has been propoſed for cotton.

Sect. II. *Of the Chemical Agents employed in Dyeing.*

Before we proceed to the deſcription of the particular proceſſes that are employed in the art of dyeing, it may be proper to take notice of the particular effects that are produced on ſtuffs by the uſe of various acids and ſalts. For the manner of preparing theſe ſubſtances, ſee Chemistry. There are alſo a variety of other materials employed in the art of dyeing, which will be noticed in treating of the different proceſſes into which they enter.

Sulphuric or *vitriolic acid.*—The principal uſe of this acid in the art of dyeing has hitherto been to diſſolve indigo, and for this purpoſe a very concentrated and pure acid is required. It is however more largely employed in preparing cotton ſtuffs for printing, and in the bleaching of linen and thread, either by the oxigenated muriatic acid, or by expoſure on the graſs; but for theſe purpoſes a very concentrated ſulphuric acid is not required. This acid alſo forms different compounds with alkalis, earths, and metallic ſubſtances.

Sulphate of pot-aſh, or vitriolated tartar, has been conſidered by Hellot, from its ſmall ſolubility, as proper for fixing colours in the pores of cloth: but Mr. Berthollet thinks that this opinion is unfounded; and that this ſalt has little action upon the colouring particles of ſubſtances.

Nitric acid.—This acid, which was formerly called *dephlogiſticated nitrous acid*, may be employed for many metallic ſolutions, the uſe of which, as mordants, may be various; but it is principally employed for making *aqua regia*, or the nitro-muriatic acid. This acid ſometimes enters into combination without being decompoſed; this is the caſe when it unites with alkalis and ſome earths: ſometimes it is decompoſed, becauſe the oxigene, one of its conſtituent parts, is taken from it by another ſubſtance: this happens with metallic ſolutions; if the metal acts ſtrongly upon the oxigene, it takes up the whole of it, and azote is ſeparated by itſelf, in the form of gas, or what has been called phlogiſticated air, the other of its conſtituent principles; but commonly it takes only a part of the oxigene, and the other part forms the combination which eſcapes in the ſtate of nitrous gas: hence ariſes the effervеſcence which the nitrous acid produces with metals. In the ſame way the nitrous acid may act merely like an acid upon colouring ſubſtances, without undergoing any decompoſition; but a part of the oxigene is taken from it ſooner or later by theſe ſubſtances, and they then undergo changes analogous to thoſe which they would ſuffer in combining with the oxigene of the atmoſphere, and which are the reſult of what has been termed a true combuſtion, by Mr. Berthollet.

Nitrate of pot-aſh has little action upon colouring ſubſtances; however, their colours are rendered a little more clear and lively by it.

Nitrate of lime, and of *magneſia*, are among the ſalts of earthy baſis, which are found in many waters, and, like thoſe waters, tend to give a deeper ſhade to colours of different kinds.

Muriatic acid.—This acid may be employed for various metallic ſolutions, which may be uſed as mordants: thus the ſolution of tin, or the muriate of tin, may be uſeful on many occaſions. In order to prepare this ſalt, tin ſhould be diſſolved by the aſſiſtance of heat, in a ſtrong muriatic acid, and the liquor ſhould be evaporated till all the ſalt which will cryſtallize is ſeparated.

Muriate of ſoda, or *common ſalt*, has a remarkable action upon colouring bodies; in general, it tends to deepen their ſhade, and to render them more fixed and permanent.

Muriate of ammoniac, or *ſal ammoniac.*—This ſalt renders colours in general deeper and more ſaturated. That which is brought from Egypt is leſs pure and fit for the purpoſes of the dyer, than that which is prepared in Europe.

Mercurial muriate, or *corroſive ſublimate.*—This ſalt acts upon many colours, rendering them deeper, more duſky, and more fixed: and it may be conſidered as a general property of muriatic ſalts, to render colours more deep and fixed.

Oxigenated muriatic acid.—This acid may be employed as a teſt of the durability of colours, and for comparing the goodneſs of colouring ſubſtances of the ſame kind. It is uſed for whitening the ground of ſome printed linens; it may alſo be uſed to deſtroy the colours of pieces which have ſuffered ſome accident in dyeing, or which have been ſpoiled by keeping, and thus fit them for receiving a new dye; but it leaves a yellow colour in wool and ſilk. Linens are completely whitened by it, unleſs iron entered the compoſition of the mordant uſed in dyeing them; in which caſe they ſhould be paſſed through water acidulated by ſulphuric acid. If the colouring particles have not been already completely removed, they may be entirely diſſolved by a weak ley. By ſome dyers the oxigenated muriatic acid is employed to brighten ſeveral colours, and to render them clear; and it is often uſeful, in this caſe, to employ oxigenated muriatic acid united to pot-aſh.

Nitro-muriatic acid, or *aqua regia*, is to be conſidered chiefly with reſpect to the ſolution of tin, as that is the principal uſe which is made of it by the dyer. The proceſs by which Mr. Berthollet has obtained a ſolution that gave the moſt beautiful colour with cochineal, both on wool and ſilk, and that will alſo keep the longeſt without the formation of a gelatinous precipitate, conſiſts in taking nitric acid at thirty degrees, diſſolving in it one eighth of its weight of muriate of ammoniac, adding by ſmall portions an eighth of its weight of tin, and then diluting the ſolution with a fourth of its weight of water. In this proceſs a very pure tin ſhould be employed. A ſmall quantity of a blackiſh ſediment is commonly formed, from which the ſolution ſhould be decanted. Solutions of this kind, which contain a large proportion of tin, are brown, and give deeper and leſs bright colours: yet there are caſes in which they may be found more uſeful than the others. It is found that the ſolution of tin does not affect colours merely by the proportion of metal it contains. When ſal ammoniac, nitre, or marine ſalt, has entered into the compoſition of the aqua regia, the liquor which is ſupernatant after the precipitation of the colouring particles is leſs acid, than when a mere mixture of nitric and muriatic acids is employed: in the former inſtance, therefore, the liquor has leſs action upon the ſtuff, and upon the colour, than in the latter. Hence it follows, that when a ſolution of tin is to be uſed, with a ſubſtance, the colour of which is eaſily affected by acids, as madder or braſil-wood, we ſhould chooſe a ſolution of tin that would retain little exceſs of acid, or uſe it only for the preparation of the ſtuff which is intended to be dyed. There is not another mordant which the art of dyeing poſſeſſes, that is capable of producing ſuch advantageous effects as the ſolution of tin. The

folution of this fubftance acquires a gelatinous confiftence more or lefs readily. When this happens, the dyers fay that the compofition has turned. To avoid it, the preparation fhould be made but a little while before it is ufed. When the jelly is only beginning to form, the folution may be recovered by adding to it a folution of marine falt. This inconvenience arifes from the tin's continuing to oxidate by means of the oxigene which it attracts from the atmofphere, or receives from the nitric acid, whence it becomes infoluble in the acid, and falls down. Heat favours this effect, therefore the folution of tin does not keep fo long in hot weather as in cold. It is fhown from conftant obfervation, that a lefs lively and agreeable colour is obtained by employing a folution of tin made with rapidity and the difengagement of much vapour, than by ufing a folution made flowly and without effervefcence. The reafon is, that in the former cafe, the tin acquires more oxigene, the fuperabundant part of which is more difpofed to quit it, and to occafion a combuftion of the colouring particles. On this account, frefh folutions made with caution fhould be preferred to old ones, although prepared with the greateft attention. There are other folutions which may be of ufe in dyeing, which are made with nitro-muriatic acid. De la Folie has propofed that of bifmuth: and though he begins to diffolve the metal in nitric acid, it is a combination of it with the nitro-muriatic acid, which is formed in the procefs by means of the marine falt employed. The folution in nitric acid alone could not be made ufe of, becaufe, as foon as it is mixed with water, the metallic oxide precipitates, fo that it feparates before it is able to unite with the colouring particles in any degree. From the defcription given of this procefs by D'Ambourney, who has frequently employed it; one part of bifmuth is to be diffolved in four parts of nitric acid; this folution is then thrown into the bath, which contains tartar, and at the fame time a folution of marine falt is poured in. Mr. Berthollet has found, that, whether the folution of bifmuth be made immediately in aqua regia, or the folution in nitric acid be mingled with a folution of marine falt and tartar, a confiderable precipitate is always formed on mixing it with water, though lefs when water is mixed with the fimple folution in nitric acid: and alfo, that the precipitate formed by this folution, with the decoctions of colouring fubftances, has an unequal colour, and fpeedily grows of a brown colour.

Acidulous Tartar of Pot-afh, or *Common Tartar*, is much ufed in dyeing. It is indifpenfably neceffary to employ that which is purified for delicate colours, and it is beft to ufe it in all cafes. In fome proceffes red tartar has been recommended, on the fuppofition that its colour would contribute to that intended to be given to the ftuff; but, on diffolving the tartar, its red particles feparate, and fhould be confidered as impurities which are hurtful. A falt which bears fome analogy to tartar, and which may perhaps produce good effects in many cafes, is the *acidulous oxalate of pot-afh*, or falt of forrel. At leaft its property of readily diffolving the oxides of iron, and difcharging the fpots produced by them, is of confiderable utility.

Sulphate of Alumine, or *Alum*.—This fubftance is of extenfive ufe in the arts, and particularly in dyeing; but the manner in which it acts in the proceffes of this art has been already explained.

It has been found, that when lime and alkali are united with alum, they facilitate the feparation of the alumine, and confequently its combination with the fubftances fubmitted to the procefs of aluming. *Lake*, is a name fometimes given to the combination of colouring matter with alumine, obtained by mixing alum with a folution of colouring matter, and adding a proper quantity of alkali to effect or complete the precipitation. Alumine or pure clay diffolves pretty copioufly in pure or cauftic alkalis, efpecially if aided by calcination. Mr. Macquer paid great attention to this folution, and confidered it as a very advantageous mordant, particularly for dyeing cotton with madder. Mr. Berthollet has repeated and varied his experiments, but feems to have been far from fucceeding in the degree that Mr. Macquer profeffes to have done: it even appeared, that the colouring particles have too great an attraction for the alkali to feparate from it, and fix in fufficient quantity on the ftuffs, from which the alkali itfelf has the property of taking them. However, Mr. Hauffman, whofe authority is of great weight, confiders the combination of alumine and pot-afh, which he calls alumine of pot-afh, as well calculated for the purpofe of a mordant or bafis in dyeing.

Sulphate of Iron, or *Green Vitriol*.—This fubftance frequently contains a portion of copper or alum; but may be made free from thefe, if care be taken to keep pieces of iron in the evaporating veffel, as has been advifed by Mr. Monnet, fince iron has the property of precipitating both copper and the bafe of alum. There is only zinc which will not be precipitated in this way; but that is feldom found in fulphates of iron, and never in any very large proportion. But the copper contained in many forts of fulphate of iron, does not appear to be prejudicial to the black dyes, for which this metallic falt is chiefly employed. Alum feems to be more detrimental to black than copper; for when a black ftuff is boiled with that falt, it difcharges the colour, by diffolving it. But it may be freed from alum alfo, by keeping it fome time in digeftion with iron filings: but this decompofition is more difficult, and not fo complete as that of the fulphate of copper. If the fulphate of iron be kept long expofed to the air, it tarnifhes and becomes yellowifh: its folution grows turbid by boiling, a part of the iron is precipitated in the form of a yellow powder, and it lofes the property of forming cryftals. Thefe phenomena are owing to the iron attracting oxigene, or the bafe of pure air, from the atmofphere, with which when it is faturated to a certain point, it cannot be kept in folution but by an excefs of acid. Hence it continues to be precipitated, till what remains is capable of being held in folution by the acid which is found in due proportion. To avoid this kind of decompofition, the fulphate of iron fhould not be diffolved till the moment it is wanted, and it fhould be diffolved with the leaft poffible heat. Mr. Berthollet has alfo remarked, that a folution made with a low degree of heat, keeps much longer when expofed to the air without growing turbid, or depofiting a fediment, than a folution made by boiling, and fubfequent filtration. This fubftance is of great ufe in dyeing, particularly for black, gray, and other hues, which are darkened by its means. The manner in which it acts by combining with the aftringent principle and the colouring particles has already been fhewn. The folutions of iron in the acetous and fome other vegetable acids, are alfo ufed in dyeing: but all of them differ greatly in the ftate in which the metal exifts in them, and in the property of attracting more or lefs oxigene from the atmofphere.

Sulphate of Copper, or *Blue Vitriol*.—This kind of fulphate is of no great ufe in the arts. With the fulphate of copper, lime and alkalis produce a greenifh blue precipitate, which foon becomes green in the air. Ammoniac produces a beautiful blue precipitate, which it quickly rediffolves, and which alfo becomes green in the air. Thefe differences of colour depend on the proportions of oxigene combined with the copper: if it be in fmall quantity, the oxide is blue; if in a larger, it is green: whence the blue oxide becomes green in the air, by combining with the oxigene which it attracts from it. The oxide of copper combines eafily with moft kinds of colouring particles, by which it is precipitated from acids. It frequently imparts to them a pleafing colour: but as its own colour, which influences that of the combination, is eafily changed by

the air, the colours refulting from its mixture are variable, and of little duration, fo that it can feldom be employed with much advantage. It has been obferved, that the fulphate of copper attacks cloths more than that of iron. This effect is partly owing to its poffeffing a much greater quantity of active acid than the latter: for, according to Mr. Kirwan's calculation, one hundred parts of fulphate of iron contain twenty parts of fulphuric acid, and a hundred parts of fulphate of copper contain thirty. This acid is fet free when the oxide combines with the colouring particles, and exerts its action on the cloth, or rather on the combination of the cloth with the colouring particles. But what more efpecially augments on one hand the quantity of acid fet free, and confequently its action on the cloth, and on the other, the influence of the oxide of copper on the qualities of the colour, is, that this oxide enters in a large proportion into the combination which it forms with the colouring particles. Mr. Berthollet has precipitated an equal quantity of decoction of fuftic, with fulphate of copper, and with fulphate of iron, and has found the precipitate produced by the former, much more confiderable than that produced by the latter: confequently there was more fulphate of copper decompofed by the fame quantity of colouring matter, than fulphate of iron. It is evident therefore, that on two accounts the quantity of acid fet free muft be more confiderable. A circumftance that fhows that the action on the cloth is not principally owing to the oxide of copper, is, that the fame objection has not been made to the ufe of verdegris as to that of blue vitriol.

Sulphate of Zinc, or *White Vitriol.*—This fulphate, as it is generally met with in the fhops, contains iron; and when a folution of it is left expofed to the air, or made to boil, it grows turbid, and a portion of the iron precipitates; but the greater part always remains, and cannot be entirely precipitated but by boiling the folution with filings of zinc; and even by this procefs it is difficult to feparate the whole of the iron from it. In the art of dyeing, but little ufe has hitherto been made of this metallic falt. When it has been employed, it has been found to render the colours deeper; which effect is owing, in a great meafure, to the iron which it always contains. Mr. Berthollet has made fulphate of zinc by diffolving zinc in fulphuric acid: he poured fome of this folution into infufions of fumach, galls, madder, and cochineal, and compared the effects it produced with thofe of a folution of common fulphate of zinc, which had been long made, and had depofited all the iron that expofure to the air would throw down. The latter rendered the colours much deeper than the former. The depofit produced by the pure fulphate with the infufion of fumach was a violet lilac; with the infufion of galls, a little deeper; with that of madder, bright purple; with that of cochineal, firft red, afterwards a beautiful purple. In general the precipitates produced by the fulphate of zinc grow a little darker with time; which indicates, that the oxide of zinc produces a flight combuftion of the colouring matter: it appears, moreover, to combine with it but in fmall proportion. Hence the reafon is evident why it renders colours darker than the oxide of tin, though the colours of both are equal in whitenefs.

Verdegris, and *Acetite of Copper.*—It has been found that the vegetable acids cannot impart oxigene to copper: but the action they exert on it favours its combination with oxigene fo much, that it readily attracts the atmofpheric air, by which it is reduced to an oxide, and becomes foluble in the acid liquor. But that the copper may be capable of attracting the oxigene of the atmofphere, it is neceffary that the liquor be cold: hence vegetable acids, whilft hot, do not attack copper: and the fame thing holds with refpect to oils, and other fubftances which act on that metal, unlefs a portion of copper be previoufly oxidated, in which cafe it readily diffolves, whatever be the temperature of the liquor. From this the neceffity of never fuffering liquors capable of attacking copper to grow cold in veffels of that metal, and of taking care to keep them always extremely clean, that no oxide may be found formed on their furface, is extremely evident. Both the nitric acid, and nitromuriatic acid, or *aqua regia*, have the property, even when diluted with water, of imparting oxigene to copper, and of diffolving it, efpecially when the liquor is in a ftate of ebullition. Thus it is impoffible to prevent a portion of the metal from being diffolved in baths, into which is put folution of tin, for inftance, unlefs the copper be carefully tinned. One circumftance, however, tends to diminifh this effect, the action of the nitrid acid being exerted on the vegetable fubftances, and ftill more on the animal fubftances, that happen to be in the bath at fame time with it.

It is therefore obvious, that the copper in verdigris is reduced to an oxide, and combined with a greater or lefs proportion of acetous acid; that in the former the oxide of copper is completely faturated with acetous acid, or it is the acetite of copper; and that in the verdegris there is only a portion of the oxide of copper in the ftate of acetite. Verdegris fometimes confequently contains very little acetite; at others, on the contrary, it contains fcarcely a fourth of its weight of uncombined oxide of copper. Verdegris may therefore be prepared in different ways, according to circumftances, and the purpofes it may be intended to ferve. Thus, if it be neceffary that the verdigris fhould be diffolved, the greater part of what is ufed would be wafted if it contained but little acetite: in this cafe, the uncombined oxide might be diffolved in vinegar, and then the whole rendered fit for the purpofe required. In other circumftances, it is the oxide that is ufeful; when verdegris that contains little acetite fhould be chofen, we may even diffolve the acetite, and referve it for other purpofes. Verdegris, which is ufed in dyeing black, acts principally, and perhaps folely, by its uncombined oxide. This oxide ferves to precipitate the iron combined with the aftringent principle, by combining with the fulphuric acid. On this principle the obfervations of Mr. Clegg may be explained. In endeavouring to difcover fome cheaper ingredient, that might be fubftituted inftead of verdegris for dyeing black, he found that the copper of the verdegris precipitated the iron of fulphate of iron, held in folution with aftringent fubftances, in the ftate of oxide. But Mr. Berthollet has remarked, that the iron was combined with the aftringent principle, when precipitated by the oxide of copper, and even that the oxide of iron cannot be precipitated by the oxide of copper but on account of the double affinity which refults from the action of the aftringent principle. Confidering the verdegris as a precipitant of iron, Mr. Clegg fought to fubftitute for it other fubftances calculated to precipitate iron from its folvents. He firft tried alkalis, which appeared to fucceed in a fmall way, but would not anfwer on a large fcale: in fact, alkalis do not precipitate the combination of iron and the aftringent principle, but form with it a fupracompound, and give it a reddifh tinge. He afterwards afcertained, by repeated experiments, that the purpofe of verdegris might be fully anfwered by a mixture of fulphate of copper and potafh. The fulphate of copper he directs to be diffolved, and a folution of potafh to be added till the blue colour difappears, that is to fay, till the whole of the copper be precipitated. Nearly equal weights of fulphate of copper and of the alkali are requifite for this purpofe: and we are affured that thefe will fupply the place of a quantity of verdegris equal to the weight of both, particularly in dyeing hats; in which a great deal of verdegris is ufed. The great advantage of this procefs depends on the comparative prices of fulphate of copper, of potafh, and of verdegris. Inftead of the

fulphate, the folution of copper in nitric acid, made in the operation of parting, may alfo be employed.

Acetite of Lead, or *Sugar of Lead*.—This falt is in fome degree decompofed by water, and forms with it a milky liquor, that depofits a white powder, partly owing to the oxide of lead which has forfaken the acid: but this depofition may be prevented by the addition of a certain quantity of acetous acid; a procefs that may be ufeful when this falt is employed in dyeing. Befide this depofit, which takes place even in diftilled water, another occurs in waters containing fulphate, which is owing to a combination of the oxide of lead with the fulphuric acid, and is proportional to the quantity of that acid.

In order to prepare the acetite of lead, in many cafes it will be fufficient to diffolve the oxide of lead in white wine vinegar, the extractive part of which, that conftitutes its principal difference from diftilled vinegar, does not injure colours: neither will the excefs of acid which this folution may retain be detrimental, and it may prevent the formation of the precipitate that takes place when acetite of lead is diffolved in water. As the acetite of lead is of fome price, this procefs may be employed with advantage where a large quantity is employed. This fubftance forms, in general, a copious precipitate with folutions of the colouring particles; and it deepens colours, and renders them more permanent, but lefs bright: but the greateft ufe made of it is for the compofition of the principal mordant employed for printed linens.

Potafh, or *Vegetable Fixed Alkali*.—It is generally known that the vegetable alkali which is commonly ufed in the arts differs confiderably, according to the mixtures naturally found in it, or added to it, and the circumftances attending its preparation. Therefore, to afcertain the real quantity of alkali contained in it, would be of no fmall advantage. By the tafte, we fhould eafily be deceived; for that potafh which contained alkali in a more cauftic ftate, would appear far more acrid than that in which the alkali was combined with a greater quantity of carbonic acid. Trials on leys or on colouring matter might prove fallacious, for the fame reafon. A certain method of eftimating it would be, to diffolve a given weight in water, to filter the liquor, and to compare the quantity of acid it would require to faturate it, and render it incapable of turning green, the fyrup of violets, infufion of radifhes, or any other vegetable colour calculated for fuch a teft, with the quantity neceffary to produce the fame effect on a pure alkali, the weight of which had been afcertained.

This falt is of very extenfive ufe in dyeing: in general it facilitates the folution of the colouring matter, and deepens its colour. Some dyers recommend the ufe of falt of tartar, or *cendres gravelées*, in certain proceffes: but Mr. Berthollet thinks, that potafh, which is cheaper, may be fubftituted inftead of them in all cafes, if care be taken to purify it, unlefs in cafes where an alkali containing much carbonic acid be required; and even this quality may be given to the folution of potafh, by leaving it fome time expofed to the air.

From this falt having a powerful action on fubftances of an animal nature, and diffolving them when it is in a cauftic ftate, great attention fhould be paid to the proportions of this alkali employed in proceffes to which thefe fubftances are fubjected, and to the degree of caufticity which it may poffefs.

Soda, or *Mineral Alkali*.—It is neceffary when this falt is ufed to attend to its ftate; for when it is in cryftals, it contains more than half its weight of water of cryftallization, fo that when it has fallen into efflorefcence, one part will produce as great an effect as two of the cryftals. The falt of foda is a carbonate of foda, a combination of carbonic acid with pure foda. Lime takes from it its carbonic acid, and renders it cauftic; and in this ftate it is pure foda.

Arfenic.—Formerly this fubftance was much ufed in many dyes, and particularly for printed linens: but the inutility of this poifonous fubftance being now acknowledged, it is ufed in very few proceffes, and even in thefe it appears to be ufelefs. The following preparation may, however, be found ufeful. Macquer has fhewn that fixed alkali has the property of combining with arfenic. To effect this combination, oxide of arfenic in powder muft be thrown into warm water containing a confiderable proportion of alkali, till no more will diffolve. The liquor becomes of a dark brown colour, and acquires the confiftence of glue. This mixture, on cooling, becomes hard and brittle; but it attracts the moifture of the air, and again becomes vifcous. Mr. Vogler has found, that it is a very proper mordant for linen and cotton to be dyed with madder. In preparing it he employed a folution of common potafh: others ufe potafh in its pure or cauftic ftate. Orpiment is employed in fome proceffes of dyeing, particularly in certain indigo vats.

Water.—It is obvious that the qualities of different waters muft confiderably intereft the dyer: but it is perhaps of lefs importance to point out the injurious effects they are capable of producing, than to deftroy the prejudices to which they frequently give rife. It is almoft unneceffary to fay, that water employed in dyeing fhould not be muddy, nor contain putrid fubftances; and that waters fo loaded with heterogeneous principles as to be termed mineral, which are eafily diftinguifhable by the tafte, ought not to be ufed. With thefe exceptions, water acts on colouring matter, principally by means of the falts with earthy bafis which it contains. Thefe falts are nitrate of lime and of magnefia, muriate of lime and of magnefia, fulphate of lime, and carbonate of lime and of magnefia. Thefe different falts with earthy bafes oppofe the folution of the colouring particles, caufe various kinds of them to precipitate, in confequence of their combining with the earth they contain, and render their colour deeper and frequently more dull and heavy. Carbonates of lime and magnefia have alfo the inconvenience of being precipitated by boiling, which drives off the excefs of carbonic acid that held them in folution, fo that thefe earths adhere to the ftuff to be dyed, make it dirty, and prevent it from being penetrated by the colouring matter. It is therefore of confequence to diftinguifh the feveral kinds of water called hard, that they may be avoided in moft operations of dyeing; and an eafy and common experiment is fufficient to fhew whether water contains fuch a quantity of thefe falts as may be injurious; the folution of foap. For all falts with earthy bafes decompofe foap by a double affinity: their earth combines with the oil of the foap, while their acid unites with its alkali; and this combination of oil and earth forms an earthy foap, which, being infoluble in water, produces the curdling obferved in trials of this kind.

When therefore a water is clear, not ftagnant, void of fenfible flavour, and diffolves foap well, it may be deemed proper for dyeing; and all waters poffeffed of thefe qualities are equally proper for the purpofe. It is not, however, always in our power to choofe our water; therefore, means of correcting bad waters, at leaft thofe which are fo to a certain degree, have been fought; particularly for the purpofe of dyeing delicate colours. With this view, water in which bran has been made to grow four, generally known by the name of four water, or *fours*, is moft commonly made ufe of. In preparing the four water, twenty-four bufhels of bran are put into a tub or vat that will contain about ten hogfheads: a large boiler is filled with water, which, when juft ready to boil, is poured into the vat: the acid fermentation foon commences, and in twenty-four hours the liquor is fit to be employed. Mr. Berthollet fuppofes, that the four water acts by decompofing the carbonate of lime and magnefia, from which its acid, being more power-

ful, disengages the carbonic acid: thus the earthy sediment, which is occasioned by boiling, is prevented from being formed.

Plants of the mucilaginous kind are also boiled with water, in order to correct it. The mucilage coagulates, and carrying with it the earths that separate by ebullition, as well as those which might happen to be simply mixed with the water and render it turbid, forms a scum which must be removed. The salts with earthy bases, which are in general prejudicial in dyeing, may be in some cases useful, and serve to modify tints. Thus a crimson hue would be given to the colour of cochineal, by a water of this kind.

PART III.

OF THE PROCESSES OF THE ART OF DYEING.

HAVING thus examined the nature of different animal and vegetable substances, and fully described the various operations by which they may be prepared for taking different kinds of dye; and likewise considered the effects of some of the more powerful chemical agents that are employed in this art; we shall proceed to give an account of the most useful and advantageous processes for dyeing different colours.

Sect. I. *Of Black.*

But a very few substances have hitherto been met with capable of affording by themselves a permanent black, and these have been tried only on linen and cotton. The juice of the cashewnut communicates a black colour, that will not wash out, and even resists boiling with soap or alkalis. The *anacardium occidentale* affords likewise a durable dye, but it is merely of a brownish colour; and the juice of the *toxicodendron* produces nearly the same effect. That of the stalks of the hop-plant gives a very durable brownish red colour. And the juice of the sloe affords a pale tint of a brownish hue, which becomes deeper after having been repeatedly washed with soap, and afterwards wetted with a solution of alkali. On boiling sloes, their juice becomes red, and the red tinge, which in that state it imparts to linen, is converted by washing with soap into a blueish colour which has some degree of durability. But these methods of obtaining a black colour cannot be employed in dyeing, because the substances from which it is procured are not to be gathered in sufficient quantity to supply the demands of the art, and the black which they afford is by no means comparable to that formed in the common processes of the dye-house. All black colours, therefore, are the effects of combination. To produce them, the black particles formed by the union of the astringent principle with the oxide of iron held in solution by an acid, are fixed on the stuff that is intended to be dyed.

The nature of the astringent principle, and the manner in which astringents act on the oxide of iron, and combine with it to form black particles, have been already noticed. But it is to be observed, that when the particles are precipitated from the mixture of an astringent and a solution of iron, they have only a blue colour; if they be then left exposed to the air, and moistened with water, their colour grows deeper, but still the blue is distinguishable in it. The stuff itself then contributes to increase the intensity of the black, whether it be that in this state of combination it undergoes a slight combustion, or that the colouring particles undergo a further degree of combustion from presenting a larger surface to the air, for without the action of the air a fine black cannot be obtained; on which account the operations about to be described are performed at different intervals, during which the stuff is taken out of the bath, that it may be exposed to the air. Mr. Berthollet has ascertained, that black stuffs placed in contact with pure air diminish its volume, and consequently absorb a certain portion of it. It seems from the process described by Hellot, that woollen cloth, to be dyed black, ought to have received the deepest blue tint, or mazarin blue, to have been washed in the river as soon as taken out of the vat, and afterwards to have been cleansed by means of the fulling-mill.

In order to dye a hundred pounds of stuff, ten pounds of logwood, and ten pounds of aleppo galls powdered, are put into a bag, and boiled for twelve hours in a middle-sized copper, with a sufficient quantity of water. One third of this bath is put into another copper with two pounds of verdegris, and into this the stuff is put, stirring it continually for two hours, observing to keep the bath very hot, without letting it boil. The stuff is then taken out, and a portion of the bath equal to the former is put into the copper with eight pounds of vitriol or sulphate of iron. The fire is now to be diminished, and the bath suffered to cool for half an hour, while the vitriol dissolves; when the stuff is again put in, moved about well for an hour, and then taken out to air. Lastly, the remainder of the bath is added, taking care that the bag be well pressed out. Fifteen or twenty pounds of sumach are now put in, and the bath is made to give one boil, which is immediately stopped with a little cold water: two pounds more of sulphate of iron are added, and the stuff is kept another hour. The stuff is now washed, aired, and again put into the copper, constantly stirring it for an hour: it is then carried to the river, well washed, and fulled. When the water comes off clear, another bath is prepared with weld, which is made to boil for a moment, and after being cooled, the stuff is passed through it, to soften it, and render the black more firm. In this manner a very beautiful black is procured without rendering the stuff in any degree too harsh.

However, in common more simple processes are employed. Thus blue cloth is merely boiled in a bath of galls for two hours; it is then kept two hours in the bath of logwood and sulphate of iron, without boiling; and afterwards washed and fulled very well. The following method has been found to answer very well, by Mr Hellot. For fifteen ells of deep blue cloth, a bath is to be made with a pound and half of yellow wood, five pounds of logwood, and ten pounds of sumach. After having boiled the cloth in this for three hours, it is taken out; ten pounds of sulphate of iron are put into the copper, and the cloth is kept in it two hours longer: it is then aired, put into the bath again for another hour, and afterwards washed and fulled. This black is less velvety than that of the process first described. He has found by experience, that the maddering formerly employed only tends to give a reddish cast to the black, which is much more beautiful and velvety without using it.

For stuffs of a low price, black may be dyed without a blue ground. In this case a *root colour ground* is first given them, that is, they are dyed fawn colour with green walnut peels, or the root of the walnut tree; they are then blackened as directed above, or in some other way as suits the dyer. It has been found that logwood increases the beauty of the black dye; but the quantity of galls may be diminished by increasing that of the sumach, which indeed may be used altogether instead of them, as is the case in some good manufactories.

The proportions most commonly employed by our dyers are, for a hundred pounds of woollen cloth, dyed first a deep blue, about five pounds of sulphate of iron, five pounds of galls, and thirty of logwood. They begin with galling the cloth, and then pass it through the decoction of logwood, in which the sulphate of iron has been dissolved. After the cloth is completely dyed, it is washed in river water, and fulled till the water comes off clear and colourless. Some dyers recommend fine cloths to be fulled with soap-suds: but this operation requires an experienced workman to cleanse the cloth perfectly of the soap; and others advise to give the cloth a dip in a bath of weld when it comes from the fulling-mill, which they say softens it, and at the same time fixes the black. But Dr. Lewis thinks that the weld bath is totally useless when the cloth has been treated with soap-suds, though in other cases it may be of advantage: he does not, however, ascribe its effects to any quality of the weld, but to the alkali with which the dyers commonly prepare its decoction. However, the weld itself may act by dissolving the black particles which are not fixed in the cloth by the attraction which it has for them. It has been proposed to employ *uva ursi*, gathered in autumn, and carefully dried so that the leaves may remain green, instead of galls. The method recommended is to boil a hundred pounds of wool with sixteen of sulphate of iron and eight of tartar, for two hours. The next day the cloth is to be rinsed as after aluming. A hundred and fifty pounds of *uva ursi* are then to be boiled in water for two hours, and after being taken out, a little madder is to be added to the liquor, at the same time putting in the cloth, which is to remain there an hour and a half, or an hour and three quarters, after which it is to be rinsed in water. Dr. Lewis has observed, that this process gives a pretty good black to blue cloth, but to white only a deep brown, and that the madder and tartar are useless.

For the purpose of dyeing silk black, different operations are to be attended to, such as boiling the silk, galling it, the preparation of the bath, the operation of dyeing, and softening the black. It has been already observed, that silk naturally contains a gummy substance, which gives it that stiffness and elasticity which in its natural state it possesses. This substance does not increase the strength of the silk, which is then called raw; on the contrary, it renders it more liable to wear out, from the stiffness it imparts to it: and though raw silk takes a black colour with more facility than silk which has been scoured or divested of its gum, that black is much less perfect with respect to intensity, and resists the reactives calculated to dissolve the colouring matter in a much less forcible manner. In order to cleanse silk intended to be dyed black, it is commonly boiled four or five hours with a fifth of its weight of white soap, after which it is beetled and washed with care. For the purpose of galling the silk, nearly three fourths of its weight of galls are boiled for three or four hours: but aleppo galls being dear, a greater or less portion of white galls, or even of an inferior kind called berry or apple galls, is mixed with them. The proportion commonly used in France is two parts of aleppo galls to eight or ten of berry galls. After the boiling, the liquor is left at rest about two hours, that the galls may subside: the silk is put into the bath, and left there from twelve to thirty-six hours: it is then taken out, and washed in a running stream. As silk is capable of combining with more or less of the astringent principle, its weight receives a considerable augmentation, not from the weight of the astringent principle alone, but also from that of the colouring matter, which fixes in it in proportion to the quantity of the astringent principle combined with it; the processes for dyeing it are therefore varied, according as the operator is desirous of rendering the silk of a greater or less weight. And this difference constitutes the distinction between a light and heavy black. It is found that a pound of silk loses nearly one fourth of its weight in the boiling when complete; and that it recovers in the light black, and the galling which precedes it, an ounce and a half, or two ounces; so that the original pound is reduced to about fourteen ounces: but in the heavy black this same pound is increased in weight to twenty or twenty-two ounces, or even more; so that the buyer, deceived by the low price at which it is offered him, pays in every pound for several ounces of a substance which is not merely useless, but is even injurious to the beauty of the colour and the strength of the stuff. The black which is much overcharged is never of a fine colour; it is therefore generally employed for the woof, and covered with a warp of a fine black. The circumstances of difference in the process for obtaining heavy black consist in leaving the silk a longer time in the gall-liquor, in repeating the galling, and dipping the silk in the dye a greater number of times, leaving it in this also a considerable while. The first galling is also commonly performed with galls which had been already used, fresh ones being taken for the second. But this method is insufficient to give so great a surcharge as is necessary in some blacks. For this purpose the silk is galled raw, and afterwards rendered supple by wringing with the pin. A vat is preserved by the silk-dyers for the black; and its composition, greatly overcharged, varies in different dye-houses. These vats have commonly been set for many years, and when the black dye is exhausted, it is renewed by what is called a brevet. When the grounds which accumulate in them become too considerable in quantity, they are taken out, so that after a time nothing remains of several of the ingredients which composed the original bath, but which are not used in the brevet. Macquer has given a description of a bath and brevet of this kind, in which there are seeds of fenugreek, fleawort, cummin, colocynth, buckthorn berries, agaric, nitre, ammoniacal muriate, sal gem, litharge, antimony, lead ore, orpiment, corrosive muriate of mercury, &c. He, however, owns that many of these ingredients are useless; and indeed several of them are no longer employed: but the compositions of different countries and dye-houses vary. Filings of iron are generally added to the dye bath; but some dyers use in its stead *slippe*, or the powder found in the troughs of cutlers' grindstones. The action of this powder probably depends on the particles of iron which it contains being in a state of extreme division. During the time in which the silk is preparing for dyeing, the bath is heated, taking care to stir it occasionally, that the grounds which fall to the bottom may not acquire too much heat. This bath ought never to be heated so far as to boil. Gum and solution of iron are added in greater or less proportions, according to the different processes; and when it is judged that the gum is dissolved, and the bath is near boiling, it is left to settle for about an hour. The silk is then dipped into it, being in general first divided into three parts, each of which is put into the bath successively. Each part is wrung gently three times, and hung up to air after each wringing. The purpose of this operation is to squeeze out the liquor with which the silk is impregnated, and which is exhausted, that it may imbibe fresh, and particularly to expose the silk to the action of the air, by which the black becomes of a deeper shade. Three wringings having been given to each portion of the silk, it is necessary to heat the bath anew, putting in gum and sulphate of iron as at first. The operation performed in the interval between two heatings is called a fire. The light black has only two fires: but the heavy requires three, and for this the silk is suffered to remain in the bath about twelve hours after the last fire. Sixty pounds of silk, termed a copper, are commonly dyed at one operation. If only half that quantity be dyed for the light black, one fire may be sufficient. After the operation of dyeing is finished, some cold water is put into a back, and in this the silk is

rinsed by turning or shaking over. The silk when taken out of the black dye is extremely harsh, and the operation by which it is deprived of this quality is styled *softening*. For this purpose, a solution of four or five pounds of soap to every hundred pounds of silk is poured through a cloth into a large vessel of water: being well mixed, the silk is introduced and left about a quarter of an hour; it is then wrung out, and dried carefully.

But in order to dye raw silk, it must be galled cold, in the gall bath which has already been used for scouring silk; and for this purpose, silk with the natural yellow hue is preferred. It may be remarked, that if you would preserve a part of the gum of the silk, and afterwards soften it, the galling should be performed in a warm bath, as usual: but here, where it is intended to preserve the whole of the gum, and the elasticity which it communicates to the silk, the galling is performed cold. If the gall liquor be weak, the silk must remain in it several days. Silk, when thus prepared and washed, readily takes the black dye; and the rinsings, to which sulphate of iron may be added, are sufficient to communicate it. This dyeing is performed cold; but it requires more or less time according to the strength of the rinsings. Sometimes three or four days are necessary; after which it is washed, giving it one or two beetlings, and in order that it may not be softened, it is dried without being wrung. But raw silk may be dyed more speedily, by turning or shaking it over in the cold bath after galling, and airing it, repeating these operations a few times; after which it must be washed and dried in the manner which has been described.

A more simple process has been described by Macquer for the black with which they dye velvet at Genoa, and he affirms that this process rendered even still more simple has succeeded very well at Tours in France. It is this—To dye a hundred pounds of silk, twenty pounds of aleppo galls in powder are to be boiled an hour in a sufficient quantity of water. The bath is then left to settle till all the galls have fallen to the bottom, when they are taken out, and two pounds and a half of English vitriol, twelve pounds of iron filings, and twenty pounds of gum collected from the trees of the country, are put into a copper cullender with two handles, and immersed in the bath. The cullender is supported by sticks, so as not to touch the bottom, and an hour is allowed for dissolving the gum, which is occasionally stirred. If at the end of the hour any gum remain in the cullender, it is a proof that the bath, which contains two hogsheads, has acquired as much as is necessary: if, on the contrary, all the gum be dissolved, three or four pounds more may be added. The cullender is still left in the copper, taking it out only whilst dyeing, and putting it in again as soon as that operation is over. The copper must be kept hot the whole time, but without boiling. The silk is galled with one third of aleppo galls, leaving it in the liquor six hours the first time, and twelve hours the second. The remaining part of the process is conducted in the ordinary method. Dr. Lewis observes, that he has tried this process in the small way, and, by adding more and more sulphate of iron, and repeating the immersions of the silk a great number of times, has at last procured a black of a good kind. But, in short, the sulphate of iron appears to be in too small proportion in Macquer's process, and inconveniences were no doubt found to attend it, as it is not now followed at Tours. Dr. Lewis thinks that the gum is useless, and that it is all carried off in washing the silk; but it is probable that if he had continued to dye in the same bath, he would have found it contribute to keep it up: the quantity seems however to be too great; but if lessened, it will be necessary to add the sulphate of iron gradually after each fire.

It is further remarked by Dr. Lewis, that though white silk may be dyed a good black, without using either logwood or verdegris, the addition of those two ingredients contributes greatly to improve the colour both in silk and in wool. But as the great use of galls in dyeing silk black renders it very expensive, it is of consequence to find some method of diminishing their quantity. Mr. Anglês has proposed the following process—When the silk has been carefully boiled and washed in the river, it is to be immersed in a strong decoction of green walnut peels, and left in it till the colour of the bath is exhausted. It is then taken out, slightly wrung with the pin, dried, and washed in the river. The decoction of walnut peels is made by boiling a full quarter of an hour, when it is taken from the fire, and suffered to subside before dipping the silk, which has been previously immersed in warm water. A blue ground is next given by means of logwood and verdegris. For every pound of silk, an ounce of verdegris is dissolved in cold water; the silk is left in this solution two hours; it is then dipped in a strong decoction of logwood, wrung out slightly, and dried before it is washed at the river. For light blacks, galling may be altogether omitted; but to obtain a heavy black, half a pound of galls must be employed for every pound of silk intended to be dyed.—In order to prepare the bath, two pounds of galls and three of sumach are macerated in twenty-five gallons of water over a slow fire, for twelve hours. After straining, three pounds of sulphate of iron and as much gum arabic are dissolved in it. In this solution the silk is dipped at two different times, leaving it in two hours each time, taking care to air it after the first dipping, and to dry it before giving the second fire, when it is to be again aired and dried: it is then beetled twice at the river; after which a third fire is given it, in the same manner as before, except that it is left in the bath four or five hours. When drained and dried, it is again beetled twice at the river. Care must be taken that the heat during the operation does not exceed 122 degrees of Fahrenheit's thermometer; and before the last two fires, an addition of half a pound of sulphate of iron and as much gum arabic is to be made. For the purpose of removing the harshness that silk acquires from the black dye, Mr. Anglês thinks that the decoction of weld should be preferred to that of a solution of soap. He also remarks, that if silk be dyed blue with indigo previous to its being dipped for black, it will take only a mealy black, but that a velvety black will be obtained if it be prepared with logwood and verdegris; and that green walnut peels soften the silk. Though a fine black may be procured from green walnut peels, and the bath above described, he notwithstanding adds logwood and verdegris, that he may not be obliged to use a large quantity of sulphate of iron, which weakens the silk too much. He thinks that galls only serve to give the silk weight, and that sumach is adequate to the dye.

But linen and cotton do not easily take a black of any intensity that will resist soap; therefore to dye them black, particular processes are necessary. In order to dye cotton and linen black, a solution of iron is used, which is kept in a cask called the *black cask*. This solution is prepared with vinegar small beer, or small wine made from the grapes after they have been pressed by adding water to them, which is soured with rye meal, or some other ingredient, in order to procure an acid liquid at a low price. Pieces of old iron are thrown into this liquor, which is left to stand till wanted, but never used in less than six weeks or two months. To this bath astringents are frequently added, particularly the decoction of alder bark, which of itself has the property of dissolving the oxide of iron in a pretty large proportion.

The method followed at Rouen for dyeing linen and cotton threads, as described by Mr. le Pileur d'Apligny is this—They are first dyed sky-blue in the vat, then wrung out and dried. They are next galled, using four ounces of galls to every pound of thread, and leaving them twenty-four hours in the gall liquor, after which they are wrung out, and then well dried. The liquor of the black cask, in the proportion of about

five quarts for every pound, is then poured into a tub, in which the thread is worked with the hand pound by pound about a quarter of an hour, when it is wrung out and aired. This operation is repeated twice, adding each time a fresh quantity of the black bath, which ought to be carefully scummed. After this it is again aired, wrung out, washed at the river to cleanse it well, and then dried carefully at the time. When this thread is to be dyed, a pound of alder bark for every pound of thread is boiled for an hour in a sufficient quantity of water. About half the bath that served for the galling, and half as much sumach as alder bark are then added, and the whole boiled together for two hours, and then strained through a sieve. When the liquor is cold, the thread is put into it on the sticks, and worked pound by pound, airing it from time to time: it is then let down into the bath again, left in it twenty-four hours, wrung out, and dried as before.

For the purpose of softening this thread when it is dry, it is customary to soak and work it in the remains of a weld bath that has been used for other colours, adding to it a little logwood. From this it is taken out and wrung, and instantly put into a tub of warm water, into which has been poured an ounce of olive oil for every pound of thread. It is then wrung out and dried carefully.

A solution of iron in acetous acid is used for printing cottons black, and the stuff is dipped in the madder bath. Mr. le Pileur d'Apligny describes a process in which he employs madder also for giving linen and cotton thread a black colour, and which he considers as a very fine and durable black. In this process the thread is first to be scoured as usual, galled, then alumed, and afterwards dipped in the weld bath. When taken out of this bath, it is to be dyed in a decoction of logwood, to which a quarter of a pound of sulphate of copper has been added for every pound of thread. After this it is to be washed in the river, and wrung several times, but not too hard. Finally, it is dyed in a madder bath, in the proportion of half a pound to each pound of thread. That the black may not be liable to be discharged, the thread must be dipped in a bath of a solution of soap.

Mr. Wilson has described the method which is followed at Manchester. A galling is made with galls or sumach; after which the stuff is dyed with the liquor of the bath, consisting of a solution of iron in vegetable acid, frequently composed of alder bark and iron, and then dipped in a decoction of logwood with a little verdegris. This process is repeated till a deep black is obtained; and it is necessary to wash and dry after each of these different operations.

A great variety of experiments made by Mr. Beunie, have led to the following results. The preparations used by him in the two processes which he describes, must be first mentioned. They are these:

1. *Neutralized Alum.*—Ten pounds of powdered alum are to be dissolved in fourteen gallons of well-water; and also ten ounces of pot-ash in ten quarts of well-water: let the latter solution stand some time to settle, and when it is clear, pour it into the former, constantly stirring it.

2. *Liquor of Brasil-Wood.*—Twenty-five pounds of brasil-wood are to be boiled in fifty quarts of well-water for one hour, then strain the decoction through a sieve, or linen cloth, and put fifty quarts more of well-water to the residuum, and boil it again: strain this liquor, and put the former with it into a cask.

3. *Infusion of Galls.*—Four pounds of galls, grossly powdered, are to be infused in fifty quarts of warm water. More galls might be used, which would render the liquor still better.

4. *Solution of Iron.*—Into a cask put fifty gallons of good vinegar, fifteen pounds of iron filings, twenty-five pounds of old iron, and three pounds of common salt: draw off the vinegar occasionally, and pour it into the cask again. This solution will be fit for use in a month, but it is the better for being kept longer.

5. *Another Liquor of Galls.*—Boil a hundred pounds of oak saw-dust, or small chips of oak, not lixiviated, in a hundred gallons of well-water, for two hours: press out the liquor, and boil in it ten pounds of galls and twenty-five pounds of logwood: strain and keep for use. This bath is better for being kept.

Process for fine Goods.—An indigo ground, as deep as possible, is given to the stuff in the warm vat; then dip it into No. 1, wringing it a little, that the alum may penetrate it, and dry it in the shade. After this, soak it two hours, and rinse it well. When it is half dry, boil it half an hour in No. 2, adding a quarter of an ounce of verdegris, rinse it, and wring it well. It will now be a deep purple. When it is dry, soak it an hour in No. 3, taking care not to let it boil: take it out, and in a few hours put it again into No. 3, and afterwards into No. 4. Dry it, and then rinse it till the water comes off without being in the least coloured.

Process for low-priced Goods.—The thread or cotton is to be dipped in No. 1, as above; then boil it in No. 2, with some verdegris; dip it next in No. 5, and lastly in No. 4, observing the directions given in the above process.

On many occasions it is useful to given linen a print capable of resisting the action of soap or ley, to serve as a mark. The best means of doing this is the following. A solution of silver is diluted with distilled water: in this a little gum is dissolved: the end of the cloth on which the mark is to be impressed, is impregnated with a solution of isinglass, and on this the gummy solution of silver is applied. This soon becomes a very black purple.

On these processes a few observations may be necessary. Experience seems to have taught, that the processes should vary according to the nature of the stuffs to be dyed. It will therefore be useful to endeavour to ascertain the circumstances which occasion a variation in the processes: but, in doing this, recourse may be had to the theory already laid down.

It is generally known that the dyeing of wool is the most easy; wool having a greater attraction for the black particles than silk or cotton: yet particular attention is necessary to obtain a deep black, which may be permanent, and possessed of the lustre by which that colour is peculiarly distinguished. The different astringents are all capable of striking a black on wool: but the black struck with oak bark is not so durable as that struck with galls, though it be equally deep, if a sufficiently large quantity of the bark be used. It seems that astringents differ from one another chiefly by the permanency of the black they produce, and the quantity of the astringent principle they contain. In order to produce an equal intensity of colour, the quantity used ought to be in proportion to the quantity of their astringent principle. Logwood will not of itself strike a deep and lasting black, but in conjunction with galls, or sumach, it adds lustre to the colour. Of all the astringents known, sumach approaches nearest to galls with regard to the quality of the black it gives, and it appears to be even equal to them in that respect; but the proportion of astringent principle that it contains is not so large, and the proper quantity of vitriol or sulphate of iron seems to be that which answers to the quantity of the astringent principle; so that the whole of the iron be precipitated by the astringent, and the whole of the astringent taken up by its combination with the iron. But as it is impracticable to hit this point with precision, it is better that the sulphate of iron should be predominant, because the astringent principle, when it is superabundant, opposes the precipitation of the black colouring particles, and has even the power of dissolving them in some degree.

This peculiar property of the aſtringent principle is ſo active, that if a pattern of black cloth be boiled with galls, it will be reduced to a gray; and it has been ſeen, when treating of aſtringents, that the firſt black particles formed on mixing a ſolution of ſulphate of iron with an infuſion of galls were rediſſolved by the latter. This ſerves to explain an obſervation of Lewis, that if cloth be repeatedly dipped in the colouring bath after it has taken a good black, inſtead of the colour being heightened, it will be weakened, and become browniſh; and that too great a quantity of ingredients will produce the ſame effect: but in this the diſengaged ſulphuric acid concurs, as will be ſeen hereafter. It therefore follows, that when ſumach is uſed inſtead of galls, the proportion muſt be increaſed, without increaſing that of the ſulphate of iron, taking into the calculation the logwood that is employed at the ſame time with it. It is neceſſary, in order to obtain a fine black, to give the cloth a blue ground, as then a leſs quantity of the ingredients will be required to produce a deep tint, and conſequently there will be leſs vitriol decompoſed by the aſtringent particles. But by this decompoſition the ſulphuric acid is diſengaged; and if it happen to be concentrated to a certain degree, it acts upon the ſtuff, diminiſhes its ſoftneſs, and weakens it. It may even rediſſolve the black particles which were fixed in it, or rather prevent them from fixing in ſufficiently large proportion. Even a ground of any other dark colour may be given, particularly fawn colour, but then the black will not be ſo fine. In dyeing black, it is well to uſe a little verdegris; the oxide of copper, which it contains in greater or leſs quantity, favouring the precipitation of the black particles, by combining with the ſulphuric acid. Probably that part of the verdegris which is in the ſtate of acetite of copper or diſtilled verdegris, is ſerviceable in the ſame way; the oxide of copper combining with the ſulphuric acid, while the acetous acid is diſengaged and aſſumes its place: but the acetous acid does not act upon the black particles. From the experiments of Mr. Clegg, it ſeems that the place of verdegris may be ſupplied by oxide of copper precipitated from ſulphate of copper, or blue vitriol; and no doubt any other oxide of copper would be equally proper.

It has been obſerved by Dr. Lewis, that the proceſſes employed for dyeing wool, would give only a ruſty black to ſilk. This animal ſubſtance is much leſs diſpoſed than wool to combine with the black colouring particles; and its union with them is much weaker, for the mineral acids, tartar, and alum, ſeparate them much more eaſily from ſilk than they do from wool. But, on the contrary, ſilk is much more diſpoſed to combine with the aſtringent principle than wool. Mr. Berthollet has found by experience, that ſilk gains double the weight acquired by wool in the ſame galling; he alſo found that ſilk galled with white galls acquired more weight than ſilk galled with black; that an equal weight of the latter produced with ſulphate of iron one fifth more of black precipitate; and that ſilk treated with theſe galls gained in the dye-bath, or *flat*, an increaſe of weight that compenſated the deficiency of weight in the galling. Silk treated with a quantity of ſumach double that of the galls was not ſo much increaſed in weight; but it acquired a little more in the bath, ſo that the ultimate difference of weight was but very trifling. It is to be noticed, that the aſtringent has ſuch an attraction for the black particles, as in a certain degree to take them from the wool with which they were combined. It may therefore be eaſily conceived how the aſtringent combined with a ſtuff, communicates to it not only the property of decompoſing ſalts of iron to ſeize on their oxide, but alſo of combining with the black particles already formed. Therefore ſilk, which has little attraction for the black particles, and much for the aſtringent, ought to be firſt galled, which imparts to it the property of combining with the black particles. But though we may begin the dyeing of wool alſo by galling, this preliminary operation may be conſidered as at leaſt uſeleſs, ſince the mixture of the aſtringent with the ſulphate of iron will give it a fine black all at once.

The little diſpoſition of the black particles to fix on ſilk explains the compoſition of the bath made uſe of. This compoſition is by no means uniform. Mr. Berthollet has compared ſeveral receipts, and has found them ſo different, and all of them ſo complex, that he could not make choice of any of them: but it appeared to him, that the end attained by them in different ways, was to make a bath in which the black particles, very abundant and near together, ſhould not be retained by an acid, and ſhould be held but weakly by the liquor. Hence, 1ſt, the uſe of litharge, verdegris, and iron filings put into the bath: 2dly, the utility of gummy and mucilaginous ſubſtances, which ſerve to prevent the black colouring particles, that ought to remain ſuſpended in the bath, from ſubſiding: 3dly, the advantages of an old bath, in which the colouring particles are accumulated in large quantity, and feebly retained; for it has been ſeen, that the black particles formed by the mixture of ſulphate of iron with an aſtringent, are not precipitated without difficulty, when the liquor is not diluted with much water. This excellent chemiſt has not only confirmed this theory, but, by the following experiments, has been led to a very ſimple proceſs.

He galled an ounce of ſilk with an ounce of nut-galls, and a bath was made with it.—Of nut-galls and logwood, each one ounce; gum, two ounces; ſulphate of iron, or vitriol, half an ounce; and verdegris, one dram twenty-four grains.

After the ſilk was taken out and aired, it was put again into the bath twice, adding each time one dram twenty-four grains of ſulphate of iron and two of verdegris: after this it was dipped in weak ſoap-ſuds. The black obtained by this proceſs was imperfect, and inclined to violet colour. He repeated the operation with a bath compoſed of the ſame ingredients; but it was expoſed to the air for twenty days before it was uſed, and the verdegris was not put in till the inſtant of beginning to dye: by this means he obtained a deep and fine black. He repeated theſe experiments, ſubſtituting ſumach inſtead of galls; but uſed double the quantity of ſumach, both for the galling and for the bath, without altering the quantities of the other ingredients; and obtained an imperfect black in the firſt method, but in the ſecond as fine a black as that produced when the galls were employed.

It may be obſerved, that this bath differs from that commonly uſed for hats, only in the proportions of the ingredients; and indeed the reſiduum of the hatters bath has been employed for dyeing ſilk ſtockings with conſiderable ſucceſs. In ſhort, it evidently appears to him that ſumach may be uſed inſtead of galls for dyeing ſilk and hats, with the ſimple precaution of taking double the quantity of ſumach.

It is by no means eaſy to explain, in a ſatisfactory manner, the difference of the proceſſes employed for linen and cotton, to which, like ſilk, the black particles adhere but weakly. It has been remarked, that the ſolution of ſulphate of iron forms a precipitate when left expoſed to the air, and that the iron in this caſe acquires a greater proportion of oxigene: but the ſolution in acetous acid, or other vegetable acids analogous to it, does not in ſimilar circumſtances form a precipitate, but only aſſumes a deeper hue. Beſides, theſe acids take up a larger portion of iron than the ſulphuric does. But, on the contrary, it may be noticed, that iron highly oxidated has a great attraction for linen and cotton, producing in them ſpots not eaſily diſcharged; and that in all the proceſſes, the ſolution is directed to be left a long time expoſed to the air, and even ruſty old iron to be made uſe of and preferred.

From theſe circumſtances it appears to Mr. Berthollet, that

the iron which is to enter into the compoſition of the black particles, ought to retain more oxigene to unite with linen and cotton, than to unite with wool or ſilk: that a ſolution in vegetable acid, expoſed a long time to the air, poſſeſſes this advantage: and that, beſides, it leaves in the liquor that remains on dyeing, a weak acid, which has no action on the black particles. Mr. Berthollet attempted a confirmation of this theory by the following experiment. He diſſolved iron in nitric acid, precipitated it by fixed alkali, and calcined it in a crucible. In this ſtate it is known to be ſcarcely ſoluble in the ſulphuric acid. With this calx he ſaturated vinegar as completely as poſſible, and dyed cotton, firſt alumed and afterwards galled, with the ſolution freſh made. After this firſt dyeing, he galled and dyed the cotton a ſecond time; when it had acquired as deep a black as the cotton to be met with in commerce, only it was a little harſh. A ſimilar experiment made with ſumach inſtead of galls, uſing double the quantity, proved ſucceſsful in an equal degree.

It is well known that it is extremely difficult to obtain a fine black on linen, or cotton; but to come as near to it as may be, it is proper to give a blue ground as deep as poſſible, becauſe then a ſmall quantity of colouring matter is ſufficient to produce a black, and perhaps the indigo itſelf contributes to fix the black particles. For common blacks, however, this would be too expenſive. The galling is preceded by aluming, becauſe the alumine, which is thereby fixed, renders the galling more effectual. The place of galls, which bear a conſiderable price, is frequently ſupplied by oak bark, oak ſaw-duſt, ſumach, the cups and huſks of acorns, or other common aſtringents, which are of conſiderably leſs price.

Of Gray.—In dyeing, it is well known that the ſhades of black are grays, from the deepeſt to the lighteſt. Grays may be produced in two different ways. In the firſt, a decoction is prepared from bruiſed galls, and the vitriol is diſſolved ſeparately. A bath is made proportionate to the quantity of ſtuff to be dyed of the lighteſt ſhade; and when it is ſo hot that the hand will juſt bear it, ſome of the decoction of galls, and ſome of the ſolution of vitriol, are poured in. Into this the wool or cloth is dipped. When it has attained the ſhade deſired, it is taken out, and more of the decoction, with more of the ſolution, is added to the ſame bath. Into this more cloth is dipped, to give it a deeper ſhade than the preceding. In the ſame manner the operator proceeds to the deepeſt ſhades, always adding ſome of each of the liquors: though for black gray, and other deep ſhades, it is beſt to give the cloth previouſly a blue ground more or leſs deep according to circumſtances. The ſecond way of producing gray, which Hellot prefers to that juſt deſcribed, becauſe in it the ſtuff takes the decoction of galls more firmly, and there is a greater certainty of putting no more ſulphate of iron than is neceſſary for the ſhade required, conſiſts in boiling for two hours the proper quantity of galls, bruiſed and incloſed in a thin linen bag: in this bath the cloth is to be boiled for an hour, being kept ſtirring, after which it is taken out: a little ſolution of vitriol is then added to the ſame bath, and the cloth that is to have the lighteſt ſhade is dipped in it. For the deeper ſhades more ſolution of iron is to be introduced. But in either of theſe methods we may begin with the deepeſt ſhades, if not confined to patterns which muſt be ſuited exactly. In the latter caſe, each piece of ſtuff ſhould be left a longer or ſhorter time till it has acquired the intended ſhade in an exact manner.

It is impoſſible to determine the proportions of the ingredients, the quantity of water, and the time neceſſary for all theſe operations: they muſt be judged of by the eye. If the bath be greatly loaded with colour, the wool muſt remain in it a leſs time: if, on the contrary, the bath begins to be exhauſted, a longer time is required. If we find the ſtuff not dark enough, it muſt be re-dipped a ſecond or third time, or even more: if it be too dark, it muſt be dipped into another hot bath, into which has been put a ſmall portion of decoction of galls, or into a bath of ſoap-ſuds, or of alum. If in this operation we go beyond the mark, the colour muſt be darkened as before; but repeating theſe operations is prejudicial to the ſtuff, ſo that we ſhould endeavour to catch the proper ſhade at once, by taking it out of the bath different times. It muſt be obſerved, that care muſt be taken that the bath do not boil, and that it be rather warm than too hot. In whatever manner grays are dyed, they ſhould be immediately waſhed in a large body of water, and the darkeſt may even require ſoap to cleanſe them. It is often required to give grays a tint of another colour, as a nut, agate, or reddiſh caſt. In this caſe, having given a tint more or leſs blue according to the object intended, the ſtuff is dipped in the remains of ſome cochineal liquor, that has ſerved for dyeing either ſcarlet or violet, adding to it galls, logwood, madder, &c.; they are then browned more or leſs deep with ſolution of iron. For the nut-gray, yellow wood and logwood are added to the galls, and the ſtuff is to be dyed from white.

Silk is found to take all grays, except black gray, without previous aluming. The bath is compoſed of fuſtic, logwood, archil, and ſulphate of iron. Theſe ingredients are varied according to the tint to be given. Thus more archil is employed for grays that are to have a reddiſh caſt, more fuſtic for thoſe that ſhould incline to a ruſſet or green, and more logwood for thoſe that are to be of a darker gray. For iron gray, logwood and ſolution of iron are only employed. But black gray requires aluming; after which the ſilk is taken to the river, and then dipped in the well bath. A part of this bath is thrown away, and its place ſupplied with logwood liquor. When the ſilk is impregnated with this, a ſufficient quantity of ſolution of iron is added, and as ſoon as it has acquired the proper ſhade, it is to be waſhed and wrung carefully. If the gray ſhould happen to be darker than it ought, the ſilk is dipped in a ſolution of tartar, and afterwards in warm water: and if by theſe means the colour be weakened too much, the ſilk is again dipped in a bath of dye that is quite freſh. It is found neceſſary that linen and cotton ſhould have a blue ground given them for black-gray, iron-gray, and ſlate-gray, but for no other. All the ſhades require a galling proportionate to the gray to be produced. Gall-baths that have before ſerved for other purpoſes are often employed. When the thread has been galled, wrung, and dried, it is dipped on the ſticks in a tub of cold water, to which is added a proper quantity of the bath from the black caſk, and of a decoction of logwood. The thread is worked in this pound by pound, and afterwards waſhed and dried properly. Two other proceſſes for dyeing gray are given by Mr. Pileur d'Apligny, which, according to him, produce a colour which is more permanent. They are theſe, 1. The thread is galled, dipped in a very weak bath of the black caſk, and then maddered.—2. The thread is dipped in a very hot ſolution of tartar, wrung gently, and dried. It is then dyed in a decoction of logwood. After this operation the thread appears black; but, on working it attentively in warm ſoap-ſuds, the ſurplus of the dye is diſcharged, and it remains of ſlate-gray, that is both very pleaſing and durable.

Sect. II. *Of Blue.*

Of Dyeing in the Blue Vat with Indigo, and with Paſtel.—There are many different proceſſes employed for dyeing blue by means of indigo. However, the preparation for dyeing this colour is not made in a copper, like thoſe for other colours, but in a large wooden veſſel called a vat. This is ſunk into the ground ſo as to be only breaſt high above it. As it is of

importance to preserve the heat of the vat, it is not fixed in the same place as the coppers, which require a free circulation of air, but in a place adjoining, constructed in such a manner as to retain the heat. This place is called *guesdre* by the French dyers; and the title of *guesdrons* is given to the men that work the vat, who ought to be instructed by long experience to prevent the accidents to which it is liable.

It is found that blue may be dyed with pastel or woad; which give a permanent, though not deep blue; as they afford only a small quantity of colouring matter. But if indigo be mixed with them, vats will be obtained very rich in colour; and these are almost the only ones used for wool or woollens. They are distinguished by the name of pastel vats. It does not appear that Hellot has accurately determined the proportions of the substances employed: Mr. Quatremère has however given a good description of a vat of this kind. But still it must be observed, that the proportions vary, not only in different dye-houses, but according to the shades that are to be produced. Into a vat of seven French feet deep, and five in diameter, are thrown two balls of pastel, weighing together four hundred pounds, taking care first to break them. Thirty pounds of weld must be boiled in a copper for three hours, in a sufficient quantity of water to fill the vat. When this decoction is made, twenty pounds of madder and a basket full of bran are added, and it is boiled half an hour longer. This bath is cooled with twenty buckets of water, and after it is settled, the weld is taken out, and it is poured into the vat. All the time it is running in, and for a quarter of an hour after, it must be stirred with the rake. This being done, the vat is covered up very hot, and let stand six hours, when it is uncovered, and raked again for half an hour. This operation is repeated every three hours. When blue veins are perceived on the surface of the vat, what is called *its ground* is given it, that is, eight or nine pounds of quick-lime. As soon as this substance is put in, new appearances are perceived: the colour of the vat becomes a blacker and deeper blue, and the exhalations which arise are more acrid. Soon after using the lime, or at the same time with it, the indigo is put into the vat, being first ground in a mill with the least possible quantity of water. When it is diluted to the consistence of thick pap, it is drawn off through a cock at the lower part of the mill, and thrown into the vat without any further preparation. The quantity of indigo to be used, depends on the shade to which the wool or cloth is to be brought: from ten to thirty pounds may be put into a vat composed in the proportions above mentioned, without any inconvenience being produced.

When, on striking the vat with the rake, a fine blue scum called flower is obtained, nothing more is requisite previous to dyeing, than to stir it with the rake twice in the space of six hours, that the ingredients may be thoroughly mixed. It is however sometimes necessary to add a small portion of lime. The bath, when first poured on the pastel, is boiling hot; and care must be taken not to leave the vat exposed to the air, except the time necessary for stirring it. As soon as that operation is over the vat is covered with a large wooden lid, on which thick cloths are spread, and every method of preserving its heat without the assistance of fire is employed. Notwithstanding these precautions, and the being favoured by the construction of the *guesdres*, the heat can only be kept up for a certain time. At the end of eight or ten days it is greatly lessened: and will at length be entirely dissipated, if the liquor be not heated again. This operation consists in pouring the greater part of the liquor of the vat into a copper, under which a large fire is made. When this bath is sufficiently hot, it is returned into the vat as before, and covered in a careful manner. The pastel vat is liable to two particular accidents. In the one it becomes *repelled*, in the language of the *guesdrons*. This is found to be the case when, on uncovering a vat that has already afforded fine shades of blue, it appears black, without any blue veins, and without flower: if it be stirred, the black colour grows deeper and deeper, and the smell, instead of being somewhat sweetish, as it is when the vat is in a proper state, affects the nose with a very pungent odour. If an attempt be made to dye with a vat exhibiting these marks, the stuff takes no colour, or comes out of a dirty gray. These bad qualities are owing to an excess of lime. By the *guesdrons* different means are employed to recover a repelled vat. Some put into it tartar, bran, urine, or madder: others content themselves with reheating it. According to Hellot, the best remedy is to put in bran and madder at discretion. If it have but a little too much lime, it is sufficient to leave it at rest five or six hours or more, putting in only a certain quantity of bran, and three or four pounds of madder, which are to be sprinkled on the surface, when it is to be covered, and tried after a due interval. If it be repelled to such a degree as not to give a blue but when it is cold, it must be left to recover without disturbance; and sometimes it must remain whole days without being stirred with the rake. When it begins to afford a tolerable pattern, the bath must be reheated. In general this revives the fermentation: or it may be excited with bran and madder, or even by adding fresh pastel in the quantity of a basket or two. But d'Orval and Ribeaucourt advise, merely to let the vat rest without raking, if it be but slightly repelled: but if it be so in a considerable degree, to put in a few pounds of bran enclosed in a bag, at the same time sprinkling in three or four pounds of powdered tartar. In five or six hours the bag, which rises to the top, is to be taken out, and the vat raked. If it be not yet recovered, the process is again to be had recourse to.

It is observed by Mr. Quatremere, that in order to recover a vat, which he had repelled by overloading it with lime, he contented himself with reheating it twice, leaving it at rest afterwards two days, when it gave a well-marked flower. After this he let it stand three days, reheated it a third time, and found it to be recovered very perfectly. The second kind of accident to which the pastel vat is liable is putrefaction. When this happens, the veins and flower disappear, the colour of the vat becomes ruddy, the paste rises from the bottom, and a fetid smell is perceived to arise. It is asserted by Mr. Quatremere, that a pattern of a deep blue plunged into a vat in this state, becomes several shades lighter. Putrefaction takes place in the vat because it has not been sufficiently supplied with lime. As soon as signs of putrefaction appear, we should hasten to correct it, by adding lime and raking it. In two hours time more lime is to be put in, and the vat raked again; and these operations are to be repeated till it is recovered: but care must be taken not to run into the opposite extreme. It is evident that nothing requires so much attention in the management of a pastel vat, as the distribution of the lime. In considering this vat alone, it would be difficult to determine what passes in it: but the experiments related in treating of indigo, shew, that to render that substance soluble by lime or alkalis, it must be deprived of the oxigene it contains. The pastel in which putrefaction has commenced, and which is much disposed to run into the true putrid state, acts in two ways: it seizes the oxigene of which the indigo is to be deprived, and at the same time affords a blue colouring matter analogous to indigo. But the putrefaction of this drug would take place with too much rapidity, if it were not restrained by the lime, which, as Pringle's experiments shew, has the property of resisting putrefaction. A principal use of the lime then is, to moderate the disposition of the pastel to putrefy, and to confine it to a state of gentle fermentation, sufficient to deprive the indigo of its oxigene, and to produce in the colour-

ing matter of the pastel that slight combustion which it must undergo, to acquire properties analogous to those of indigo. Another use of the lime, or of one part of it, is to dissolve the blue particles which are rendered soluble. If too much lime be put into the vat, the necessary fermentation is stopped, and it must be renewed, either by heat, or by fermentable substances, or by absorbing the excess of lime by vegetable acids. If, on the other hand, too little lime be put in, the pastel runs into a true putrefaction, which would destroy the indigo, and which must be brought back to a due degree of fermentation, by repeatedly adding lime till it is reduced exactly to the proper state.

The vat must be raked about two hours before dyeing, and to prevent the sediment, called paste, from occasioning inequalities in the colour, a kind of lattice formed of large cords, termed a cross, is introduced; and indeed when wool is to be dyed in the fleece, a net with small meshes is placed over this. The wool or cloth being thoroughly wetted with clear water a little warm, is pressed out, and dipped into the vat, where it is moved about a larger or shorter time, according as the colour is required to be more or less deep, taking it out occasionally to air. The action of the air is necessary to change the green colour given by the bath to a blue. In a rich bath it is difficult to give an uniform colour to light blues: the best method of obtaining such shades, therefore, is to use vats already exhausted, and which are growing cold. Wool and cloth dyed blue should be washed with great care, in order to carry off the particles not fixed in the wool; and those which are of a somewhat deep blue ought even to be carefully cleansed by fulling with soap, which does not alter the colour. Those designed to be dyed black ought to be treated in the same manner; but it is not so necessary for those which are to be green, to be thus prepared.

That kind of vat which contains neither pastel nor woad is called an *indigo vat*. The vessel used for this preparation is a copper, which, being of a conical figure, leaves between it and the brick-work that surrounds it, and on which its brim rests, an empty space sufficient for containing the fire. Into this copper are poured forty buckets of water, more or less, according to its capacity, in which have been boiled six pounds of *cendres gravelées*, twelve ounces of madder, and six pounds of bran. This liquor is to be put into the vat, grounds and all. Six pounds of indigo ground in water are then to be put in, and after raking it carefully, the vat is to be covered. A slow fire is to be kept up round it. Twelve hours after it is filled, it is to be raked a second time; and so on every twelve hours, till it is come to or become blue, which it will be in forty-eight hours. If the bath be well managed, it will be of a fine green, covered with coppery scales, and have a blue scum or flower at the top. It may be noticed that the theory of this vat is the same as that of the foregoing, except that the indigo is here dissolved by means of alkali instead of lime. When this vat, which is much more easily managed than that of pastel, is in a proper state, it may be used for dyeing in the same manner as that described above. There are two vats described by Hellot, in which the indigo is dissolved by means of urine. Madder is added to it, and in the one vinegar, in the other alum and tartar, of each a weight equal to that of the indigo. The quantity of urine ought to be very considerable. There is a probability that the indigo, deprived of its oxigene by the urine and madder in fermentation, is dissolved by the ammoniac, which is formed by the urine, either by the action of heat, or by putrefaction. Hellot remarks, that an effervescence takes place on pouring in the solution of alum and tartar, which probably tends to stop the putrefaction. These vats are by no means comparable with that of pastel, or that of indigo before described, much less work being expedited by them, so that they are adapted only for dye-houses upon a small scale.

For the purpose of dyeing silk blue, the indigo vat before described is used. In general a larger proportion of indigo is put in than is there directed, but nearly the same quantities of bran and madder. Macquer observes, that if half a pound of madder be employed for every pound of *cendres gravelées*, the vat becomes greener, and its colour is more fixed in the silk, without being of a less pleasing cast. The pastel vat, and the others that have been described, are not proper for dyeing silk, because they do not colour it in a sufficiently ready manner. When the vat is come to, what is called a *brevet* is given it, with about two pounds of *cendres gravelées*, and three or four ounces of madder: it is then raked, and in four hours is ready for dyeing. The heat ought to be at that time moderated so that the hand may be held in it without pain being given. Before it is dipped in this vat, the silk must be boiled with soap, in the proportion of thirty pounds of soap to a hundred of silk, and well cleansed from it by two or more beetlings in a stream of water. As the silk is very liable to take an uneven colour, it is necessary to dye it in small portions. Thus the workman dips each hank one after another, having first put it on a wooden cylinder; and when he has turned it once or oftener in the bath, he wrings it strongly over it, and airs it, to turn the green colour to a blue. When the green appears thoroughly changed, he throws it into some clear water, after which he rings it with the pin repeatedly; and care must be taken that the silk dyed blue dry speedily. In the winter, and in damp weather it should be dried in a chamber heated by a stove, being hung on a kind of frame which is constantly in motion. When the bath grows weak, and the green colour diminishes, a brevet is given it, into which are put a pound of *cendres gravelées*, an ounce of madder, and a handful of bran well washed. When the indigo is exhausted, more of that also must be added, with the due proportions of *cendres gravelées*, madder, and bran. But some dyers use vats that are grown weak to dye light shades: however the blue obtained in that case is less beautiful, and less permanent, than when fresh vats containing a smaller quantity of indigo are made use of: but indigo alone is incapable of giving silk a deep blue: therefore, when this is required, it is necessary to prepare it by giving it another colour or ground. For the *Turkey* blue, which is the deepest, a very strong archil bath is first given; and for the royal blue one of the same kind, but weaker. Other blues are dyed without any ground being previously given. There is however a blue made as deep as the royal blue, for the ground of which cochineal is used instead of archil, in order to render it more permanent, whence the title *bleu fin* has been given it. A blue of little durability may be given to silk by means of verdegris and logwood: but it might be made more lasting, by first giving it a lighter shade than is intended in a bath of this kind, afterwards dipping it in an archil bath, and in the vat after that.

When raw silk is to be dyed blue, that should be chosen which is naturally white. It should be thoroughly soaked in water, and afterwards put into the vat in separate hanks, in the same manner as the scoured silk. In general raw silk takes the dye more readily, and, if it be possible, the scoured silk is put into the vat before it. If raw silk require archil, or the other ingredients above-mentioned, it is to be treated in the manner that has been already mentioned. According to the method of Mr. Pileur d'Apligny, the vat for dyeing linen and cotton is a cask of about a hundred and twenty gallons. The quantity of indigo used is generally from six to eight pounds. This indigo, after being pounded, is boiled in a ley drawn off clear from a quantity of lime equal to the indigo, and double its weight of pot-ash. The boiling is continued till the indigo is thoroughly penetrated by the ley, carefully stirring it all the while, that the indigo may not stick to the bottom of the vessel and be burned. While the indigo is boiling, an equal

weight of quick-lime is to be ſlacked. About twenty quarts of warm water are added, and in this is diſſolved as much vitriol or ſulphate of iron as amounts to twice the weight of the lime. When the ſolution is completed, the liquor is to be poured into the vat, which muſt be previouſly half filled with water. To this the ſolution of the indigo muſt be added, with the remainder of the ley which was not uſed in boiling it. When all theſe are put into the vat, it is to be filled up to within two or three fingers of the brim, and ſtirred with the rake two or three times a day, till it is in a ſtate fit for dyeing, which it will be in eight-and-forty hours, and frequently ſooner, according to the temperature of the atmoſphere, on which the time required to make this vat depends in a great degree. But ſome dyers add to a vat compoſed nearly in the ſame manner as the above, a little bran, madder, and paſtel.

However, at Rouen in France a more ſimple proceſs is followed, which is thus deſcribed by Mr. Quatremere. The vats are conſtructed of a kind of flint, covered within and without with a coating of fine cement. In every dye-houſe there is a certain number arranged in one or more parallel lines. Each vat is capable of containing four hogſheads of water, and into it may be put eighteen or twenty pounds of indigo. The indigo having been macerated for a week in a cauſtic ley ſufficiently ſtrong to bear an egg, and then ground in a mill, in which not unfrequently the maceration is made, about three hogſheads and a half of water are put into the vat, and afterwards twenty pounds of lime. When the lime is thoroughly ſlacked, the vat is raked, and ſix-and-thirty pounds of ſulphate of iron or engliſh copperas are put in. When the ſolution is completed, the ground indigo is poured in through a ſieve. On that day it is raked ſeven or eight times: and, after having ſtood at reſt ſix-and-thirty hours, it is fit for the purpoſe of dyeing with. However it is neceſſary to have vats ſet at different times. The cotton, or thread, is firſt dipped in that which is moſt exhauſted, going on from vat to vat, till it comes to the ſtrongeſt, unleſs it have before attained the proper ſhade. It ſhould be wetted before it is put into the firſt vat, and ſhould not be left in the bath more than five or ſix minutes, as in that time it will have acquired nearly all the blue that can be taken up by it. But as ſoon as the dyeing in one vat is over, it ſhould be raked and not uſed again, till it has ſtood at leaſt four-and-twenty hours, unleſs it be newly ſet, when it need not ſtand ſo long a time. After a vat has been dyed in three or four times, it begins to change: no more veins are ſeen on its ſurface after raking it, or it grows black. It is then neceſſary to *repleniſh* it, and for that purpoſe four pounds of ſulphate of iron, with two of quick-lime, are added, and it is raked twice. A vat may be repleniſhed three or four times, diminiſhing the ingredients in proportion as it falls off in ſtrength and quality. But this vat may be rendered ſtill more ſimple. It may be compoſed, as directed by Bergman, in the following proportions. Take three drams of indigo powdered, three drams of ſulphate of iron, ſix drams of lime, and two pints of water. Rake it well, and in a few hours the vat will be ready for the purpoſes of dyeing.

Another vat is mentioned by Bergman, which is very convenient and expeditious for dyeing thread or cotton. It is thus deſcribed by Scheffer. To very ſtrong ſoap-boilers' ley indigo well powdered is added, in the proportion of three drams to a quart. After a few minutes, when the colouring feculæ are well penetrated by the ley, ſix drams of powdered orpiment are added. The bath is to be well raked, and in a few minutes it becomes green, and exhibits the blue flower with a pellicle at top, when the fire is to be put out, and the dyeing is to be begun. But Mr. Oberkampf, whoſe proceſſes have been improved with great care, uſes a ſtill greater proportion of indigo. In Bergman's proceſs, the indigo is ſcarcely an eightieth part of the water: in that of Scheffer ſtill leſs; and an eighth in Mr. Oberkampf's. The proportions of the other ingredients in theſe proceſſes alſo vary. Theſe preparations would probably ſucceed on a ſcale in which the proportions ſhould be greatly augmented, and there would be no difficulty in determining which would beſt attain the object that is aimed at.

Of Saxon Blue.—That colour which is dyed by means of a ſolution of indigo in ſulphuric or vitriolic acid has received the appellation of *ſaxon blue*, from its having been diſcovered in Saxony. At firſt the ſolution was not made with indigo alone; but alumine, antimony, and other mineral ſubſtances were previouſly digeſted in the ſulphuric acid, the indigo was added afterwards, and when the ſolution was finiſhed, it was employed for dyeing. Mr. Bergman has made many experiments on this proceſs, and he thinks that, if it have hitherto afforded only a fading colour, it has been becauſe the acid uſed was too weak. He puts one part of indigo finely powdered into eight parts of ſulphuric or vitriolic acid, ſo concentrated that its ſpecific gravity is to that of diſtilled water as 1900 to 1000. The mixture being made in a glaſs veſſel ſlightly ſtopped, a great heat is excited. After a digeſtion of twenty-four hours, in a heat of from 100 to 122 degrees of Fahrenheit, the indigo is diſſolved, but the mixture is quite opake and black: by the addition of water it is rendered clear, and affords ſucceſſively the various ſhades of blue, according to the quantity of water added.

It has been found, that thread and cotton take only very pale ſhades from this dye; and that the deepeſt ſhades obtained by this proceſs, when concentrated ſulphuric acid is employed, ſuffer no change, as has been aſſerted by Bergman. He ſays, that having expoſed all the patterns to the ſun for two months, the deep blues, ſuch as are known by the name of Coventry blues, were ſcarcely weakened; but that the light ſhades ſuffered much more, becoming dull and of a greeniſh caſt.

Mr. Quatremere found only two dye-houſes among ſeveral, in which it was known how to make the dye of indigo with ſulphuric acid penetrate into the internal part of the ſtuff, when the colour is ſaid to pierce or *cut*. He obſerves that he gave it this property, by introducing fixed alkali, one ounce to an ounce of indigo and ſix ounces of ſulphuric acid. With this preparation he dyed a pattern of a moſt deep and vivid blue, and the cut was as deeply tinged as the ſurface. And Mr. Poerner, who has paid great attention to this preparation, adopts the addition of alkali. He ſays, that by means of it the colour is rendered more pleaſing, and penetrates deeper. He directs only four parts of ſulphuric acid to one of indigo. In the proceſs deſcribed by him, four parts of concentrated ſulphuric acid are poured on one of indigo reduced to a fine powder: the mixture is ſtirred for ſome time; after having ſtood twenty-four hours, one part of good dry pot-aſh in fine powder is added: the whole is again well ſtirred, and having ſtood twenty-four hours longer, water is to be added gradually in a greater or leſs proportion. A preparation of indigo in a dry form has alſo been diſcovered by the ſame writer, which is more advantageous, more eaſy to be uſed, and more convenient than the preceding. The public have not yet however been informed of the nature of this preparation.

In order to dye ſaxon blue, the cloth is prepared with alum and tartar. A greater or leſs proportion of the ſolution of indigo is to be put into the bath, according as the ſhade required is deep or light. In the dye-houſe this ſolution is called *compoſition*, and the colour obtained by it frequently *pruſſian blue*. The light ſhades may be dyed after the deep ones: but they have more luſtre when dyed in a freſh bath. For deep ſhades it is beſt to put in the ſolution of indigo in different portions, the cloth being raiſed on the winch at the time.

Of Dyeing Blue by Prussian Blue.—From this blue furnishing a beautiful and permanent colour in paints, attempts have been made to employ it in dyeing. Prussian blue is a combination of iron with a peculiar acid, which acid is formed by calcining animal substances with alkali, and which is distinguished by the name of *prussic*, and its compounds are called *prussiates*.

Mr. Macquer first attempted to soak thread, cotton, wool, and silk, in a solution of alum and sulphate of iron; then in an alkaline solution partly saturated with prussic acid; and next in water acidulated with sulphuric acid, which was to dissolve that part of the oxide of iron not combined with the prussic acid, which the alkali not combined with that acid had precipitated. Repeating successively these immersions, he obtained a fine blue, but very unequal: and the wool and silk were become harsh to the touch, from the action of the alkali, and of the sulphuric acid. It is easy to perceive, that this process could not succeed. For as an alkali not saturated with prussic acid was used in the second immersion, that part of the alkali which was not saturated must dissolve more or less of the blue taken up in the first. If any one, therefore, would repeat these experiments, he should employ an alkali saturated with prussic acid; or perhaps lime-water, or rather magnesia, both of which have the property of combining with that acid very readily. But in a second process, that learned chemist boiled his patterns in a solution of alum and tartar, and afterwards passed them through a bath in which prussian blue was mechanically diffused. They were now dyed evenly, and were soft to the touch; but the colour was faint, and it could not be rendered more deep.

Another process for thread and cotton has been proposed by the abbé Menon. It consists in first dyeing them black: then soaking them a few minutes in a solution of prussiate of alkali; and afterwards boiling them in a solution of alum, in which they acquire a very deep blue. If a lighter blue be required, they must be passed through a weak acid. This process is very curious: in it the prussic acid seems to take the place of the astringent principle. Different trials have been made to turn these experiments to advantage, particularly the first: but whatever care has been taken, the colour was frequently weak, dull, and uneven. They seem therefore to have been renounced, and the only one now used has considerable analogy to the second of Macquer. In this the prussian blue is merely diluted by means of muriatic acid, which does not form with it a true solution, but attenuates it sufficiently to make it penetrate more copiously into cotton stuffs.

The description of it is as follows.—On fine prussian blue, in the proportion of a pound to a piece of stuff, powdered and passed through a very fine sieve, pour, in a vessel of delft ware, as much marine acid as will reduce it to the consistence of a syrup. Stir it continually while it ferments for about half an hour. Dilute it well, and stir it every hour for a day till no more fermentation be perceptible, the particles are extremely divided, and united with the acid very intimately. Afterwards, in a trough narrower than the common ones, but widening more toward the top, being two feet and a half high, two feet and a half diameter at top, and two feet at bottom, put seven or eight buckets of water for one piece of velvet. To these add the composition, well diluted with water in a separate vessel, and poured into the bath through a very fine sieve. As soon as the piece is placed on the winch over the trough, stir the bath very briskly, and let down the piece speedily, working as fast as possible for one, two, or three hours; passing the piece from the winch to the horse or board, and from the board to the winch successively. From the prussian blue not being really dissolved, but only very minutely divided, and being weighty, it is quickly deposited on the stuff, and always in greatest quantity on the first that presents itself. Hence it follows, that the colour is at first wavy, and frequently in patches, whatever care be taken. At this we should not be surprised, though we ought to avoid it as much as possible: work and rework the stuff; wash the parts that have taken too much colour with the bath itself; work it over again, now one end first, then the other; dry it; work it again, always as evenly and speedily as possible; dry it once more if necessary, and work it again, till we attain the proper shade, and the colour be perfectly even. There is no colour that requires a more experienced workman than this. The stuff is always to be washed and beetled between the dryings. In all kinds of baths it is necessary that the stuff be put in thoroughly wet; if dry, the colour will not penetrate it without great difficulty, and always very unequally. The last time it is not washed, and is dried on the tenters in the open air, either in the sun or in the shade, provided the piece be stretched out very well.

This is one of the most beautiful colours produced by art, and is not changed by the air, though exposed to all its vicissitudes. Mr. Roland de la Platiere left patterns of it in the open air for six months together: for a long time the colour heightened, and at last had lost but little. Acids are not injurious to it: boiling with alum even produces in it but little alteration. However, dust, and rubbing on the creases of it, soon tarnish it; and the slightest touch of an alkaline liquor instantly decomposes it. But for this operation, instead of the muriatic acid, Mr. Guliche uses a solution of tin in nitro-muriatic acid.

A kind of sea-green colour was formerly in esteem, made with sulphate of copper; but this colour, which approaches very near to blue, possesses no durability, and is no longer in use. The process for it is this. The cloth, after having been fulled and moistened with warm water, is left for an hour in strong soap-suds, after which it is kept half an hour or three quarters of an hour in a solution of sulphate of copper or blue vitriol; a net is employed to prevent the cloth from being rendered dull by the sediment from the soap and sulphate of copper: sometimes, in order to produce a more distinct green, a solution of copperas is mixed with a bath of weld; and sometimes verdegris is substituted for sulphate of copper. Hellot describes a somewhat different process, by which the Dutch produced this colour in perfection. He says, that they mixed together equal parts of lime and sulphate of copper in a bag, and turned the cloth out of the copper with the soap-suds, into another that was contiguous, in which, by the particles of the copper that passed through the bag, a green colour was given to the cloth.

Sect. III. *Of Red.*

Of the Processes of Dyeing with Madder.—It has been already observed, that wool would receive from madder only a perishable colour, if its colouring particles were not fixed by a base which occasions them to combine with the stuff more intimately, and which in some measure defends them from the destructive influence of the air. For this purpose, the woollen stuffs are first boiled for two or three hours with alum and tartar, after which they are left to drain; they are then slightly wrung and put into a linen bag, and carried into a cool place, where they must remain for several days. The quantities of alum and tartar, as well as their proportions, vary much in different manufactories: Hellot recommends five ounces of alum and one ounce of tartar to each pound of wool; if the proportion of tartar be increased to a certain degree, instead of a red, a deep and durable cinnamon colour is produced, because acids have a tendency to give a yellow tinge to the colouring particles of madder. Mr. Poener somewhat diminishes the proportion of tartar, he directs that it should be only one seventh of the alum: Scheffer, on the contrary, directs that the quantity of tartar should be double that of the alum; but

Mr. Berthollet has found that by employing one half tartar, the colour fenfibly bordered more on the cinnamon, than when the proportion was only one fourth of the alum.

In order to dye with madder, the bath muft not be permitted to boil, becaufe that degree of heat would diffolve the fawn-coloured particles, which are lefs foluble than the red, and the colour would be different from that which it is intended to obtain. At the time the water is at a degree of heat which the hand can bear, Hellot directs us to throw in half a pound of the beft grape madder for each pound of wool to be dyed, and to ftir it well before the wool is put in, which muft remain for an hour without boiling; but in order to be more certain of the dye, it may be boiled for four or five minutes towards the end of the operation. Mr. Beckmann advifes the addition of a little alkali to the madder bath; and in the dyeing of thread and cottons, Mr. Berthollet thinks the addition judicious. But the reds obtained by this procefs are never fo beautiful as thofe produced even by kermes, much lefs thofe from lake and cochineal; but as they coft but little, they are ufed for common low-priced ftuffs. The madder reds are fometimes rofed with archil and brazil wood, in order to render them more beautiful and more velvety, but the brightnefs given them in this way is by no means durable.

But the quantity of madder which Mr. Poerner employs is only one third of the weight of the wool, and Scheffer advifes only one fourth. Mr. Poerner fays, that having added to the alum and tartar a quantity of folution of tin, of equal weight with the tartar, and after two hours boiling, having let the cloth remain in the bath that had been left to cool for three or four days, he dyed it in the ufual way, and obtained a pleafing red. He defcribes another procefs, in which, after having prepared the cloth by the common boiling, he dyed it in a bath but flightly heated with a larger quantity of madder, tartar, and folution of tin; he let the cloth remain twenty-four hours in the bath, and after it had become cold, he put it into another bath made with madder only, and there left it for twenty-four hours; in this way he obtained a pleafing red, fomewhat clearer than the common red, and bordering a little on a yellow. According to Scheffer, by boiling wool with a folution of tin, the quantity of which he does not mention, with one fourth of alum, and by dyeing with one fourth of madder, an orange red may be procured. Bergman obferves, that if without boiling the wool it be dyed with one part of a folution of tin and two parts of madder, it acquires a cherry colour, which when expofed to the air acquires a ftill deeper caft. Wool, on being boiled for two hours with one fourth of fulphate of iron, then wafhed, and afterwards put into cold water with one fourth of madder and then boiled for an hour, a coffee colour is produced: Bergman adds, that if the wool has not been foaked, and if it be dyed with one part of fulphate of iron and two of madder, the brown obtained approaches to red. It feems from thefe chemifts, that by employing fulphate of copper as a mordant, we obtain from madder a clear brown bordering on yellow. A colour of the fame kind will be produced, by dyeing the wool fimply foaked in hot water, with one part of fulphate of copper and two of madder; if equal parts of thefe two fubftances be ufed, the yellow will be fomewhat more obfcure, bordering on a green; in both thefe cafes, the colour does not become darker by expofure to the atmofphere.

Mr. Berthollet has employed a folution of tin in various ways, both in the preparation and in the maddering of cloth; and has ufed different folutions of tin, and has found that the tint was always more yellow or fawn-coloured, although fometimes brighter than that obtained by the ufual procefs.

Though madder has not been found to afford a colour fufficiently bright for dyeing filk, De la Folie has given a procefs for employing it for that purpofe. Half a pound of alum is to be diffolved in each quart of hot water, to which two ounces of potafh are to be added; after the effervefcence has ceafed, and the liquor has begun to grow clear, the filk muft be foaked in it for two hours; it is then to be wafhed and put into a madder bath. Silk dyed in this way becomes more beautiful by the foap proof.

It is well known that madder is ufed for dyeing linen and and cotton red, and even for giving them many other colours by means of different admixtures; it is the moft ufeful of all the colouring fubftances employed in this kind of dyeing. It is therefore proper to enter into a fomewhat minute detail of the different means by which this kind of dye may be rendered more certain, more beautiful, and varied. Thread does not fo eafily take a colour from madder as cotton, but the proceffes which fucceed beft for the one, are alfo to be preferred for that of the other. The madder red of cotton is diftinguifhed into two kinds; the one is called fimple madder red; the other, which is much brighter, is called Turkey or Adrianople red, becaufe it comes from the Levant, and has feldom been equalled in brightnefs or durability by the dyers in this country. The reds introduced by madder likewife differ very much in brightnefs and permanency, according to the proceffes employed. We are indebted to Mr. Vogler for fome very interefting experiments on this fubject. He firft confiders the bafes or mordants, and afterwards the preparation of the madder bath. The firft mordant that was tried confifted of a folution of three drams of roman alum in fourteen ounces of water. Thread and cottons boiled for fome minutes in this folution, and afterwards paffed through the different madder baths, which will be hereafter defcribed, took a flight poppy-coloured red. The author obferved in this, and many other experiments, that roman alum was much better than common alum, and gave greater brightnefs to the colours. He always ufed yellowifh thread and cotton, which he firft leyed, then wafhed and dried carefully. The proportion of alum juft mentioned appeared to him the beft; but though he repeated the aluming three times, he was not able to give the thread and cotton a good colour. The addition of the fmalleft quantity of any kind of acid rendered it paler; the addition of arfenic produced no effect; fheep and cow dung, and *album grecum*, added to the mordant, as alfo urine employed inftead of water to diffolve the alum, contributed fomewhat, but not much, to ftrengthen the colour. Muriate of foda and ammoniacal muriate had more effect, but thefe falts rendered the colour more dull; lime-water acted very much in the fame way. The fubftances which had the beft effect were gum arabic, ftarch, fenugreek-feed, and, above all, glue. The author fays he has attempted to impregnate thread and cotton with fifh oil, hogs-lard, and olive oil, but without fuccefs. The gaftric juice and the ferous part of the blood of animals act in a manner fimilar to glue. The thread and cotton may be foaked alternately in a folution of glue and a folution of alum, or the glue may be diffolved with the alum, in the proportion of from one dram and a half to four drams, with the quantity of alum directed. It is neceffary to choofe fine glue. This fubftance ufed with alum produces a more faturated colour, but without alum the red is of a dufky colour.

It is alfo found that muriate and nitrate of alumine not only produce a more intenfe and durable red than alum, but the tint is pleafanter, more efpecially when the nitrate is employed. In general, muriates render the colour darker, more faturated, and more durable. Corrofive mercurial muriate produces an effect of a fimilar kind. Having diffolved in a ftrong ley of pot-afh as much powdered white arfenic as it would take up with the affiftance of heat, and having mixed this folution, which had been diluted with two parts of water, with a faturated folution of alum, the mixture became turbid and of the confiftence of

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jelly ; it recovered its tranfparency on a folution of alum being gradually added. It was found that thread and cotton foaked for twelve hours in this mordant, when wafhed and dried, received from madder a beautiful well faturated colour. Thread and cotton which had been for fix hours in nitro-muriatic acid, and afterwards wafhed and dried, took from madder a more beautiful and durable colour than that which dyers obtain from annotta ; fome bad madder, by means of this mordant, afforded a yellowifh brown, that had a fhade rather agreeable.

This colour is capable of being changed into a poppy-coloured red, which may vie with the moft beautiful colours of this hue obtained from brafil wood and cochineal, by firft foaking the ftuff in a folution of alum and common falt, and boiling it a fecond time with madder. Mr. Vogler macerated for a night three drams of pot-afh with an equal quantity of common madder in a pound of water ; he then applied a boiling heat, and put into it fome thread and fome cotton ; and after half a quarter of an hour's boiling, he took it out, rinfed and dried it, then foaked it in a folution of alum and common falt ; after which he paffed it through a folution of glue, and at laft dipped it in a madder bath ; when it took a full red, which was very fine. But if to the preparation of madder and pot-afh annotta be added, the thread and cotton take in this bath a beautiful orange colour ; it is thus that the dyers in many places prepare that colour, but it is not fo durable as that defcribed above. When inftead of pot-afh roman alum is employed, a colour is obtained which is at firft weak though more lively than with the pot-afh, and on going on with the procefs a fine full red is procured. And by giving a weak madder colour to thread and cotton that have been alumed, by afterwards foaking them in a folution of alum and falt, impregnating them with glue, and dyeing them a fecond time in a madder bath, they take a beautiful red, which is very lively. The red of thread and cotton coloured by two maddeings, was found to be very much weakened by the nitric, fulphuric, and muriatic acids diluted with two parts of water, and became more or lefs pale and yellow. The action of the nitric acid was the moft powerful, and that of the muriatic the weakeft ; this laft turned the colour brown. The vegetable acids have a much weaker action ; a folution of alum powerfully diffolved the colour, rendered it clearer, and at the fame time brighter ; pot-afh and lime water have the property of extracting much of its colour, and changing it to a red which is very deep.

It is found that galls difpofe thread and cotton to receive the madder colour. Mr. Vogler's preparation for galling confifted of five drams of black galls, kept for twenty four hours in a pound of water, which was then boiled for ten minutes, and fometimes he added fix drams of common falt. The galled thread and cotton, after having received the mordant of alum and falt, took with the madder a perfectly faturated colour, but which was of a dark red. Thread and cotton fucceffively impregnated with a folution of tin and glue, fteeped in an infufion of cochineal and galls, wafhed and dried, and afterwards impregnated with the alum and falt mordant, and laft of all dyed in a madder bath, received an uncommonly beautiful colour, which was very bright and confiderably durable. The mordant of alum and corrofive muriate of mercury, and that of alum and falt, gave a colour of a fomewhat deeper caft.

The fame gentleman was equally fuccefsful when inftead of galls he ufed feveral other vegetable aftringents, fuch as the ground bark of the alder and oak, the powdered bark of walnut-tree root, flowers and bark of pomegranate, the leaves, bark, and tops of the fumach. He made many experiments with metallic and earthy falts, all of which, except the aluminous and the folution of tin, appeared to him to be but little adapted or entirely hurtful in the dyeing of red. The principal refults are the following. A folution of nitrate of lead employed as a mordant, produced a very loaded dirty red, inclining to brown. In general, folutions of lead ufed as mordants for thread and cotton, difpofe them abundantly to receive colours from all vegetable colouring fubftances, but they have always a dark and dirty appearance. Thefe mordants may be employed for brown or black colours ; the bad brown juft mentioned for inftance will change to a perfect brown of a very beautiful fhade, if paffed through a mordant of alum and falt, and boiled a fecond time with madder. A very fine black, by galling thread and cotton impregnated with falt of lead, and then putting them into a folution of fulphate of copper, and boiling them in a logwood bath. Cobalt diffolved in the nitro-muriatic acid produced a very pleafant colour, nearly refembling a very faturated violet. A folution of fulphate of copper gave a bad lilac, and verdegris diffolved in vinegar produced the fame effect ; but the nitrate of copper produced a much more beautiful and faturated colour.

The thread and cotton that has received the mordant of fulphate of copper or iron, takes in the madder bath a dirty dull violet colour. Mr. Vogler having added the alkaline folution of arfenic juft mentioned, to a moderately faturated folution of fulphate of copper or iron, produced a turbid mixture which effervefced, and he rendered it tranfparent by adding fulphate of iron. Thread and cotton impregnated with this preparation received a beautiful faturated puce colour which penetrated them in a deep manner. But the nitrate and muriate of iron produced a better effect than the fulphate and acetite, they afforded a beautiful well faturated violet colour. The alkaline folution of arfenic mixed with earthy and metallic falts generally render them better mordants for all colours. This likewife renders the effect of the mordants into which it enters more lafting, fo that the ftuff impregnated with it many years before, may be dyed without difadvantage, a circumftance we do not remark refpecting any other mordant, excepting a folution of tin. Sulphate of zinc afforded a weaker violet than fulphate of copper. Sulphate of lime and calcareous nitrate produced no effect. Sulphate of manganefe difcovered fome though but little action. Mr. Vogler remarks, that it is neceffary always to rinfe the cotton and thread when they come out of a mordant ; if this precaution be neglected, a weak colour only is frequently obtained, where a ftrong one was expected, becaufe the particles of the mordant difperfed through the bath combine with the colouring particles and are precipitated with them ; this precaution is efpecially neceffary when we dye with fubftances in which the colouring matter is not in a large proportion.

The madder bath is prepared in different ways by Mr. Vogler. He put three drams of madder into from fixteen to eighteen ounces of water ; he macerated it for twenty four hours, then boiled it for a quarter of an hour, introduced the thread and cotton, and boiled them for half a quarter of an hour ; he afterwards wafhed them in two or three waters, and then dried them in the fhade ; he remarks that by long boiling the colour of the ftuff is taken away and entirely deftroyed. If frefh urine be fubftituted for water, it affords more lafting colours ; but in fummer it is liable to become putrid foon, fo as to render the infufion incapable of giving the dye. A dram of fheep's dung or *album grecum* produced the fame effect as the urine ; and three drams of muriate of foda, or one dram of ammoniacal muriate, produced a fuller but lefs bright colour. Sulphate of pot-afh and nitre had no effect whatever. Three drams of white fugar afforded a more beautiful and faturated colour ; on four drams of long pepper being added, it was found to have become more capable of refifting the nitric acid. A dram or a dram and a half of ftarch or gum arabic thrown into the bath juft as it begins to boil, and before the cotton is put in, gives a finer and more faturated colour ; one dram of fenugreek feed produced very nearly the fame effect. If in the beginning of the digeftion

four drams of Spanish pepper be added, colours are obtained from the liquor, which are more durable than the preceding, especially if three drams of common salt be afterwards added. If from one ounce to one ounce and a half of glue in the state of jelly be thrown into the liquor as the ebullition commences, it affords a particularly beautiful full colour, and the addition of three drams of common salt not only renders the colour more lasting, but preserves the infusion from running into the putrid state. But the most beautiful colour of all is obtained by mixing four drams of ox gall with the decoction: at the same time, however, it must be observed, that this colour is more easily destroyed than any other by the nitric acid.

It is easy to preserve all the madder baths, except those prepared with urine, glue, and animal dung, for a long time without losing their power. Mr. Vogler kept some till they became mouldy and fœtid, and yet they dyed very well: nay he observes that they produced more durable colours, or at least colours which resisted the action of the nitric acid in a more powerful manner. But on putting from thirty-six to forty grains of crystals of tartar into the bath, just as the linen was thrown in, the colour produced was found capable of resisting the nitric acid. The sulphuric, nitric, and muriatic acids, in very small quantity, produced the same effect; in too large a quantity they weakened the colour and rendered it pale. One dram and a half of powdered alum made the colour finer, but not more durable; twenty-four drams of corrosive muriate of mercury rendered it more obscure, but more permanent. White arsenic employed in different proportions never occasioned the least change, though dyers frequently use it as well as orpiment, with a view of making the colour have more durability. In the experiments of Mr. Vogler, cotton always took the colour better than thread; the difference, however, was not very great, when he employed linen or hempen cloth that had been a little worn, and that had become soft to the touch, and when its texture was loose and the thread twisted only in a slight degree.

The following process employed at Rouen, for dyeing cotton red, has been described by Mr. le Pileur d'Apligny. The cotton must be scoured, galled with one part of galls to four of the cotton, after which it must be alumed with four ounces of roman alum to one pound of cotton, and an equal weight of water; to the solution of alum, one twentieth part of a solution of soda, consisting of half a pound of soda to a quart of water, is to be added. But some use only half the quantity of soda, and one sixth less of water, which they replace by a solution of tartar and arsenic. Mr. le Pileur d'Apligny thinks these last ingredients counteract each other. It has been seen by the experiments of Mr. Vogler, that tartar used with the mordant weakens the colour, and that arsenic only proved useful when combined with an alkali. Other dyers add acetite of lead, or saccharum saturni, or muriate of tin; but d'Apligny recommends the addition of some vinegar to the acetite of lead, in order to prevent the precipitation which is formed, when it is dissolved in water. After the cotton is taken out of the mordant, it is slightly wrung with the pin, and dried; the colour is more beautiful as the drying is slow. They generally dye only twenty pounds of cotton at a time; it is better to dye even only ten, because when too great a number of hanks are wrought in the copper, it is much more difficult to dye them in an equal manner. But a copper in which ten pounds of cotton are to be dyed, should hold about two hundred and forty quarts of water, which must be heated; when almost too hot for the hand, six pounds and a quarter of good Dutch grape madder are to be added, and carefully dispersed through the bath. When it is well mixed with it, the cotton, which has been previously put upon the sticks and placed on the edge of the copper, is to be immersed hank by hank. All the cotton being put into the bath, it is to be worked, the hanks on each of the stick being turned for three quarters of an hour, and the bath kept constantly at the same degree of heat without boiling. At the expiration of this time, the cotton is taken out and placed on the edges of the copper, a pint of the above ley of soda is to be added to the bath; the cotton is then to be returned into the bath, and boiled from twelve to fifteen minutes; it is then to be taken out and left to drain, wrung, washed in a stream of water, and again wrung on the pin. Two days afterwards, the cotton receives a second maddering in the proportion of eight ounces to the pound, and is worked about as in the first maddering, with this difference, that no ley is added, and that well water is employed for the bath: this maddering being finished, the cotton is left to cool, washed, wrung, and dried afterwards.

It is not thought by d'Apligny that this method of dyeing by two baths is a good one, because it requires more time and fuel, and because the second maddering cannot furnish much dye, the salts of the mordant having been exhausted by the first. He proposed another method, in which he says several dyers have already succeeded; it consists in aluming the cotton twice, and then dyeing it by one bath only. And in order to render this red more lively, a quantity of warm water, sufficient to moisten the cotton, is put into a caldron or vat, into which about a pint of the ley is to be poured; the cotton is to be soaked in this bath, pound by pound, left there for a moment, taken out, wrung, and dried. According to the same writer, this operation is useless, for as the red cotton is intended for making stuffs, from whence it is necessary to separate the preparation when they are to be wrought, the colour of the cotton is at the same time rendered more lively, because it is passed through warm water rendered more active by the addition of a little ley. When the stuffs are taken out of this water, they are washed in a stream, and spread upon the grass, where the red brightens more than it would do by any other method of proceeding.

But the Adrianople red possesses a degree of brightness which it is difficult to approach by any of the processes hitherto mentioned; it has likewise the property of resisting much more powerfully the action of different reactives, such as alkalis, alum, soap, and acids. Mr. Vogler confesses that by his numerous processes, he has not been able to obtain a red of a degree of permanency equal to that of the Adrianople red, though he has much excelled in this respect the false Adrianople reds used for Siamese and other red stuffs. It is necessary to remark, that soap-suds weaken and destroy the most durable madder colours, even that of the Adrianople cotton; hence it appears, that we ought as much as possible to be sparing in the use of soap in the washing of thread and cotton of this colour: the only difference between the true and false Adrianople red, is this, that the one resists these influences much longer than the other. Aqua fortis, or dilute nitric acid, is, according to Mr. Vogler, the best and most expeditious test for distinguishing the true Adrianople red from the false. If we immerse a thread of the latter dye in it, it soon becomes pale, and in less than a quarter of an hour white; while the true Adrianople red will remain in it for an hour without any alteration, and indeed never entirely loses its colour, which acquires an orange hue or cast.

The abbé Mazeas has published some experiments which throw considerable light on this kind of dye; but the process recommended has not completely succeeded. The following is the method which Mr. Henry has recommended, in a very ingenious paper on dyeing.

Of the Process for dyeing Adrianople or Turkey Red.—It is proper, he observes, that all the wooden vessels employed should be made of deal, or of some white wood, free from astringent matter; and that the most convenient quantity for operating

on, in proportion to the ingredients uſed in the ſeveral operations, is ſixty-ſix pounds of cotton. From ſixty pounds of Alicant barilla, a ley is drawn, by means of ſoft water, amounting to ſixty gallons—and then, by the pouring on of freſh water, a ſecond ley is formed, meaſuring forty gallons—after this, a third ley is alſo extracted from the ſame barilla, the quantity of which ſhould be about fifty-two gallons. A liquor is alſo prepared, conſiſting of four gallons of ſheeps' dung, collected, after it has been excreted from the animal, and before it has been expoſed to rain, diſſolved in twenty gallons of water, and ſtrained through a hair ſieve, to ſeparate from it the groſſer parts. Having taken theſe preparatory meaſures, the different operations may be begun.

1ſt Operation. This conſiſts in adding nine pounds of Gallipoly oil to eight gallons of the ſecond barilla liquor; this forms a kind of ſoap, to which are to be added twenty-four gallons of the firſt barilla liquor, twelve gallons of the dung liquor, and forty-eight gallons of ſoft water. Into this liquor, when nearly of a ſcalding heat, the cotton is to be put; room being made for it by taking out about twenty gallons of the liquor, which is to be gradually returned into the pan, in proportion to the waſte by evaporation: and the whole is to be kept boiling, during five hours. After which the cotton is taken out of the pan, ſuſpended over it to drain, and then well wrung, waſhed in clear water, and hung on ſmooth poles to dry, either in the open air or in a ſtove; but the former is to be preferred, if the weather be fair. The liquor when wrung out of the cotton is to be preſerved, together with the remainder in the pan, for a future operation; and, at this time, ſixteen gallons of ſoft water are to be added to the dung liquor.

2d Operation. It conſiſts in pouring three pounds and a half of Gallipoli oil into a bucket, containing four gallons of the ſecond barilla liquor, and adding this mixture to ſix gallons of the firſt barilla liquor, and four gallons of dung liquor. Of this compoſition two or three gallons are to be put into a tub, and in it about a pound and a quarter of the cotton is to be well ſoaked, and afterwards wrung, but not too cloſely, over a tub kept for that purpoſe. A ſimilar portion of cotton is then to be treated in the ſame way; and ſo on, till the whole has paſſed through the mixture; adding about a pint or three half pints of liquor, on the immerſion of every freſh parcel of cotton. The cotton is then to be thoroughly dried, which it muſt alſo be after the ſubſequent operations; and theſe are to be conducted in the ſame manner, with reſpect to the manipulations, as in the preſent one.

3d Operation. In this operation the liquor which had been wrung out of the cotton, is to be poured back into the tub in which the ſoaking has been performed: and to this are to be added of Gallipoli oil three pounds and half, and of the ſecond barilla dung, and firſt barilla liquors, four gallons each. After this operation the dung liquor is to be ſtrengthened by the addition of about two handfuls of ſheeps' dung, diluted with a little water.

4th Operation. This is ſimilar to the third. The liquor which remains is to be ſet aſide, for the purpoſe of mixing with the reſiduary liquor, after the eighth operation; to be uſed for other cotton, in any ſubſequent proceſs.

5th Operation. In this the dung liquor is omitted, and the mixture employed in the three following operations is called the white liquor, to diſtinguiſh it from that uſed in the three preceding parts of the proceſs, which, from the colour imparted by the dung, is named the green liquor.

6th Operation. The ſame quantity of oil, as before, is to be mixed in a bucket with four gallons of the ſecond barilla liquor; and poured into a tub, where are to be added to it, three gallons more of the ſame liquor, and four gallons of the firſt barilla ley. About four gallons of this liquor remain after the wringing, and theſe are to be added in this operation to the ſame quantity of oil, firſt mixed with four gallons of the ſecond ley, and then with two gallons (more or leſs, in proportion to the quantity of white liquor remaining after the preceding operation) of the ſame ley, and four gallons of the firſt.

7th Operation. In this the quantities of all the ingredients are the ſame as in the ſixth. The reſiduum of the white liquor, after the three laſt operations, will be about eight gallons, and is to be preſerved to be uſed in the fourteenth operation.

8th Operation. It conſiſts in heating the third barilla liquor, amounting to fifty-two gallons, to about the warmth of new milk; removing it, when thus warmed, from the copper to a tub, immerſing the whole of the cotton therein, and ſuffering it to remain for twelve hours, or longer. It is then to be taken out, and laid on a cloth ſpread on four or five ſticks, placed acroſs a large tub, into which the liquor drains as it runs from the cotton. The cotton is then to be well wrung, and afterwards thoroughly waſhed, that no looſe oil may remain, which would be injurious to the next operation. The wringing tub and peg are now to be well waſhed, and a freſh ſet of poles uſed; for if any oil were to come into contact with the cotton in the next parts of the proceſs, it would receive a blackiſh tinge in the dyeing.

9th Operation. This is the galling. Sixteen pounds of galls, or if the blue galls be uſed, a ſomewhat ſmaller portion, are put into twenty-four gallons of water, nearly boiling. The liquor is then brought to boil, and the ebullition continued for fifteen minutes. But as ſoon as the boiling commences, the fire ſhould be withdrawn; as the heat already received will keep it up for a ſufficient time, and the galls will not ſettle if it be too violent. The liquor is to be carried to the wringing tub, in the quantity of three or four gallons at a time, according as it is ſoaked up by the cotton, till one half of it has been thus employed. And the cotton is to be worked in it as hot as poſſible, by means of a ſtick paſſed through the ſkains. After this, it is to be dried, either wholly or in part, in the open air. If it cannot be thus completed, for rain would in this ſtate, and eſpecially as the cotton approaches to dryneſs, be highly prejudicial, the drying muſt be finiſhed in a ſtove. The liquor which has been wrung out is to be added to the remaining half in the copper.

10th Operation. The remaining decoction of galls is to be heated, the thick ſediment at the bottom being previouſly ſeparated by a hair ſieve, and the cotton again treated as in the ninth operation.

11th Operation. This is the aluming of the cotton. Thirty pounds of Roman alum, finely powdered, are put into ſixteen gallons of water, gradually heated, and continually ſtirred. As ſoon as it becomes ſo hot that the operator can eaſily bear his hand in it, the fire is to be removed. Six gallons of the firſt barilla liquor are then to be added by degrees, and the whole agitated till the ſolution is complete. The cotton is to be placed in the wringing tub, about three gallons poured on it, and, in proportion as the ſolution is ſoaked up, more is to be added, till about one half of it is employed. The cotton having been thoroughly worked in the alum liquor, is to be well wrung and dried, and the portion which is wrung out is to be returned to the remainder in the pan.

12th Operation. In this the above liquor is uſed, and the operation is performed exactly in the ſame manner as the eleventh. After which the dried cotton is to be well waſhed, by handfuls, in running water, the workman holding in each hand about twenty ounces of cotton for two minutes. Each portion is then wrung and ſeparated, waſhed and wrung again, and laid

upon a coarſe cloth. The whole is then carried up from the river, wrung a third time, and hung to dry. The cotton will now be ready for the following operation, in which the colouring ſubſtance is applied to the cotton.

13th Operation. The cotton is firſt divided into four equal parts, each of which is to be dyed ſeparately; and theſe are ſubdivided into ſkains or parcels of about a pound and quarter each. The copper pan is then to be filled with water, within about ſix inches of the top; and twenty-ſix pounds of Smyrna, or rather of Cyprus madder, added to it. As ſoon as the water becomes milk warm, fourteen pounds of ſheeps' blood, as freſh as it can be procured, are to be ſtirred into it. When the liquor is ſo warm that the workman can juſt bear his hand in it, one fourth part of the cotton is to be put into it, ſuſpended on ſticks, by means of which it is moved backwards and forwards in the pan every five minutes; and the ſkains are to be inverted every ten minutes, ſo that they may receive the dye equally in every part. This buſineſs is continued for about fifty minutes. The cotton is then hung on five ſticks only, and ſo ſuſpended by ſtrings as to be wholly immerſed in the liquor, which is now made to boil, and continued boiling for forty-five or fifty minutes. A white froth, which about this time appears on the ſurface, is a ſign that the madder is exhauſted of its colouring matter, and that the cotton can receive no benefit, though it will get no injury from continuing longer in the liquor. It is then to be withdrawn, carried to be well waſhed in the river or waſh-wheel, and then wrung and dried. The other three-fourths of the cotton are then to be ſucceſſively dyed in the ſame manner, freſh ingredients being uſed for each parcel.

14th Operation. This is repreſented as highly eſſential to the ſucceſs of the proceſs. Should it be omitted, the colour, it is ſaid, would not only be ſo unfixed as to loſe much in the ſubſequent operation, but would likewiſe require more time for the enlivening. About eight gallons of the white liquor, which remained after the ſeventh operation, and were directed to be reſerved, are now to be mixed with four gallons of the firſt barilla ley. Two gallons of this mixture being put into the wringing tub, the whole of the cotton is to be waſhed in it, adding more liquor in proportion as it is ſoaked up by the cotton, which is afterwards to be wrung and dried.

15th Operation. This is that of enlivening or reviving the colour. The copper pan being about half filled with water, twenty-eight or thirty gallons of the liquor remaining after the firſt operation are to be added, ſo that the liquor may reach to within ſix inches of the top. When the liquor is nearly boiling, the cotton is to be put in; being previouſly formed into parcels of about two pounds and a half each; nearly four ounces being kept ſeparate for the purpoſe deſcribed below. The cotton is to be well preſſed down in the pan, and confined by ſticks. The pan is covered with a wooden lid, having a ſmall hole, through which the ſmall portion of cotton reſerved for that intention may be occaſionally withdrawn, in order to obſerve the progreſs of the operation. This hole has a moveable cover. The lid is then to be ſecured by a ſtrong croſs of wood, with a ſtraight piece over it, and the ſides made cloſe, ſo as to confine the vapour, by laying round the edges of the lid a quantity of damp linen cloth. The fire is then to be raiſed, ſo as to make the liquor boil, and the boiling is to be continued for nine hours. The proceſs is finiſhed by taking the cotton out of the liquor, wringing and drying it. But the drying is never to be performed either in a ſtove or in ſtrong ſun-ſhine. The colour will be moſt brilliant if the cotton be dried in the ſhade, with a free acceſs of air.

A proceſs very nearly reſembling the above, is employed by Mr. Clerc in a manufactory at Vandreuil, in France, by which cotton may be dyed of a beautiful and durable red colour. This proceſs is fully deſcribed by Mr. Berthollet in his Elements of the Art of Dyeing.

This laſt gentleman is in the habit of giving the cottons a dip after they have become quite dry; he makes a ſolution of tin in aqua fortis, taking for a hundred pounds of cotton three or four pounds of aqua fortis at twenty-ſix degrees; to which he adds an ounce of ſal ammoniac for each pound, and then diſſolves in it ſix ounces of fine tin in grains; he adds to the bath a pound and a half of mineral cryſtal, and then dilutes the mixture with eight buckets of water, and dips the cotton; it is then waſhed. This dip, he ſays, gives the cotton a very fine fire.

Mr. Henry ſeems to think that an animal acid is ſupplied to the cotton, in the proceſs for dyeing the Adrianople red; and that the attraction between the cotton and acid being ſtrong, and that between the latter and the earth of alum being likewiſe powerful, ſuch an union is effected as aſſiſts in rendering the material capable of attracting and retaining the colouring matter, in as forcible and permanent a manner as can be done either by wool or ſilk. The uſe of the galls alſo in this and other proceſſes ſeems intended to promote a ſimilar purpoſe. Cotton either unbleached, or which has undergone no proceſs but that of bleaching, when immerſed in a ſolution of alum, produces no change in the appearance of the ſolution; but cotton previouſly ſteeped in an infuſion or decoction of galls, ſoon renders the liquor turbid, occaſioning a precipitation of the earth of alum on the cotton. The imperfect ſoap alſo, formed by the union of the alkali and oil when mixed with the alum, will both decompoſe that ſalt, and be itſelf decompounded, and a ſoap of a different nature will reſult from the union of the oil with the earth of alum. It is probable alſo that the blood which is employed with the madder, may ſupply both animal ſalts and a glutinous matter to the cotton.

The experiments of Mr. Gren throw conſiderable light on the theory of the Adrianople red. He took two ounces of ſpun cotton, on which he poured freſh oil, and left it to ſoak for fifteen days, taking care to work the cotton well with it from time to time; he then ſqueezed out the oil as much as poſſible, and put the cotton into a boiling ſolution of barilla. After boiling it for half an hour, he poured out the ley, which had a milky appearance, and ſupplied its place with freſh urine, in which he boiled the cotton a quarter of an hour; but he has aſcertained that water may be ſubſtituted for the urine. He made a decoction with half an ounce of alum and two drachms of ſumach, and put the cotton, which had been well waſhed, into it while boiling hot, and kept up the ebullition for an hour: after which he let it cool, and kept the cotton in it twelve hours; when taken out of this bath, it was dried in the ſhade, waſhed in cold water, and dyed with a decoction of half an ounce of madder: he choſe whole roots of madder the moſt ſlender he could find, cut them into ſmall pieces, and pounded them. He left the cotton to grow cold in the bath. When waſhed, it ſhewed a very fine colour, which differed from the true Turkey red cotton only in luſtre, which it did not poſſeſs in ſo high a degree, but it ſuſtained the ſame proofs. Thus it retained its colour after being waſhed in boiling water; the brightneſs of the colour was increaſed by waſhing in a cold ley of aſhes; vinegar did not change it; expoſure to the ſun and air for three weeks produced no ſenſible alteration in its colour. Ground madder of a middling quality produced, under ſimilar treatment, a dirty brown colour without any brightneſs; but Zealand madder of a good quality produced a colour ſimilar to the former. And the addition of fixed alkali, even in ſmall quantity, to the decoction, produced a deeper colour. The addition of ſolution of tin gave the colour a more pleaſing hue. He only obtained a bad colour, which ſimple waſhing diſcharged, when he uſed pure or cauſtic pot-aſh inſtead of ſoda; but carbonate

of pot-ash succeeded as well as soda, when care was taken to squeeze out the oil from the cotton previous to its being put into the solution of the salt; if the oil was not squeezed out, the colour was but indifferent: whence he infers, that the alkali ought not to be so caustic as to deprive the cotton entirely of the oil, while, at the same time, it ought to possess sufficient activity not to allow it to retain too much. To produce this red colour in perfection, the best kind of madder must be used.

Mr. Bertholiet has found that the acetite of alumine formed by the mixture of alum, and the acetite of lead or salt of saturn, as already explained, was a better mordant than alum for fixing the colour of madder, and that it was still more efficacious when it contained an excess of acid. Alum saturated with pot-ash to such a degree as to afford a slight sediment, was also a much more efficacious mordant than common alum, probably for the same reason. Solution of arsenic in pot-ash produced a similar effect, and even seemed to be superior in some degree. Galling renders the colour more fixed, and appears to darken it a little; yet galling is employed in the Adrianople process. Galls cannot be mixed with madder, because they prevent the extraction of its colouring part. Mr. Berthollet begins his processes by galling, after having leyed the cotton. Leying renders the cotton more disposed to become saturated with colour. Mucilages and gums render the colour more fixed, and glue is particular in producing this effect: it combines with the alumine and the cotton, and thus imparts to the cotton the property of animal substances. Complete exsiccation between each of the processes is very useful, but should not be too rapid. When the water is expelled, its attraction no longer opposes the combination or decomposition of the mordant to which it proved an obstacle. Long maceration and long continued boilings with the mordant seem to be useless; it is sufficient that the cotton be well impregnated with the mordant; nor is any greater effect produced by repeating the aluming two or three times successively, than by one operation properly conducted.

The processes by means of which Mr. Berthollet came nearest the Adrianople red, without using a consistent oil, were by employing, as mordant, a solution in the nitric acid of the precipitate from alum by common pot-ash, and by adding oxide of tin to the madder bath. By this last process he obtained a red which might easily be confounded with that of Adrianople.

It is evident, from many observations of the above gentleman, that in the Adrianople red the cotton retains a little of the oil. The best madder must also be employed. From further experiments of the same writer we may also consider in cotton dyed with madder its power of resisting the action of the air for a long time, or that of resisting alkalis or soap. This last can only be obtained by means of oils and grease; but the first depends principally on the mordants employed, and the number of dryings. It is therefore proper, independent of the beauty of the colour, to employ processes similar to that of Adrianople, for such stuffs as are to be subjected to leying or frequent washing with soap.

It may be observed also that the oxigenated muriatic acid represented the action of the air on the madder reds exposed to its influence, indicating the patterns which would resist its action most powerfully; while the nitric acid, on the contrary, indicates the cotton dyed in the Adrianople manner, by giving it a yellow colour. This effect seems to depend on the combination of the animal oil with the cotton, to which, as to all other animal substances, the nitric acid gives a yellow colour, by destroying the proper colour of the madder: it is this combination of animal oil with the cotton which forms the distinguishing characteristic of this species of dye: a different kind of oil might produce a bright colour, but probably it would not be so durable or lasting.

Mr. Berthollet has also tried the oxide of tin in dyeing wool. The decoction of madder acquires a more clear and lively red by the addition of this oxide; its colouring particles became fixed much more quickly and more abundantly upon cloth which had been prepared by a decoction of alum and tartar in the ordinary manner. The cloth came out of the dye bath of a much more saturated and beautiful red than a similar pattern dyed with an equal weight of madder without oxide of tin; the advantage does not, however, appear so great as to render the process worthy of being employed generally. It was also found that oxide of zinc, used instead of tin, produced a fine orange colour in the cloth; oxide of lead a dull brick colour; but that that of iron had no evident effect.

Of Dyeing Scarlet—This is the finest and most splendid colour in the art of dyeing. The same taste with respect to the shade that is preferred does not however always prevail: sometimes it is required to be of a deeper and more perfect red; at others, to incline more or less to the colour of fire. It cannot be expected to obtain the desired shade from the precise proportions prescribed in the processes, because the quantity of colouring matter contained in different kinds of fine cochineal varies, and still more, because the solutions of tin employed may differ considerably from each other: but it is easy to ascertain, by trials on a small scale, the proper proportion of ingredients to be used for obtaining a particular shade; and if the pieces dyed be found to go beyond the point, or fall short of it, it is difficult to bring them to it. As we have already taken notice of the solution of tin, it is not necessary to say any thing more respecting it here.

The dyeing of scarlet is performed at two operations: the first is called the boiling; the second, the finish or reddening. For the boiling designed for dyeing a hundred pounds of cloth, six pounds of pure tartar are thrown into the water when a little more than warm. The bath is stirred briskly, and when it is a little hotter, half a pound of powdered cochineal is added, and well mixed. A moment after, five pounds of very clear solution of tin are poured in, and carefully mixed. As soon as the bath begins to boil, the cloth is put in, and moved briskly for two or three turns, after which it is moved more slowly. When it has boiled a couple of hours, it is taken out, aired, and carried to the river in order to be well washed. In order to prepare the second bath, which is the reddening, the boiler is to be emptied. When the bath is ready to boil, five pounds and three quarters of cochineal powdered and sifted are put in. These being carefully mixed, when after having ceased stirring, a crust, which forms on the surface, opens of itself in several places, thirteen or fourteen pounds of solution of tin are poured in. If, after that, the bath rise above the brim of the boiler, it must be cooled by means of cold water.

After the solution is well mixed, the cloth is to be put into the bath, taking care to turn it quickly the first two or three turns. In this bath it is boiled for an hour, pushing it down with a stick when the boiling raises it up. It is then taken out, aired, and cooled, and then washed in the river, and dried. On examining the proportions of cochineal and of solution of tin, put either into the boiling, or into the reddening, it appears that they are by no means fixed. There are dyers who, according to Hellot's account, succeed very well by putting two-thirds of the composition, and a fourth of the cochineal, into the boiling, and the remaining third of the composition, with the remaining three-fourths of the cochineal, into the reddening. He also asserts that it does no harm to use tartar in the reddening, provided not more of it than half the weight of the cochineal be put in; and he thinks that it even renders the colour more permanent. This is at present the practice of several dyers. It has been seen that tartar promotes the solution of the colouring matter, an effect that especially occurs

when it is ground with the cochineal, whence the residuum is more completely exhausted.

But some dyers do not take the cloth out of the boiling, only refreshing it to make the reddening in the same bath, by pouring in an infusion of cochineal, which they have made apart, and with which they have mixed the proper quantity of composition. In this way they save time and fuel; and they affirm that the scarlet is equally fine that is produced in this way. But as scarlet is in general required to be very lively, and to approach the colour of fire, a yellowish tinge is given it by boiling fustic in the first bath, or by adding a little turmeric to the cochineal. The yellow tinge might be obtained by increasing the quantity of composition: but this has the inconvenience of rendering the cloth harsh, and even of preventing the colouring matter from fixing in it in a certain quantity. Thus, though neither fustic nor turmeric gives a permanent colour, it is better perhaps to use them in small quantity, than to add too much solution of tin. That these ingredients have been used is discoverable by cutting the cloth, the inside of it appearing in that case yellow; whilst in the common processes the cochineal does not penetrate the cloth, leaving it internally white, when it is said to *cut* by the dyers. It is also of advantage in dyeing scarlet to use tin boilers, because the acid employed attacks copper, and the solution it forms with it may injure the beauty of the colour. But as these are difficult to make of any considerable size, and are liable to melt, if the workmen forget to withdraw the fire before emptying them, many dyers use copper ones. It is necessary, however, to keep these very clean, not to let the acid liquor remain in them, and to prevent the cloth dyed in them from touching the copper, by means either of a net, or of an open-work wicker basket introduced within the boiler.

For the boiling, an ounce and a half of solution of tin, with an equal quantity of starch, and as much tartar, is recommended by Scheffer to every pound of cloth. He says, that the starch serves to render the colour more uniform; and he advises to throw into the water when it boils, a drachm of cochineal, to stir it well, to boil the wool an hour, and afterwards to wash it. The wool is then to be boiled half an hour in the reddening bath, with half an ounce of starch, three quarters of an ounce of solution of tin, half an ounce of tartar, and seven drachms of cochineal. In this process there is a smaller quantity of the solution of tin than in the above.

Three principal processes, which vary according as the shade of the scarlet is to be more or less deep, or more or less inclining to orange, are described by Poerner. He puts no cochineal into the boiling, which he composes of one ounce six drachms of tartar, and an equal weight of solution of tin, added after the tartar is dissolved, for every pound of cloth. After it has boiled a moment, he puts in the cloth, and lets it boil two hours longer. And for the reddening of the first process, he uses two drachms of tartar, and an ounce of cochineal; afterwards pouring in two ounces of solution of tin in a gradual manner. But for the reddening of the second process, he uses the same quantity of cochineal, and two ounces of solution of tin; the tartar is omitted. For that of the third, he directs two drachms of tartar, an ounce of solution of tin, and two ounces of common salt, with the quantity of cochineal which has been mentioned above.

It must be observed that the scarlet of the first process is of the deepest shade; that of the second is less full, but more lively; and that of the third is still more bright and pale. Tartar gives a deeper and more rosy hue to the colouring matter of cochineal precipitated by solution of tin. It moderates the action of the nitro-muriatic acid, which tends to give scarlet an orange cast, though this orange cast is not to be seen in the precipitate produced by the solution of tin, which is, on the contrary, of a fine red. It is probable, that the solution of tin gives scarlet an orange tinge, by means of the action the nitro-muriatic acid exerts on the wool, which it turns yellow as well as all other animal substances.

It is therefore evident, that, by putting more or less tartar into the reddening, a deeper and fuller scarlet may be obtained; and, on the contrary, the scarlet may be rendered more inclining to orange, by this ingredient being omitted. The solution of tin may also influence the colour, according to the proportions of tin and ammoniacal muriate it contains. Dr. Bancroft however, objects to the above opinion respecting the effects of tartar and solution of tin, as being highly erroneous.

It appears from the experiments of Mr. Berthollet, that a solution of tin made with sixteen parts of nitric acid, at thirty degrees of Beaumé's areometer, two parts of ammoniacal muriate, and three parts of tin, gave a less lively and somewhat deeper colour, than a solution in which the acid and ammoniacal muriate were in the same proportions, but which contained only two parts of tin. These last mentioned proportions succeeded the best of many which were tried. He mixes with the solution four parts of water. Putting only half a part of muriate of ammoniac, the colour was more bright, and inclining to orange. In fine, by using a solution of murio-ammoniacal salt of tin, which contained near half its weight of oxide of tin, and adding to the solution a little muriatic acid to prevent the precipitation of the metal, he obtained a crimson colour: but on adding tartar in the reddening, the cloth took a beautiful deep red, which resisted the oxigenated muriatic acid better than common scarlet. But in using this last salt, the bath is sooner and more completely exhausted, than with the solution of tin commonly employed.

It is found that scarlet may be brightened by common salt; and that the colour will at the same time penetrate deeper, and leave less cut. Muriate of ammoniac also renders the colour more bright and pale, but it carries the effect too far. It is not, however, easy to explain the reason, why common salt, which deepens a little the colour of infusion of cochineal, and produces the same effect on colours in general, should diminish the intensity of scarlet. It is observed by Mr. Poerner, that the proportion of common salt he directs is the greatest that can be employed; and that a more agreeable shade, though lighter, will be obtained, if less used. He thinks that the addition of five ounces of white sugar to the ingredients of the second process will produce a finer colour, which is always lighter than that of the first process; and he asserts, that a more pleasing and more permanent colour will be obtained, if the cloth be left in the boiling twenty-four hours after it is cold. When the scarlet which has been just dyed is found to have too much of the orange cast, this may be weakened by washing with hot water, particularly if the water contain any salt with an earthy base.

Mr. Berthollet observes, that if the quantity of cloth to be dyed scarlet be large, we may use for the boiling a reddening with which we have just dyed, taking from the ordinary quantity of cochineal as much as we suppose to be left in the bath, diminishing also the quantity of solution of tin. But if we would have a fiery colour, we must begin by boiling a bag of fustic, which is to be removed before the other ingredients are added. After this the bath may be used, as soon as the cloth is taken out, for making pomegranate colour, boiling in it a bag of fustic. That which has already been in a bath, is fitter than new for this shade. As soon as this is taken out, some tartar and composition are put into the bath, which is well raked, and the cloth treated as for dyeing scarlet; and the bath may be used after this for capuchin colour, boiling in it fustic, and adding tartar and solution of tin. The preceding boiling may also be employed for langouste, orange, cassis, gold colour, and jonquille, by boiling in it fustic, and adding a little cochineal, and more or less tartar, and solution of tin, as may be necessary.

After all the cloths which are to be dyed have gone through the boiling, proceeding from the deepeſt colour to the lighteſt, they are then to be paſſed through the reddening, proceeding contrariwiſe from the lighteſt to the deepeſt, adding more and more cochineal, and ſolution of tin, till we come to the pomegranate and fire colours. When it is come to the turn of the gold colour and jonquille, fuſtic is to be added, at leaſt if they were not finiſhed in the firſt bath, which, as we ſhall ſee, may be done for ſome ſhades. For the gold colour and caſſis, the addition of a little madder is neceſſary.

It is neceſſary to obſerve, that the colours of gold, caſſis, jonquille, and buff, may be made after the ſcarlet boiling, by adding for the former two, fuſtic, ſolution of tin, and a little madder; a little more fuſtic, and a little leſs ſolution of tin, for the firſt than for the ſecond. For the buff much leſs ſolution of tin muſt be uſed. A dun colour may be made after boiling ſcarlet without any addition. *Le caffé au lait* requires a little fuſtic and ſolution of tin, and a very ſmall quantity of madder: for *le chocolat au lait*, a little cochineal and tartar are added to the ingredients laſt mentioned.

But for the boiling for cherry colours, a freſh bath, compoſed of tartar and ſolution of tin, is commonly uſed. And then for dyeing them, a reddening that has been uſed for ſcarlet is employed, adding to it tartar, ſolution of tin, and a little cochineal. In boiling and reddening theſe, only half the time required for ſcarlet is taken up: and in general the time is ſhortened in proportion to the delicacy of the tint. For the boiling for roſe colour the reddening of cherry colour may be employed, and its reddening compoſed of a little ſolution of tin, a little tartar, and a very little cochineal. The colour may be deepened by paſſing the cloth when it comes out of the dye, through hot water. Fleſh colour is made after a reddening, by throwing away a little of the bath, and cooling it. It may alſo be made after a violet colour, by adding a little ſolution of tin. It muſt boil but a little time. The reddening from which ſcarlet has been taken out, may alſo be uſed for grays that are to have a purple caſt; refreſhing the bath with the addition of galls, and afterwards a little ſulphate of iron, or green vitriol.

It is proper to obſerve, that weak and delicate tints, as langouſtes and orange colours, as well as lilacs, mauves, cherry, and roſe colours, have more bloom and freſhneſs when prepared in a ſingle bath, than when they have gone through both boiling and reddening. It is only neceſſary to put into the bath the proper ingredients. The cloth ſimply wetted, and impregnated with no mordant, fills itſelf with the colouring matter leſs readily, and in a more even manner. It is therefore evident, that for obtaining different ſhades of ſcarlet, and the colours derived from it, nothing more is neceſſary than to vary the proportions of cochineal, tartar, and ſolution of tin, and to add for the ſhades moſt inclining to yellow, fuſtic, for which other yellow ſubſtances are ſometimes ſubſtituted. Tartar ſerves to deepen the colour; and the ſolution of tin makes it incline to orange. For the light ſhades the time of operating muſt be conſiderably abridged.

Of Dyeing Crimſon.—The different proceſſes employed for obtaining the various ſhades of crimſon, from the deepeſt to the lighteſt, may be reduced to two. Either the ſhade of crimſon required is given to cloth previouſly dyed ſcarlet, or the cloth is at once dyed crimſon. It is found that alum, ſalts with earthy baſes in general, and fixed and volatile alkalis, have the property of changing the colour of ſcarlet to crimſon, which is the natural colour of cochineal. Nothing more is therefore neceſſary, than to boil cloth dyed ſcarlet for about an hour in a ſolution of alum, proportioned in ſtrength to the deepneſs of the colour deſired. But as other ſalts with earthy baſes have the ſame property, and water contains more or leſs of theſe ſalts, whence it gives a proportionate roſy tinge to ſcarlet paſſed through it, particularly if it be warm, the quantity of alum neceſſary to obtain a crimſon varies according to the nature of the water employed: nay, if the water be loaded with earthy ſalts, it will anſwer the purpoſe of itſelf, without the addition of alum. If a piece of ſcarlet have any defects, it is converted into a crimſon. Hellot ſays, that he has tried ſoap, ſoda, pot-aſh, and *cendre gravelée:* that all theſe ſubſtances produced the crimſon deſired, but ſaddened it, and gave it leſs luſtre than alum: that ammoniac, on the contrary, produced a very good effect; but, as it evaporates quickly, a conſiderable quantity muſt be put into the bath a little more than warm, a little ammoniacal muriate, or ſal ammoniac, and an equal quantity of common pot-aſh. In this method the cloth inſtantly took a very bright roſy colour. He thinks that it heightens the colour ſo much as to render leſs cochineal neceſſary. But Mr. Poerner, who gives the ſame proceſs, directs the ſcarlet to be left twenty-four hours in a cold ſolution of pot-aſh and ammoniacal muriate.

In order to dye crimſon at once, a ſolution of two ounces and a half of alum, and an ounce and an half of tartar, to every pound of cloth, is uſed for the boiling: and the cloth is afterwards dyed with an ounce of cochineal. Solution of tin is commonly added, but in leſs proportion than for ſcarlet. The proceſſes employed vary greatly, according as the ſhade required is deeper or lighter, or more or leſs diſtant from ſcarlet. Common ſalt is alſo uſed for the boiling by ſome dyers. For ſaddening crimſons, and giving them more bloom, archil and pot-aſh are frequently uſed, but the bloom thus imparted is by no means permanent. Sometimes alſo, the boiling for crimſon is made after a ſcarlet reddening, by adding tartar and alum: and it is affirmed, that the *ſoupe au vin* has more bloom, if both its boiling and reddening be made after ſcarlet, than when it is dyed in a freſh bath. For theſe colours the *cochinilla ſylveſtris* may be employed inſtead of the fine, but in larger quantity. The reddening which has been uſed for crimſon may alſo be employed for purples, and other compound colours.

Both ſcarlets and crimſons in half-grain are made by ſubſtituting madder for half the quantity of the cochineal, giving the ſame boiling as for ſcarlet in grain, and following in other reſpects the proceſſes for reddening the ſcarlet or crimſon. Other proportions of madder may be uſed inſtead of half, according to the effect which is to be obtained. The common madder red alſo acquires a greater luſtre, when its boiling is made after a reddening for ſcarlet.

It is proper to obſerve, that in ſilk the grain crimſon, produced by cochineal, is diſtinguiſhed from falſe crimſon, which is obtained by means of brazil wood. And ſilk when deſigned to be dyed crimſon with cochineal, ſhould not be boiled with more than twenty pounds of ſoap to a hundred of ſilk, as the ſlight yellow caſt which ſilk has when only ſo far ſcoured, is advantageous to the colour. After the ſilk has been well cleanſed from the ſoap at the river, it is to be put into an alum liquor of the full ſtrength. In this, it is commonly left from the evening till the next morning; it is then waſhed, and beetled at the river twice. In preparing the bath, a long boiler is half or two-thirds filled with water; and when the water boils, white galls powdered are thrown in, from half an ounce to two ounces for every pound of ſilk. After boiling a few moments, from two to three ounces of cochineal, powdered and ſifted, for every pound of ſilk, according to the ſhade required, are put in, adding afterwards an ounce of tartar to every pound of cochineal; and as ſoon as the tartar is diſſolved, an ounce of ſolution of tin to every ounce of tartar. This ſolution ought to contain more tin than that uſed for ſcarlet, otherwiſe the colour would be too bright. Macquer directs

this solution to be made with one pound of nitric acid, two ounces of ammoniacal muriate, six ounces of fine grain tin, and twelve ounces of water which is pure.

These ingredients being mixed, the boiler is to be filled up with cold water. The proportion of the bath is about eight or ten quarts of water to every pound of silk. In this the silk is immediately dipped, turning it on the skein sticks till it appears to be of an uniform colour. The fire is then increased, and the bath made to boil for two hours, turning the silk from time to time. After this the fire is put out, and the silk put into the bath, where it is kept a few hours longer. The silk is afterwards washed at the river, and wrung, and dried, two beetlings first being given it. When crimsons are to be saddened, they must be passed, after having been washed, through a solution of sulphate of iron, more or less strong according to the shade required. If it should have a yellow tinge, the solution must be charged with a greater or less proportion of decoction of fustic. And white galls should be chosen, because black ones would dull the colour of the crimson; and even too large a quantity of the white will produce the same effect. Macquer says, that the galls serve only to increase the weight of the silk: yet their general effect is to render colours more permanent, and they are essentially necessary for crimsons that are intended to be saddened. Vinegar is employed in distinguishing grain crimsons from false: but it will not detect colours obtained from brazil wood, if they be fixed by means of solution of tin; as then, they stand the proof with vinegar as well as those in which cochineal has been used. It is therefore evident, that a very small quantity of solution of tin is put into the bath for dyeing silk crimson. If the same process as that for dyeing wool scarlet were employed, the silk would lose its bloom, and acquire only a faint colour. Macquer and Scheffer have, however, detailed processes which differ from it only in a few circumstances, for dyeing silk rose and poppy colours by means of solution of tin, used cold, that its action on the silk might not be too powerful.

The solution of tin, which Mr. Berthollet found to succeed best, was the same as directed for dyeing scarlet: this procured him a fine cherry colour, sufficiently bright. Solutions containing a greater proportion of tin gave him deeper shades: and the solution of the murio-ammoniacal salt of tin produced a dull deep crimson. Though he has varied his experiments in several ways, he has never been able to obtain a shade comparable to scarlet. Scarlet, however, is so much in request, as to have excited artists to repeated attempts for obtaining it. Those who appear to have approached nearest to the desired end begin with dyeing the silk crimson; this dye they cover over with that of carthamus, by the process hereafter to be described; and lastly, they give it a yellow dye without heat. By these means a fine colour is obtained, but the action of the air destroys the dye of the carthamus, and the colour is soon darkened by it. The use of cochineal for dyeing cotton and linen is not much, because a fine and permanent red may be given them by means of madder. Scheffer, however, describes a process, which might be employed. The linen or cotton is to be steeped twenty-four hours in a cold solution of tin: it is then wrung, washed, and boiled a quarter of an hour with four-sixths of its weight of cochineal. The cotton takes a light red; but these colours do not stand the action of soap, though they do that of the sun.

It would seem, that the difference of the processes to which recourse must be had for giving cotton and silk a scarlet colour, are owing to the slight disposition these substances have for combining with the colouring matter of cochineal, or the compound of that colour and tin. Hence it happens, that this compound separates, unites in too large masses, and precipitates before its union with the stuff can take place. This inconvenience is prevented by first impregnating the stuff with solution of tin; because the oxide of tin being combined with it, the colouring matter of the cochineal comes to fix in it, and then the compound can no longer precipitate. Therefore this mode of operating ought to be tried, whenever we have reason to fear, that from the too feeble attraction of the stuff, the compound which is to colour it, will precipitate before it can fix in it in a sufficient degree.

Of Dyeing with Kermes.—In order to dye spun worsted with kermes, it is first boiled half an hour in water with bran; then two hours, in a fresh bath, with one fifth of Roman alum, and one tenth of tartar, to which *sour water* is commonly added; after which it is taken out, tied up in a linen bag, and carried to a cool place, where it is left some days. To obtain a full colour, as much kermes as equals three fourths, or even the whole of the weight of the wool, is put into a warm bath, and the wool is put in at the first boiling. As cloth is more dense than wool, either spun or in the fleece, it requires one fourth less of the salts in the boiling, and of kermes in the bath. Hellot advises a small handful of cot or refuse wool to be thrown into the boiler in which the kermes is, and to let it boil a moment, before the wool to be dyed is put in. This will absorb a kind of black dregs, and the wool afterwards dipped will take a better colour. Before the wool that is just dyed is taken to the river, it may be dipped in a bath of water a little warm, in which a small quantity of soap has been dissolved. In this way the colour will acquire more brightness, though it will have a crimson cast. By the use of kermes and tartar, without alum, and with as much solution of tin as is required for a scarlet with cochineal, Hellot obtained a very lively cinnamon colour in a single bath. Cloth steeped in a solution of sulphate of pot-ash, took with kermes a pretty fine and permanent agate gray: in a solution of sulphate of soda, a dirty gray of little durability: in a solution of sulphate of iron and tartar, a fine gray: in a solution of tartar and sulphate of copper, an orange colour: and the same with nitrate of copper. Solution of bismuth, added drop by drop to a kermes bath, produced a violet. All acids convert it to a cinnamon colour, which inclines more or less to red, according as the acids are weak, and their quantity small. Its colour is rendered dull and rosy by means of alkalis. But the colour that kermes imparts to wool has much less bloom than the scarlet made with cochineal, whence the latter has generally been preferred, since the art of heightening its colour by means of solution of tin has been known. The former, however, is more permanent; and spots of grease may be discharged from it without injury. The scarlet made by kermes has been called *scarlet in grain*, because that insect was supposed to be a grain. The solution of tin has been tried with kermes as well as with cochineal; and Scheffer describes several processes for dyeing in this way: but the colour always inclines to yellow or cinnamon, because the compound formed of its colouring matter and the oxide of tin, retains a yellow hue, from the action of the acid; as does the colouring matter of madder. The colour afforded by kermes is very permanent.

Dyers have not yet been able to give silk any thing more than a dull reddish colour by means of kermes. The scarlet, for which half kermes and half madder is used, is called *scarlet in half-grain*. This mixture affords a very permanent dye; but it is not lively, inclining a little to the blood-colour.

Of Dyeing with Gum-lac.—For the purpose of dyeing, stick-lac of the deepest colour should be chosen. It is to be separated from the sticks, and powdered very well. But the colour obtained by means of lac has not the bloom of scarlet made with cochineal; however, it has the advantage of being more permanent. It may be employed with advantage, by mixing a certain quantity with cochineal, when, if it be not

in too large proportion, the fcarlet will be rendered more permanent, without its beauty being diminifhed. Lac may be ufed in a very fimple manner. Nothing more is neceffary than to boil the cochineal and folution of tin for a proper length of time; after which the bath is to be cooled, and the lac put in, in powder. It requires a very moderate heat, otherwife it will dye very unequally; and alfo a greater proportion of folution of tin than cochineal. The cloth ought to be wafhed very hot at coming out of the boiler, becaufe the refinous particles fixed in it are difficult to feparate when cold. Lac may be ufed with fuccefs for *foupe au vin* colour, putting it into the boiling, in which there muft be no alum, as that would precipitate its colouring matter too quickly. In the reddening cochineal muft be employed, and the colour may be faddened in the common method. The circumftance that appears to give lac the fuperiority over kermes, is, that it is able to bear the action of folution of tin, and experiences the good effects of it, without its colour being changed to yellow.

Of Dyeing with Archil.—In order to dye with archil, the quantity judged neceffary, according to the quantity of wool or ftuff to be dyed, and the fhade to be given it, is mixed in a bath beginning to grow warm. The bath is then heated till it is ready to boil, and the wool or ftuff is dipped in it, without any other preparation, keeping that in longeft, which is to be of the deepeft fhade. A beautiful gridelin inclining to violet is thus obtained, but the colour has no permanency; fo that archil is rarely ufed, except for modifying, heightening, or giving bloom to other colours. Hellot fays, that having applied archil on wool boiled with alum and tartar, the colour did not ftand the air any better than when the wool had undergone no preparation. But he obtained a much more permanent colour from the herb archil, by putting a little folution of tin into the bath. This changes the natural colour of the archil to one more or lefs approaching to fcarlet, according to the quantity of the folution employed. This procefs is to be conducted nearly in the fame manner as that for dyeing fcarlet, except that one bath is only required. According to Mr. Poerner, one pound of wet cloth, boiled for about an hour in a bath compofed of ten ounces of archil and an ounce and a half of tartar, acquires a blueifh red colour. If previoufly prepared with tartar and folution of tin, it affumes an amaranth colour: and if prepared with alum, a paler and lefs lively colour than the foregoing. This fubftance is frequently ufed for deepening different fhades, and giving them a bloom. It is thus ufed for violets, lilacs, mallow, and rofemary flower colours. But in order to obtain a deeper tint, alkali, and cremor calcis diffufed in water, are fometimes added to it as for deep *foupe au vin* colours. The remainder of this liquor will give a beautiful agate, rofemary flower, and other delicate colours, which cannot be procured equally fine by any other means. Alum cannot be employed inftead of this fubftance for deepening colours, as it does not afford the fame bloom, and the colour is tarnifhed by it. Archil is never employed alone for dyeing filk, unlefs for lilacs: but filk is frequently dipped in an archil bath, either before or after dyeing in others, to modify various colours, and give them a bloom.

In the archil bath, for treating white filks, a quantity of archil proportionate to the colour that is required, is boiled in a proper veffel. The clear liquor is then poured quite hot, leaving the dregs at the bottom of the boiler, into a trough of a convenient fize, in which the filk, carefully cleanfed from foap, is to be turned with great care, till it has acquired the proper fhade. The filk is then to be beetled at the river. This is a fubftance of great ufe in dyeing; but as it is rich in colour, and communicates a feducing bloom, dyers are frequently tempted to make an improper ufe of it, and to go beyond thofe proportions which would add to the beauty of colours, without any great injury to their permanency. The colour, however, obtained from it by means of folution of tin, which is red, and approaches to fcarlet, is lefs fugitive, than thofe in which that ingredient is not employed. This folution appears to be the only thing capable of increafing its durability. It may be employed not only in the dye-bath, but in the preparation of the filk, when, by mixing archil with other colouring fubftances, bright colours with fufficient permanency may be procured.

Of Dyeing with Carthamus.—Wool may be dyed red by means of carthamus, but it foon changes towards an orange. This fubftance is alfo ufed for dyeing filk poppy colour, a bright orange red, cherry, rofe and flefh colour. The proceffes differ according to the intenfity of the colour to be given, and the degree in which it approaches that of fire: but the carthamus bath, which varies in the mode of ufing, is prepared in this way: Having extracted the yellow matter of the carthamus, and opened the cakes, it is put into a deal trough, where it is fprinkled at different times with *cendres gravelées*, or foda, the latter of which is beft well powdered and fifted, in the proportion of fix pounds to a hundred; mixing it well as the alkali is put in. The carthamus thus mixed with the alkali, is put into a fmall trough with a grated bottom, firft lining it with a clofely woven cloth. When this trough is nearly half filled, it is placed upon the large one, and cold water is poured on it till the lower trough be full. The carthamus is then fet over another trough, till the water comes from it almoft colourlefs. A little more alkali is then added, and frefh water is poured on, and thefe operations are repeated, till the carthamus be exhaufted, and become yellow.

After the filk has been diftributed on the rods in hanks, good lemon juice is poured into the bath, till it is of a fine cherry colour. This is called *turning* the bath. Having ftirred the bath well, the filk is dipped in, and turned on the fkein fticks as long as it appears to get any colour. For poppy colour it is taken out, wrung, drained on the pegs, and paffed through a new bath, where it is treated as in the former. It is then dried and paffed through frefh baths, wafhing and drying it after every operation, till it have obtained the depth of colour required. When it is at the proper point, it is brightened, by turning it feven or eight times in a bath of hot water, to every bucket of which about a gallon of lemon-juice has been put. But when filk is to be dyed poppy or fire colour, it muft be firft fcoured as for white; and muft then have a flight annotta ground. This filk fhould not be alumed. And bright orange reds, as well as deep cherry colours, are treated exactly in the fame way as poppy colour, except that they have not the annotta ground, and that they may be dipped in the baths that have been already ufed for poppy colour, which will exhauft them. The lighter cherry colours, rofe colours of every fhade, and flefh colours, are made from baths of the fecond and third runnings of the carthamus, which are weaker than the firft. In thefe the deepeft fhades are dipped the firft. But the lighteft of thefe fhades, which is a very pale flefh colour, requires a little foap to be put into the bath: this foftens the colour, and prevents it from taking too quickly or unevenly. The filk is then wafhed, and brightened a little in the bath which has been ufed for brightening the colours which are deeper.

Thefe different baths are ufed as foon as they are made, and as quickly as poffible, as by keeping they lofe much of their colour, which would even be entirely loft after fome time. They are alfo ufed cold, becaufe the red *feculæ* lofe their colour on being expofed to heat. The moft proper alkali to be ufed will be cryftals of foda, or the falt of tartar. In order to leffen the expence of carthamus for deep fhades, about a fifth

of the bath of archil may be mixed with the firſt and ſecond bath. But when raw ſilk is to be dyed, that which is very white ſhould be choſen, and treated as boiled ſilk, with this difference only, that the poppy colours, bright orange reds, and cherry colours, are paſſed through baths that have been uſed for the ſame colours for ſcoured ſilk. Poppy colour prepared in an acid liquor reſiſts the action of vinegar, but it ſoon changes and fades in the air.

Some experiments have been made by Mr. Beckmann reſpecting the application of the red colour of carthamus to cotton. Having macerated cotton two hours in melted lard, he waſhed it well, and dyed it in the common way with carthamus deprived of its yellow matter. This cotton took a deeper colour than ſome which had undergone no preparation. Soap ſucceeded equally well; and olive oil ſtill better. He then dipped his cotton in oil repeatedly, drying it each time. After the laſt drying he waſhed and dried it, and then paſſed it through the yellow bath of carthamus, to which he added galls and alum. Finally, he dyed it with the alkaline ſolution of carthamus and lemon-juice. By theſe means he obtained a fine full red. Cotton treated in the ſame manner, without having been impregnated with oil, took a colour of the ſame kind, but leſs full, and leſs capable of ſtanding the action of the air. From theſe trials he thinks, that cotton to be dyed with carthamus ſhould receive a preparation ſimilar to that which it receives for the Adrianople red.

In order to dye cotton poppy colour, Mr. Wilſon directs that the carthamus thoroughly freed from the yellow colouring matter be put into a veſſel, at the bottom of which is a hair ſieve, and to pour on it a ſolution of pearl-aſhes, mixing them well, and leaving them to ſtand all night. The next morning the liquor is to be drawn off by a cock at the bottom of the veſſel, and the cotton to be dyed is to be put into it, and turned by means of a winch. In the mean time a ſolution of tartar is prepared, and left to ſettle, and while it is yet hot, it is poured into the carthamus bath, till the liquor is rendered a little ſour. The cotton muſt continue to be turned in this till it has acquired the proper ſhade. It is then waſhed lightly, and dried in a ſtove; and in this way it obtains a colour which is very fine. But to give cotton a ſcarlet, it muſt firſt be dyed yellow by means of annotta, and while wet, muſt be dyed with carthamus, in the manner juſt deſcribed. It thus acquires a fine ſcarlet, which however is neither permanent nor capable of withſtanding the operation of waſhing.

Of Dyeing with Braſil-wood.—In uſing braſil-wood or any other colouring wood in a dye bath or flat, it is neceſſary to incloſe them in thin linen bags. Wool, in order to be dyed with this wood, muſt undergo certain preparations. It is to be boiled in a ſolution of alum, to which a fourth of its weight, or even leſs, of tartar, has been added. A greater proportion of tartar would render the colour yellow. The wool thus impregnated is to be kept at leaſt a week in a cool place, after which it is dyed by boiling gently in the braſil-juice. The colouring matter which is firſt depoſited does not yield ſo fine a colour; it is proper, therefore, to dip the coarſeſt ſtuff in the bath firſt. In this manner a bright red is obtained, which ſtands the action of the air in a tolerable degree. When the red colour of braſil-juice is deſtroyed by means of any acid, it gives woollens a more or leſs dun colour, which is very durable.

It is the cuſtom of Mr. Poerner to prepare the cloth with a boiling compoſed of ſolution of tin, alum, and a little tartar; and to make his bath with braſil-wood, and a conſiderable proportion of alum. In the reſiduum of this bath he dyes a ſecond piece, which has received a ſimilar preparation. The firſt piece takes a fine brick colour; the ſecond, a colour that approaches ſcarlet. The ſhades may be conſiderably varied by varying the proportions of the ingredients employed.

A proceſs is given by Mr. Guhliche, by which he pretends finer and more permanent colours are obtained than by thoſe in uſe. He directs pure vinegar, or aceto-citric acid, which is a mixture of lemon-juice and vinegar, or aqua regia, to be poured on braſil-wood, reduced to a powder, or very ſmall chips, till it is covered with liquor, or even till the liquor is a certain height above it; the mixture to be well ſhaken, and then left to ſettle for twenty-four hours; after which it is to be decanted, filtered, and kept for uſe. On the reſiduum a vegetable acid, or pure water, is to be poured, and, having ſtood a day or two, filtered. This is to be repeated till all the colouring matter is extracted, when the wood will be found to be black. All theſe liquors are then to be mixed together very carefully. The ſtuff being prepared with a ſlight galling of ſumach, or white galls, is ſlightly alumed: being juſt rinſed, it is put quite wet into a bath prepared in the following manner: A portion of the acid ſolution of braſil-wood is diluted with a quantity of water proportionate to the quantity of the ſtuff, and the depth of the colour to be given it. When this is ſo hot that the hand will juſt bear it, ſolution of tin is poured in, till it is of a fire colour: it is then ſtirred, and the ſtuff is put in. After this has remained in half an hour, it is taken out and waſhed. The remainder of the bath may be uſed for lighter ſhades; but thoſe ſtuffs ſhould only be galled which are for deep ſhades.

This wood is uſed for dyeing ſilk what is called *falſe* crimſon, to diſtinguiſh it from that produced by means of cochineal, which has far more permanency. For this the ſilk ſhould be boiled with ſoap, in the proportion of twenty pounds of the latter to a hundred of the former, and afterwards alumed. Leſs aluming is required for this than for grain crimſon. Having refreſhed it at the river, it is dipped in a bath, more or leſs charged with braſil-juice according to the ſhade to be given. If water containing no earthy ſalt be employed, the colour will be too red for crimſon: to remedy which, the ſilk may be paſſed through a ſlight alkaline ſolution, or a little alkali may be added to the bath. Waſhing the ſilk in hard water till it have acquired the proper hue, will produce the ſame effect. In order to make falſe crimſons deeper, or dark reds, juice of logwood is added to the braſil bath, after the ſilk has been impregnated with the latter. A little alkali may alſo be put in according to the ſhade required. But to imitate poppy or fire colour, the ſilk muſt have an annotta ground, even deeper than when it is to be dyed with carthamus: after which it is waſhed, alumed, and dyed with the braſil-juice, to which a ſmall portion of ſoap-ſuds is generally put.

But the ſolution of tin cannot be uſed for dyeing ſilk with the juice of braſil-wood, as with cochineal; and the reaſon in both is the ſame: the colouring particles would ſeparate too quickly to be capable of fixing on the ſilk, which does not attract them ſo powerfully as wool. The colours imparted by dye-woods may however be much improved by ſteeping the ſilk in a cold ſolution of tin. A ſtrong decoction of braſil-wood gives yellow ſilk a ſcarlet colour, inferior indeed to that given by cochineal, but finer and more permanent than if it be ſteeped in alum only, and as capable of ſtanding the proof by vinegar, as crimſon or poppy in grain. But it is neceſſary, inſtead of uſing raw ſilk, to give a yellow ground to ſilk that has been ſcoured, or to mix ſome yellow ſubſtance with the braſil-juice.

Different experiments have been made by Mr. Poerner on methods that may be employed for dyeing cotton with braſil-wood by means of different mordants, as alum, ſolution of tin, ſal ammoniac, pot-aſh, &c. uſed either in the bath, or in the preparation of the cotton. He could not produce a colour, however, that would ſtand waſhing with ſoap, though ſome

would ſtand the action of the air, and waſhing with water, tolerably well. Cottons thus dyed ſhould be dried in the ſhade. The following proceſs is recommended by Mr. Brown for giving cotton a crimſon colour: A ſolution of tin is prepared in the proportions of nitric acid two pounds, muriatic acid one pound, tin eight ounces, water one pound. The liquids being mixed together, the tin is gradually added. Then for a piece of cotton velvet weighing fifteen or ſixteen pounds, a bath is prepared, conſiſting of boiling water four parts, ſtrong decoction of galls two parts. Having ſtirred the bath with the rake, the piece is put in, worked for half an hour, and left to ſoak two hours, when it is taken out, and left to drain. Another bath being prepared with three buckets of boiling water, and one of decoction of braſil-wood, alſo boiling, is to be raked, and the piece worked in it an hour. This bath is to be thrown away, and the vat waſhed out, and then filled with a pure decoction of the wood, in which the piece is to be worked half an hour, and then raiſed on the winch. A bath of very clear river water, with a quart of ſolution of tin, being prepared and raked, the piece is to be worked in it a quarter of an hour. It is then raiſed on the winch, and ſet over the vat containing the bath of decoction of braſil-wood, one ſixteenth of which is to be taken out, and replaced by an equal quantity of boiling decoction. This being raked, the piece is worked in it half an hour, raiſed on the winch, and carried back to the vat containing the ſolution of tin. Theſe operations are performed alternately ſix or eight times, obſerving each time to take out a ſixteenth of the bath of braſil-wood, and replace it with an equal quantity of boiling decoction of the ſame wood, to rake the bath of compoſition each time, and to finiſh the dyeing with the latter. The piece is to be waſhed in the river, and dried in a dark ſhady ſituation.

In order to give greater permanency to the fine and various colours obtained from braſil-wood, it is neceſſary to conſider its properties. The two combinations of it with alumine and oxide of tin, appear beſt calculated to render it durable. It is therefore adviſeable to ſeek the circumſtances moſt proper to favour the formation of theſe combinations according to the nature of the ſtuff to be dyed.

Of Dyeing with Logwood.—Stuffs would only take a ſlight and fading colour from the decoction of logwood, if they were not previouſly prepared with alum and tartar. A little alum is added alſo to the bath. By theſe means a pretty good violet is produced in them. But a blue colour may be obtained from this wood, by mixing verdegris with the bath, and dipping the cloth till it have acquired the ſhade which is deſired. The grand uſe of logwood is for blacks, to which it gives a luſtre and velvety caſt, and for grays of certain ſhades. It is alſo of very extenſive uſe for different compound colours, which it would be difficult to obtain of equal beauty and variety, by means of drugs affording a dye of greater permanency. It is uſed for dyeing ſilk violet. For this the ſilk muſt be ſcoured, alumed, and waſhed; becauſe without aluming it would take only a reddiſh tinge, that would not ſtand wetting. To dye ſilk thus, it muſt be turned in a cold decoction of logwood, till it have acquired the proper colour: if the decoction were uſed hot, the colour would be in ſtripes and very uneven. Bergman has obſerved, that a fine violet might be produced from logwood, by impregnating the ſilk with ſolution of tin. In fact, we may thus obtain, particularly by mixing logwood and braſil in various proportions, a great number of fine ſhades, more or leſs inclined to red, from lilac to violet. And if decoction of logwood be ſubſtituted for that of braſil in the proceſs communicated by Mr. Brown, a fine violet colour will be produced. The remarks made on braſil-wood are equally applicable to this.

Sect. IV. *Of Yellow.*

Of Dyeing with Weld.—The yellow communicated to wool by means of weld has little permanency, if the wool be not previouſly prepared by ſome mordant. For this purpoſe alum and tartar are uſed, by means of which this plant gives a very pure yellow, which has the advantage of being permanent or durable. For the boiling, which is managed in the common way, Hellot adviſes four ounces of alum to every pound of wool, and only one ounce of tartar: many dyers, however, uſe half as much tartar as alum. Tartar renders the colour paler, but more lively. For the purpoſe of dyeing with weld, the plant is boiled in a freſh bath, encloſing it in a bag of thin linen, and keeping it from riſing to the top by means of a heavy wooden croſs. Some dyers boil it till it ſinks to the bottom of the copper, and then let a croſs down upon it: others, when it is boiled, take it out with a rake and throw it aſide. Hellot directs five or ſix pounds of weld for every pound of cloth; but dyers ſeldom uſe ſo much, contenting themſelves with three or four pounds, or even much leſs. Many, indeed, add to the weld a little quicklime and aſhes, which favour the extraction of the colouring matter, and heighten its colour, but at the ſame time render it liable to be changed by the action of acids. The quantity of weld, however, ought to be proportionate to the depth of the ſhade that is required. Both lighter and brighter ſhades may be obtained by dyeing after deeper ones, adding water at each dipping, and keeping the bath boiling: but light ſhades procured in this way are not ſo lively as when freſh baths are uſed, proportioning the quantity of weld to the depth of the ſhade intended to be procured. If common ſalt be added to the weld bath, it renders its colour richer and deeper: ſulphate of lime, or gypſum, alſo deepens it: but alum renders it paler and more lively; and tartar, ſtill paler. Sulphate of iron or vitriol makes it incline to brown. The ſhades obtained from weld may be modified by ſuch additions, by the proportion of the weld, by the length of the operation, and by the mordants employed in preparing the ſtuff. Thus Scheffer ſays, that by boiling the wool two hours with a fourth of its weight of ſolution of tin, and the ſame of tartar, waſhing it and boiling it fifteen minutes with an equal weight of weld, it will take a fine yellow, which, however, will not penetrate its external texture. Mr. Poerner alſo directs the cloth to be prepared as for dyeing ſcarlet. By theſe means greater brightneſs and permanency are given to the colour, which, every thing elſe being equal, is alſo lighter. The colour may alſo be modified by paſſing the cloth, when it comes out of the dye, through another bath. Therefore, to produce a golden yellow, the cloth, when it comes out of the welding, may be paſſed through a ſlight madder bath; and for a tawny, through a bath made with a little ſoot.

In order to dye ſilk plain yellow, no other ingredient than weld is in general uſed. The ſilk ought to be ſcoured in the proportion of twenty pounds of ſoap to the hundred, and afterwards alumed and refreſhed, that is, waſhed after having been alumed. Then a bath is prepared with two pounds of weld for each pound of ſilk, which, after a quarter of an hour's boiling, is to be paſſed through a ſieve or cloth into a vat: when it is of ſuch a temperature as the hand can bear, the ſilk is put in, and turned until the colour is become uniform: during this operation the weld is boiled a ſecond time in freſh water; about half of the firſt bath is taken out, and its place ſupplied by a freſh decoction. This freſh bath may be uſed a little hotter than the former; too great a degree of heat however muſt be avoided, that no part of the colour already fixed may be diſſolved: it is to be turned as before, and in the mean time a quantity of *cendres gravelées* is to be diſſolved in a part of the ſecond decoction; the ſilk is to be taken out of the

bath, that more or less of this solution may be put in, according to the shade required. After it has been turned a few times, a hank is wrung with the pin, that it may be seen whether the colour be sufficiently full, and have the proper gold cast: if it should not, a little more of the alkaline solution is added, the effect of which is to give the colour a gold cast, and to render it deeper. In this way the process is to be continued, until the silk has attained the desired shade: the alkaline solution may also be added along with the second decoction of the weld. Care must however be taken that the bath has not too great a degree of heat.

If it should be wished to produce yellows with more of a gold or jonquille colour, a quantity of annotta, proportioned to the shade required, must be added to the bath at the same time with the alkali. But for light shades of yellow, such as pale lemon, or canary-bird colour, the silk ought to be scoured as for blue, because the shades are more beautiful and transparent, in proportion as the ground on which they are laid is whiter: the strength of the bath is proportioned to the shade wished to be obtained; and if it be intended that the yellow should have a tinge inclining to green, more or less of the indigo vat is added, if the silk has not been azured. To prevent the shades from being too deep, the silk may be more slightly alumed than is commonly practised.

It is directed by Scheffer that the silk should be soaked twenty-four hours in a solution of tin, made with four parts of nitric acid, one of common salt, and one of tin, and saturated with tartar; that it should be washed, and boiled half an hour with an equal quantity of weld flowers. He observes, that a fine straw colour is thus obtained, which possesses the advantage of resisting the action of acids. By following this process, very little tin should be left in the solution, as it is precipitated by the acid of tartar. In order to dye cotton yellow, it is necessary to begin by scouring it in a bath prepared with the ley of the ashes of green wood; it is then washed, dried, and alumed with one-fourth of its weight of alum; after twenty-four hours it is taken out of the aluming, and dried without being washed. A weld bath is then prepared, with the proportion of a pound and a quarter of weld for each pound of cotton: in this the cotton is dyed, by being turned and wrought in it until it has acquired a proper shade; it is taken out of this bath to be soaked for an hour and a half, in a solution of sulphate of copper or blue vitriol, in the proportion of one-fourth of the weight of the cotton: it is then thrown, without being washed, into a boiling solution of white soap made with the same proportions; after being well stirred, it is boiled in it for nearly an hour, then washed and dried very well.

But if a still deeper yellow be required, the cotton is not alumed, but two pounds and a half of weld for each pound of cotton are employed, to which a drachm of verdegris mixed with a part of the bath is added; in this, the cotton is dipped and worked, until it have acquired an uniform colour; it is then taken out of the bath, that a little ley of soda may be poured in; returned into the bath and kept there for a full quarter of an hour, when it is taken out, wrung, and dried very carefully. A lemon colour is dyed by the same process, except that only one pound of weld is employed for each pound of cotton, and that the proportion of verdegris may also be diminished, or even entirely omitted, aluming being substituted in its stead. The shades of yellow may thus be varied in many different ways. The processes for thread are to be managed in the same manner.

Of Dyeing with Yellow-wood, or Fustic.—When this wood is used, it must be split, or, what is better, cut into chips, and enclosed in a bag. Weld gives an unprepared cloth only a pale yellow, which soon changes in the air; but fustic without the aid of mordants gives it a brownish yellow, which is dull indeed, but which stands very well when exposed to the air; its colour is rendered more bright and fixed, by the mordants employed with weld, which act on it in a similar manner; thus alum, tartar, and a solution of tin, render the colour brighter; common salt, and sulphate of lime or gypsum, render it deeper. Fustic may therefore be treated in the same way as weld, with only this difference, that in order to obtain the same shade, much less yellow wood is required; thus from five to six ounces of this wood are sufficient to give a lemon colour to a pound of cloth, but the colours obtained from it incline more to orange, than those obtained from the weld; and therefore, they are sometimes used together in quantities proportioned to the effect that is desired.

Of Dyeing with Annotta.—When this substance is used, it is always mixed with an alkali, which facilitates its solution, and gives a colour less inclining to red. It is cut in pieces, and boiled in a caldron, with an equal weight of *cendres gravelées*, provided the desired shades do not require a smaller proportion of alkali; the cloth may be then dyed in this bath, either with these ingredients alone, or with the addition of others to modify the colour: but it seldom happens that annotta is used for wool, because the colours it imparts are too fading, and may be obtained of a more durable nature by other means. Hellot employed it in dyeing a stuff prepared with alum and tartar, but the permanency of the colour was not much increased; it is most generally used for silk. For the purpose of dyeing silks of an aurora or orange colour, it is sufficient to scour them with twenty pounds of soap to the hundred; after they have been well cleansed, they may be immersed in a bath of water, with which more or less of the alkaline solution of annotta, according to the shade, has been carefully mixed. The heat of this bath should be between tepid and the point at which water boils. After the silk has acquired an uniform colour, one of the hanks must be taken out, washed and wrung, to see whether the colour be sufficiently full; and if it be not, more solution of annotta must be added, and it must be turned again. This solution preserves its colour without being altered. The desired shade having been obtained, nothing remains but to wash the silks, and to beetle them twice, by a stream of water, to free them from the superfluous annotta, which would injure the beauty of the colour very much. If raw silk be to be dyed, such as is naturally white must be chosen, and it must be dyed in the annotta bath, which ought only to be tepid, or even cold, that the alkali may not dissolve the gum of the silk, and destroy its elasticity, which should be preserved carefully.

This only respects the silk intended to receive the aurora colour: to make the orange, which contains more red, after dyeing with annotta, it is necessary to redden the silks with vinegar, alum, or lemon-juice. The acid, in saturating the alkali used to dissolve the annotta, destroys the yellow shade which the alkali had imparted, and restores its natural colour, which inclines considerably to red. Orange colours which have been reddened with alum, must be washed in a stream of water; but it is not necessary to beetle them, unless the colour be too red. It is also possible to obtain shades which preserve a reddish hue, at a single operation, by employing in the preparation of the annotta bath, a smaller quantity of alkali than that which has been directed above. Some dyers, and particularly Mr. Guhliche, recommend no heat to be employed in the preparation of annotta. If the last shades be required to have less of an orange, and to approach more to nankeen, a little of the solution of galls must be put to the bath.

In order to give an orange colour to cotton, Mr. Wilson

directs the annotta to be ground while it is kept moistened, boiled in water with double its weight of alkali, left to settle for half an hour, and the clear liquor to be put into a heated vessel; in this the cotton is to be immersed, when it will take an orange colour. A hot solution of tartar is then to be poured into the bath, so that it may become weakly acidulated: it is to be again turned in it on the skein sticks, or wound upon the winch when in the piece; in this way, the colour becomes more lively, and fixes better; the cotton must then be washed slightly, and dried by means of a stove.

Of Dyeing with Saw-wort, &c.—This substance without mordants, gives a yellowish green colour which has no durability; but by means of alum, employed either in a separate boiling, or put into the bath with the plant, it gives a yellow colour which is both pleasing and durable. Mr. Poerner thinks the best mordants for it, are alum and sulphate of lime. Scheffer advises that the wool be prepared with alum and one-twelfth of tartar: he asserts, that if it be prepared with three-sixteenths of solution of tin and as much tartar, it acquires a much brighter colour than in the former instance.

Dyers Weed gives a yellow colour, but not comparable in beauty to that of weld, or saw-wort, which however becomes sufficiently fixed by means of mordants, the most advantageous of which, either for the preparation of the cloth, or for being added to the bath, are tartar, alum, and sulphate of lime.

Camomile affords a weak yellow colour of a tolerably pleasant hue, but without durability; mordants give it a little, and the most useful of these are alum, tartar, and sulphate of lime. Scheffer asserts, that a very fine yellow may be given to silk by a decoction of this plant, into which a little solution of tin mixed with tartar till its colour is become yellow, has been added drop by drop; for dyeing the silk, it is kept warm, but without boiling: he recommends that water which does not precipitate solution of tin should be made use of in the process.

Fenugreek.—The seeds of this plant when ground, are capable of giving a pale and tolerably durable yellow; and the mordants which succeed best with this substance, are alum, and common salt.

Turmeric.—This substance is very rich in colour, and there is no other which gives a yellow colour of such brightness, but it possesses no durability, nor can mordants give it a sufficient degree: common salt and ammoniacal muriate are those which fix the colour best, but they render it deeper, and make it incline to brown; some recommend a small quantity of muriatic acid. It is sometimes employed to give the yellows made with weld a gold cast, and to give an orange tinge to scarlet; but the shade imparted by turmeric soon disappears when exposed to the air.

There are two processes given by Mr. Guhliche for fixing the colour of turmeric on silk. The first consists in aluming in the cold, for twelve hours, a pound of silk in a solution of two ounces of alum, and dyeing it hot, but without boiling, in a bath composed of two ounces of turmeric, and a quart of aceto-citric acid mixed with three quarts of water. The second process consists in extracting the colouring particles from the turmeric by means of the aceto-citric acid, and in dyeing the silk alumed as already mentioned in this liquor, either cold, or only moderately warm. The colour is rendered more durable by this than by the former process. The first parcel immersed acquires a gold yellow; the colour of the second and third parcels is lighter, but of the same kind; that of the fourth is a straw colour.

French Berries give a pretty good yellow, but void of durability; when they are employed, the cloth is prepared in the same way as for dyeing with weld.

Seed of Purple Trefoil.—Mr. Vogler has found that a bath of this seed, and solution of pot-ash, afforded a very deep yellow; with sulphuric acid, a light yellow; with solutions of alum and tin, a lemon colour; with sulphate of copper, a greenish yellow. Wools impregnated with these mordants, and boiled for some minutes in a bath of red trefoil seed, are found to be permanently dyed of the colours above mentioned; these yellows give a fine green with indigo. Mr. Dizé has compared the effects of trefoil and weld, from which it appears that the trefoil seed gives wool a fine orange yellow, and silk a greenish yellow; that solution of tin cannot be employed in this dye, but that aluming is necessary; that the blue applied upon the yellow produced by the trefoil, gives a less beautiful, and more dull green, than that for which weld has been made use of.

Quercitron Bark.—Dr. Bancroft has introduced to the attention of the dyer this kind of bark, which may also be advantageously employed in the printing of linens.

But to dye wool yellow with it, he advises that solution of tin and alum should be put into the bath with the bark. Silk should be treated in the same manner as with weld; and if a very bright yellow is required, it must be prepared by means of solution of tin. According to some, wool must be prepared with solution of tin before it is dyed with this bark. There are many other substances which are employed to dye yellow, and which afford shades endued with different degrees of beauty and durability; but we cannot take notice of them here.

It seems evident that in general, alkalis render the colour of these substances deeper and more of an orange cast; they facilitate the extraction of the colouring particles; it is indeed only by means of them that we obtain the particles from annotta, but they also favour their destruction. Sulphate of lime or gypsum, common salt, and sal ammoniac, render the colour of yellow substances deeper: acids render it more clear and more durable; alum and solution of tin, while they render it more clear, also confer greater brightness and durability.

Sect. V. *Of Fawn Colour.*

It will only be necessary to take notice of a few of the substances that are employed to produce this colour.

Of Dyeing with Walnut-peels.—The colouring particles of these peels have a strong disposition to combine with wool, and give it a very durable hazel or fawn colour; mordants appear to add little to its durability, but are capable of varying its shades, and giving them greater brightness. By means of alum in particular, when the stuff is prepared with it, a richer and more lively colour is procured. If walnut-peels are to be employed for dyeing, a quantity, proportioned to that of the stuff and the depth of the shade required, is boiled for a full quarter of an hour in a copper. In cloths, the deepest shades are commonly dyed first, and the lighter ones afterwards; but for woollen yarn, the light shades are generally dyed first, and the deeper ones afterwards, fresh peels being added for each parcel. Cloth and yarn should be simply moistened with warm water before they are put into the copper, where they are carefully stirred until they have acquired the proper shade, unless they have before had an aluming.

Mr. Berthollet has dyed different patterns of wool with decoction of walnut-peels, adding to one, oxide or calx of tin, to another, oxide or flowers of zinc, to a third, semivitrified oxide of lead or litharge, to a fourth, oxide of iron. The quantity of decoction, weight of the pattern, time of boiling, and all other circumstances, were equal, both with respect to these, and another pattern which was treated without addition, and intended to serve as a standard of comparison; the oxide of tin gave a more clear and bright fawn colour, than that of the standard; the oxide of zinc a colour still more clear, and approaching to an ash-coloured gray; the oxide of lead, a colour

with more of an orange caſt; and by the oxide of iron, a greeniſh brown colour was produced.

Of Dyeing with Sumach.—This ſubſtance when employed alone gives a fawn colour inclining to green; but cotton ſtuffs which have been impregnated with printers mordant, that is acetite of alumine, take a pretty good and very durable yellow. An inconvenience is experienced in employing ſumach in this way, which ariſes from the fixed nature of its colour; the ground of the ſtuff does not loſe its colour by expoſure on the graſs, ſo that it becomes neceſſary to impregnate all the ſtuff with different mordants to vary the colours, without leaving any part of it in a white ſtate.

Mr. Berthollet thinks, that if the yellow colour which many vegetable ſubſtances produce be compared with the fawn colour which moſt of them yield, a near connection will be found between theſe colours; there are even ſome which may be referred equally to yellow or to fawn colour: there are ſome which are fawn coloured, but which by means of alum and ſolution of tin become yellow, and theſe yellows are very durable. This difference may be eſtabliſhed between them: the yellows are in general leſs fixed, and more liable to give fading colours; becauſe they have not been reduced to a permanent ſtate, by a combuſtion ſo far advanced as that which the fawn colours have undergone; and therefore the colour of yellow ſubſtances requires to be fixed by means of mordants, whereas moſt fawn-coloured ſubſtances yield of themſelves a colour which is very permanent or durable. But as the fawn-coloured ſhades obtained from different ſubſtances vary even to a great extent, ſeveral of theſe ſubſtances are ſometimes mixed together in different proportions, to produce a particular colour; they are alſo mixed with other ſubſtances, to modify the colour obtained from them, and to make it more fixed and permanent.

Red Saunders is alſo a ſubſtance that gives a fawn colour with a browniſh caſt inclining to red; of itſelf however it affords little colour, and it is ſaid to make the wool harſh; but its colouring matter diſſolves better when it is mixed with other ſubſtances, ſuch as walnut-peels, ſumach, and galls; beſides, the colour which it gives is durable, and modifies thoſe of other ſubſtances with which it is mixed very conveniently. Mr. Vogler having obſerved, that diluted alcohol or brandy diſſolved the colouring matter of ſaunders much better than water, employed this ſolution, both alone and mixed with ſix or ten parts of water, to dye patterns of wool, ſilk, cotton, and thread, which had been previouſly prepared by being impregnated with the ſolution of tin, and afterwards waſhed and dried. Theſe patterns took all of them alike a poppy colour. Patterns of the ſame kind prepared with alum, alſo took a rich ſcarlet colour; prepared with ſulphate of copper, a fine clear crimſon colour; and when prepared with ſulphate of iron, a beautiful deep violet colour was produced.

Soot is likewiſe uſed to give wool a fawn colour, or a brown, which is more or leſs deep according to the proportion of that ſubſtance which is employed; but ſoot gives only a fading colour, becauſe it only attaches itſelf feebly to the wool inſtead of combining with it; it renders it harſh, and leaves a diſagreeable ſmell: it is uſed however for browning certain colours in ſome very extenſive manufactories.

Sect. VI. *Of Compound Colours.*

It is very well known that compound colours are formed by the admixture of ſimple ones, and that if the colouring particles were not liable to vary in their effects, according to the combinations they form, and the influence exerted on them by the different ſubſtances contained in the baths, the ſhade which ſhould reſult from the mixture of two colours or ſubſtances which would produce theſe colours when unmixed, might be determined with accuracy; but the chemical action of mordants, and of the liquor of the bath, frequently change the reſults; theory may, however, be extended to the explanation of effects of this kind. It is not proper to conſider as a conſtituent part of compound colours that which is natural to the colouring particles, but that which they ought to aſſume with a particular mordant, and in a particular bath, ſo that our attention muſt be chiefly fixed on the effects of the chemical agents that are made uſe of. And it is in this department of dyeing that the knowledge of the artiſt may be moſt uſeful, by enabling him to vary his proceſſes according to the whimſical changes of faſhion, and to arrive at the end propoſed in his attempts, by the ſimpleſt, ſhorteſt, and cheapeſt methods.

As the proceſſes for compound colours are very numerous, it will only be poſſible to mention thoſe which appear to be moſt deſerving of attention.

Of the Mixture of Blue and Yellow, or Green.—It is the practice of dyers to make green by the admixture of blue and yellow, and it is diſtinguiſhed into a great number of different ſhades; but it requires addreſs and experience to obtain this colour uniform and without ſpots, eſpecially in the light ſhades of it. It is poſſible to produce green by beginning either with the yellow or the blue dye: but the firſt method is attended with ſome inconveniencies; for the blue ſoils the linen, and a part of the yellow being diſſolved in the vat, changes and makes it green; the ſecond method is therefore preferable. It is common to employ the paſtel vat, but for ſome kinds of green, ſolution of indigo in the ſulphuric acid is uſed; and then, the blue and yellow are either dyed ſeparately, or all the ingredients are mixed together, to dye by a ſingle operation. Solutions of copper with yellow ſubſtances may however be employed. The proceſſes are theſe:

It is neceſſary that the blue ground be proportioned to the green which is deſired; thus for the green like that of a drake's neck, a ground of deep royal blue is given; for parrot green, a ground of ſky blue; for *verd naiſſant*, a ground of white blue is neceſſary. After the cloths have received the proper ground, they are waſhed in the fulling-mill, and boiled as for common welding, but for the light ſhades the proportion of ſalts is diminiſhed. Moſt commonly the cloths intended for the light ſhades are boiled firſt; and when theſe are taken out, tartar and alum are added; and this practice is purſued until we come to the cloths intended for the darkeſt ſhades, more and more tartar and alum being conſtantly ſupplied. The proceſs of welding is conducted in the ſame manner as for yellow; but a larger quantity of weld is employed, unleſs for the lighter ſhades, which, on the contrary, require a ſtill ſmaller proportion. For the moſt part, a ſucceſſion of ſhades from the deepeſt to the lighteſt is dyed at the ſame time, beginning with the deepeſt and proceeding to the lighteſt: between each dip, which laſts half an hour, or three quarters, water is added to the bath. Some dyers give each parcel two dips, beginning the firſt time with the deep ſhades, and the ſecond with the light ones; in that caſe each parcel ſhould remain a ſhorter time in the bath: for the very light ſhades, care ſhould be taken that the bath does not boil.

A browning with logwood and a little ſulphate of iron is given to the very deep greens.

It is ſtill more difficult in ſilk to prevent the green from being ſpotted or ſtriped than in cloth. The ſcouring of the ſilk intended for greens, is conducted in the ſame manner as for common colours; for the light ſhades, however, it muſt be thoroughly ſcoured as in the caſe of blue. However, ſilk is not firſt dyed blue as in the caſe of cloth, but after being well alumed, it is ſlightly waſhed at the river, and divided into ſmall hanks that it may take the dye uniformly; it is then turned carefully in the weld bath. When it is thought that the ground is ſufficiently deep, a pattern is tried in the vat, to determine

whether the colour be of the proper ſhade: if it have not ground enough, decoction of weld is added; and when it is certain that the yellow has attained the proper degree, the ſilk is taken out of the bath, waſhed, and dipped in the vat in the ſame way as for blue. In order to render the colour deeper, and at the ſame time to vary its hue, decoction of logwood, fuſtic, or annotta, is added to the yellow bath after the weld has been taken out; for the very light ſhades, ſuch as apple and ſea-green, a much weaker ground is given than for the others. For all the light ſhades, except ſea-green, it is thought beſt to give the yellow by baths which have been already uſed, but which contain no logwood or fuſtic: becauſe ſilk when completely alumed takes the colour too quickly in freſh baths, and is therefore liable to be unequally dyed.

If raw ſilk is to be dyed green, that which is naturally white is choſen, as for yellow, and, after being well ſoaked, is alumed and treated in the ſame way as other ſilks. If the blue vat be employed to dye green, ſaw-wort may be employed inſtead of weld; it is even preferable, becauſe the colour it gives inclines naturally to green: *dyers-broom* may likewiſe be employed, and ſometimes theſe ſubſtances are mixed together; other ſubſtances which dye yellow are alſo proper to be employed, and a variety of ſhades may be procured in this way.

But the green obtained by means of ſolution of indigo in ſulphuric acid is known by the name of *Saxon green*; and it has more brightneſs, but leſs durability, than that above deſcribed. In the proceſs for it a boiling is given as for welding, and the cloth is then waſhed, fuſtic in chips encloſed in a bag is put into the ſame bath, and boiled for an hour and a half, then taken out, and the bath cooled to a temperature which the hand can ſupport; nearly a pound and a quarter of the ſolution of indigo for each piece of cloth of eighteen ells which is to be dyed, is then added; at firſt it is to be turned with rapidity, and afterwards ſlowly: the cloth is to be taken out before the bath boils. It is a proper practice to put in only two-thirds of the ſolution at firſt, to take out the cloth after two or three turns, and then to add the laſt third; the colour is thus rendered more uniform: if it be obſerved that the colour does not take well, a little calcined alum reduced to powder is added. The Saxon apple green is dyed in the bath which has ſerved for Saxon green, after one-third or one-half of it has been taken out, and after it has been cooled; the cloth is turned in it until it be on the point of boiling.

It is therefore evident that a great variety of greens may be produced, not only according to the proportions of the indigo and yellow dye employed, but according to the nature of the yellow ſubſtance, which may affect the green, both as to ſhade and fixity; and the colour may be ſtill further modified by reactives of different kinds.

It is obſerved by Mr. Guhliche, that three yellow ſubſtances may be employed for dyeing ſilk of a Saxon green: viz. turmeric, fuſtic, and French berries. The greens produced by means of turmeric are the moſt beautiful, but the moſt fading. The ſilk is alumed in the proportion of four ounces of alum to the pound, being left twelve hours in the ſolution when cold: a bath is prepared with an ounce of pounded turmeric, to which as much ſolution of indigo in ſulphuric acid as will give it a ſufficiently green colour is added; an ounce of ſolution of tin is then mixed with it, and the alumed ſilk dipped until it have acquired a fine green colour, when it is wrung, waſhed, and dried in a ſhady place.

If *French berries* be uſed, a more beautiful colour is obtained by employing the tincture made with the aceto-citric acid: as the bath is acid, only two ounces of alum are employed in aluming each pound of ſilk; in other reſpects, the proceſs is conducted like the former. The ſhades may be varied by the proportions of the ſolutions of indigo. If the blue prevails, a ſea green is produced. The light ſhades may be dyed after thoſe of a deeper caſt.

The cold vat of Mr. Guhliche for dyeing ſilk blue is compoſed of a pound of indigo, three pounds of good quick lime, or lime ſlaked by the air, three pounds of Engliſh vitriol, and a pound and a half of orpiment. The indigo ſhould firſt be carefully ground and mixed with water, put into a wooden vat and diluted with water to a proper degree, according to the intenſity of the colour to be obtained; the lime is then to be added, and the mixture well ſtirred, covered up, and left at reſt for ſome hours, when the vitriol reduced to powder is to be added, the whole well ſtirred, and the vat covered; ſome hours after, the orpiment in powder is to be thrown in, and the whole again left at reſt for ſome hours; after this, the mixture is to be ſtirred, and left to ſettle until the ſupernatant liquor appears clear, when the flower which covers it is put aſide; the ſilk is then dyed hank by hank, after having been previouſly dipped in warm water. When taken out of the bath, it is waſhed in a ſtream of water and dried. When the bath becomes turbid, it is left to ſettle till it grows clear, a precaution eſſentially neceſſary for the light ſhades; and when it begins to be exhauſted, one third of the ingredients are added, proceeding as at firſt. In proportion as the vat is exhauſted, the ſhades become lighter. This vat ſerves equally well for ſilk, thread, and cotton. For wool the ſame gentleman employs a vat compoſed of one pound of indigo, four pounds of pot-aſh, one pound of lime, and a pound or a pound and a half of orpiment. The proceſs is the ſame, except that he keeps this laſt vat at a moderate degree of heat.

In order to dye Engliſh blue, it is neceſſary firſt to give ſilk a light blue: when taken out of this bath, it is dipped in hot water, waſhed in a ſtream, and left in a bath compoſed of the ſolution of indigo in the vitriolic acid, to which a little ſolution of tin has been added, until it have acquired the proper ſhade, or have exhauſted the bath: before it is put into this bath, it may be dipped in a ſolution of alum, in which it muſt not be ſuffered to remain too long. Silk dyed in this way has not the reddiſh caſt given by the blue vat, nor the greeniſh caſt of the Saxon blue.

But to dye Engliſh green, which is more beautiful than common green, and more durable than Saxon green, the above dyer firſt gives the ſilk a light blue in the cold vat, ſoaks it in warm water, and waſhes it in a ſtream, dips it in a weak ſolution of alum, prepares a bath with the ſolution of indigo in ſulphuric acid, an ounce of ſolution of tin, and the tincture of French berries: in this bath the ſilk is kept until it have taken the deſired colour, when it is waſhed and dried in a ſhady place: the lighter ſhades may be dyed afterwards. The ſhades are rendered more or leſs blue, or more or leſs yellow, according to the proportions of the yellow ſubſtances and ſolution of indigo. When a goſling green is to be given to ſilk, it is firſt dyed of a light blue, either in the hot or cold vat, then paſſed through hot water, and waſhed in a ſtream, and while ſtill moiſt, dipped in a bath of annotta.

In order to give a green colour to linen and cotton thread, they are firſt ſcoured, dyed in the blue vat, cleanſed, and dipped in the weld bath. The ſtrength of the blue and the yellow is proportioned to the colour to be obtained. As it is difficult to dye cotton velvet uniformly in the common blue vat, it is firſt dyed yellow with turmeric, and finiſhed green with the ſolution of indigo in the ſulphuric acid. But it is a matter of indifference whether the yellow or the blue be begun with.

A proceſs for dyeing cotton velvet, or ſkeins of cotton, of a ſea or apple green in a ſingle bath, is deſcribed by D'Apligny. In it verdegris is mixed with vinegar, and the mixture kept well ſtopped fifteen days in a ſtove; four hours before uſing it, a ſolution of a quantity of *cendres gravelées*, equal in weight to

that of the verdegris, is added, and the mixture is kept hot. The cotton, thread, or velvet, are prepared by being soaked in a warm solution of alum, made in the proportion of one ounce of salt, and five quarts of water to the pound: they are then taken out, and the verdegris mixture added to the bath, into which they are returned in order that they may be dyed. The different shades of olive, and drake's-neck green, are made by giving the thread a blue ground, galling it, and dipping it in a weaker or stronger bath from the black cask, then in the weld bath with the verdegris, and afterwards in the bath with the sulphate of copper; and the colour is afterwards brightened by means of soap.

There does not appear to be any thing obscure in the formation of the green, produced by giving a yellow colour to a stuff previously dyed blue and washed. The colour inclines more or less to yellow or to blue, according to the depth of the blue shade, and the strength of the yellow bath. The intensity of the yellow is increased by alkalis, sulphate of lime, and ammoniacal salts; it is diminished by acids, alum, and solutions of tin. The shades also vary according to the nature of the yellow substances that are made use of. It is evident that different effects will be produced by the same ingredients in the formation of Saxon green, according to the process which is employed: if a Saxon blue be first given, and afterwards the yellow colour, separately, the effects will be similar to those just mentioned; but if the solution of indigo be mixed with the yellow ingredients, other results are obtained, for then the sulphuric acid acts on the colouring particles, and the intensity of the yellow is diminished. If a succession of shades be dyed in a bath composed of yellow and the solution of indigo, the last approach more and more to yellow, because the particles of indigo become attached to the stuff in preference to the yellow ones, which therefore become predominant in the bath.

Of the Mixture of Red and Blue.—The mixture of red and blue produces violet, purple, dove-colour, pansey, amaranth, lilac, mauve, and a great number of other shades, determined by the nature of the substances, the red colour of which is combined with the blue, by the proportion of these substances, and the different steps of the process which is employed. Hellot observes that stuff which has been dyed scarlet, takes an unequal colour when blue is to be united with it. The blue is therefore given first, which, even for violet and purple, ought not to be deeper than the shade distinguished by the name of sky-blue; a boiling is given with alum mixed with two-fifths of tartar; the stuff is then dipped in a bath composed of nearly two-thirds as much cochineal as for scarlet, to which tartar is always added. The circumstance which distinguishes the process for purple from that for violet, is, that for the former a lighter blue ground is given, and a larger proportion of cochineal is employed. These colours are frequently dyed after the reddening for scarlet, such quantities of cochineal and tartar being added as are necessary: the operation is managed in the same way as for scarlet. But lilacs, pigeon's necks, mauves, &c. are commonly dipped in the boiling which has served for violet, after alum and tartar have been added to it: the blue ground having been proportioned to the shade required, the quantity of cochineal is also adjusted in a similar manner: a little solution of tin is added for some reddish shades, such as peach blossom. It is to be observed, that though the quantity of cochineal is diminished according to the lightness of the shade required, the quantity of tartar is not lessened, so that the proportion of it compared with that of the cochineal, is so much the greater, as the colour required is lighter. Mr. Poerner is of opinion, that to procure the colours composed of red and blue, it is advantageous to employ the solution of indigo in sulphuric acid, because a great variety of shades is thus more easily obtained, and the process is shorter and less expensive. The colours obtained in this way are indeed much less durable than when the blue vat is employed; but he asserts, that they possess durability, when solution of indigo to which alkali has been added is made use of. He prepares a pound of cloth with three ounces of alum, by boiling it for an hour and a half, and leaving it a night in the liquor after it is cold. The bath is made with an ounce and a half of cochineal, and two ounces of tartar, boiling it for three quarters of an hour, and then adding two ounces and a half of solution of indigo: it is stirred and made to boil gently for a quarter of an hour; and by this means a very beautiful violet is produced.

But for the different shades which result from the mixture of red and blue, according as one or other of the colours prevails, he increases or diminishes the proportion of the solution of indigo; he increases it as far as five ounces, and diminishes it to five drachms for each pound of cloth: he also reduces the quantity of cochineal, but never below an ounce, because the colour would become too dull: he changes the proportion of tartar, and he varies the preparation given to the cloth, by the addition of tartar or solution of tin in different proportions.

In dyeing silk, two kinds of violets are distinguished, the fine and the false: the last is made either by means of archil or brasil-wood. For the fine violet, the stuff is first passed through cochineal, and afterwards dipped in the vat; the silk is prepared and dyed in the cochineal in the same manner as for crimson, except that neither tartar nor solution of tin, which serve to heighten the colour, are employed. More or less cochineal is used, in proportion to the intensity of the shade required. The common proportion for a fine violet, is two ounces for each pound of silk. When the silk is dyed, it is washed at the river and beetled twice, then dipped in a vat of greater or less strength, according to the depth that is to be given the violet; it is then washed and dried with the precautions which are proper for all colours dyed in the vat. In order to give greater strength and beauty to the violet, it is commonly passed through the archil bath; and this custom, which is frequently abused, is indispensable for the light shades, the colour of which would otherwise have too great a dullness. After the silk has been dyed with cochineal as above directed, a very light blue shade must be given it for purple: only the deepest shades are dipped in a weak vat; such as are less deep are only dipped in cold water, into which a little of the liquor of the vat has been put, because they would take too much blue in the vat itself, though ever so weak. The light shades of this colour, such as gillyflower, gridelin, and peach blossom, are made in this way, by the proportion of cochineal being lessened.

But the false violets in silk are procured in different ways; those which are most beautiful and most in use, are prepared with archil. The strength of the archil bath is adapted to the colour that is to be obtained; the silk is turned in it on the skein sticks, after having been beetled at the river after scouring: when the colour is thought to be sufficiently deep, a pattern is tried in the vat, to see whether it takes the violet wished for. If the shade is found to be of the proper depth, the silk is beetled at the river and dipped in the vat as for the fine violets; less of the blue, or less of the archil colour are given, according as the violet is intended to incline to red or blue.

The general method of dyeing thread and cotton violet, is first to give them a blue ground in the vat, proportionate to the shade wanted, and to dry them; they are then galled, in the proportion of three ounces of galls to a pound: they are left for twelve or fifteen hours in this gall bath, after which, they are wrung and dried again. The thread and cotton are then passed through a decoction of logwood, and when well soaked are taken out, and two drachms of alum, and one

drachm of diſſolved verdegris for each pound of thread and cotton, are added to the bath; the ſkeins are then redipped on the ſkein ſticks, and turned for a full quarter of an hour, when they are taken out to be aired; after which they are again completely immerſed in the bath for a quarter of an hour, then taken out and wrung. Then the vat which has been employed is emptied; half of the decoction of logwood which had been reſerved is poured in, two drachms of alum are added, and the thread dipped afreſh, until it is brought to the ſhade required. The decoction of logwood ought to be ſtronger or weaker according to the ſhade we want: this violet ſtands the action of the air tolerably well, but cannot be compared in durability to that obtained by means of madder. In the production of violet by means of cochineal, it may be obſerved, that the woollen ſtuff has been diſpoſed to take a crimſon, by the bath, which contains alum; but the tartar added to the dye bath, brings the colour back to red; this is a general property which acids poſſeſs. For purple, the red is rendered a little more predominant, by increaſing the quantity of the cochineal, and diminiſhing the intenſity of the blue ground. But the ſhades bordering on theſe two colours ſhould have a diſtinct red, and the ſame proportion of tartar is preſerved, though that of cochineal and the depth of the blue ground be leſſened.

In dyeing ſilk, the tartar is omitted; it naturally acquires from cochineal a colour, to which it is only neceſſary to add a ſlight blue ſhade to produce purple; a deeper blue ſhade gives a violet colour, but to increaſe the fulneſs of the violet and give it brightneſs, archil muſt be made uſe of.

In uſing a ſolution of indigo in fulphuric acid, the acid acts in different ways on the red ſubſtance employed; it produces little change in the colour of cochineal, already diſpoſed to a crimſon tinge by the aluming; but it ſhould give a fawn colour to madder, upon which acids readily produce this effect: and it does not ſeem probable, that that ſubſtance could be employed with advantage in this proceſs; it is better to employ it in dyeing ſtuff, which has already received a blue ground. Brazil and logwood too ſeem ill adapted to produce fine colours with the fulphuric ſolution of indigo, becauſe acids alſo change them yellow, though in a leſs diſtinct degree; but they retain their red colour, when their colouring particles are precipitated by oxide of tin, as has been already noticed.

Of the Mixture of Red and Yellow.—In treating of cochineal, we have deſcribed the principal ſhades obtained by the mixture of the red of this ſubſtance with yellow. Theſe ſhades may be infinitely varied by the different proportions of the ingredients, by the yellow ſubſtances made choice of, by the preparations given to the cloth, and by the mordants added to the dye bath. Mr. Poerner deſcribes a great many varieties, which he obtained by uſing weld, ſaw-wort, dyers-weed, and other yellows, and by employing in the preparation of the cloth, or in the bath, tartar, alum, ſulphate of zinc, or ſulphate of copper. Various colours may alſo be obtained from madder united with yellow ſubſtances. It is in this way, that mor-doré and cinnamon colours are produced; theſe colours are commonly made in two baths. We begin by the maddering, preceded by a boiling with alum and tartar, as for the common maddering, and give a weld bath afterwards. But for cinnamon colours, the maddering is weaker, and a bath which has ſerved for mor-doré is generally employed. The proportions are varied, according as the red or yellow is to prevail; ſometimes galls are added, and ſometimes the colour is darkened by means of a browning. Mr. Poerner has obtained many colours from madder mixed with ſaw-wort; he prepares the cloth with different mordants, but more eſpecially with alum and tartar; he alſo adds alum and tartar to the bath. When the quantity of either of theſe ſalts is conſiderable, the colour has an orange caſt, becauſe acids give the colour of madder a yellow hue; but if their quantity be but ſmall, a reddiſh yellow is obtained. He has procured reddiſh brown colours, by putting ſulphate of zinc or white vitriol into the dye.

It is alſo cuſtomary to employ brazil-wood with yellow ſubſtances, and ſometimes it is mixed with cochineal and madder. But when inſtead of weld or other yellow ſubſtances, walnut-tree root, walnut-peels, or ſumach, are employed, ſnuff, cheſnut, muſk colours, &c. are produced.

But marrones, cinnamons, and all the intermediate ſhades, are given to ſilk, by logwood, braſil, and fuſtic, for which the ſilk is ſcoured as uſual, alumed, and a bath prepared, by mixing decoctions of the three above-mentioned woods made ſeparately; the proportion of each is varied according to the ſhade required, but that of the fuſtic ought to prevail: this bath ſhould be of a moderate temperature. The ſilk is turned on the ſkein ſticks in the bath; and when it is taken out, if the colour be uniform, it is wrung and dipped in a ſecond bath of the three ingredients, the proportions of which are regulated according to the effect of the firſt bath, in order that the proper ſhade may be procured.

The cinnamon and mor-doré colours are given to thread and cotton, by beginning the proceſs for dyeing them with verdegris and weld; they are then dipped in a ſolution of ſulphate of iron, wrung and dried. When dry, they are galled in the proportion of three ounces of galls to the pound, dried again, alumed as for red, and maddered. When dyed and waſhed they are put into very warm ſoap ſuds, and turned until they are ſufficiently brightened; in the aluming, decoction of fuſtic is ſometimes added.

For ſome colours, blue is combined with red and yellow; it is thus that olives are made. A blue ground is firſt given, then the yellow dye, and laſtly, a ſlight maddering. The ſhade which reſults from this operation depends on the proportion of the three colours of which it is compoſed: a browning is given with a ſolution of ſulphate of iron, for the more deep ſhades. Mr. Poerner combines blue with yellow and red, by uſing the ſolution of indigo in the ſulphuric acid, to which he adds alkali. He prepares a bath with cochineal and fuſtic, adds the ſolution of indigo, and dyes the cloth in it after it has been alumed. He alſo makes a bath with fuſtic and brazil-wood, to which he adds tartar or alum, and in this way obtains different colours inclining more or leſs to blue, red, or green.

But the blue vat is not employed to produce olives in ſilk, which, after the aluming, is dipped in a very ſtrong weld bath; to this, juice of logwood is afterwards added, and when the ſilk is dipped, a little ſolution of alkali is put in, which turns it green, and makes the ſilk take an olive colour. The ſilk is dipped in this bath afreſh, until it has acquired the proper ſhade. For the colour which is called *olive rouſſe*, or rotten olive, fuſtic and logwood, but no alkali, are added to the bath after the welding: if it be intended that the colour ſhould have a more red caſt, only logwood is added. A kind of reddiſh olive is alſo made, by dyeing the ſilk in a bath of fuſtic, into which more or leſs ſulphate of iron and logwood have been introduced.

A fine olive is given to thread and cotton, as D'Apligny has obſerved, by boiling four parts of weld and one of pot-aſh in a ſufficient quantity of water; brazil-wood which has been ſteeped over night, is boiled ſeparately with a little verdegris; theſe two ſolutions are mixed in different proportions according to the ſhade required, and the cotton or thread afterwards dipped into the liquor.

Of Shades reſulting from a Mixture of Black with other Colours, and of Brownings.—Browning is an operation which is neceſ-

fary to be defcribed in this place. In order to give a browning, ftuff which has been juft dyed, is dipped in a folution of fulphate of iron to which an aftringent has been added, and which confequently forms a *black bath;* more frequently, a fmall quantity of folution of iron is mixed with a bath of water, and more is added, till the dyed ftuff dipped in it has attained the fhade required: more rarely, fulphate of iron is added to the dye bath, but the defired effect is obtained with greater precifion, by dipping the dyed ftuff in a folution of fulphate of iron. Mr. Poerner often foaks the ftuff in a folution of fulphate of iron, to which he fometimes puts other ingredients, and when taken out of this mordant, it is dipped in the dye bath. The firft mode is ufed for marrones, coffee, damafcene colours, and other fhades of browns of the common dye; a more or lefs deep colour is given them, according to the fhade to be obtained by the browning; a bath is then made with galls, fumach, and alder bark, with the addition of fulphate of iron. The ftuffs intended for the lighteft fhades are dipped firft; and when they are finifhed, the browner ones are dipped, fulphate of iron being added in proper proportion in each operation.

It may be obferved, that the other brownings have nothing peculiar in the procefs.

It has been feen already, that for feveral kinds of gray, a flight blue ground was given. Mr. Poerner makes blueifh grays, by employing the folution of indigo in fulphuric acid, which he adds to a mixture of decoction of galls and fulphate of iron, varying the fhades by the different proportions of thefe three ingredients: and he procures other fhades by adding fulphate of iron to a bath conftituted of cochineal, fuftic, and galls. But marrone, and the colours which border upon it, are made with faunders, galls, and a browning, and fometimes logwood is added: thefe colours are fometimes made to incline towards purple and crimfon, by dyeing them in the remains of a cochineal bath, or by putting a little madder or cochineal into the bath; by a little tartar the colour is rendered lighter. For hazel colours, galls, fuftic, and logwood muft be mixed, and more or lefs madder, with a little alum, are to be put in.

In order to produce a violet colour, Mr. Guhliche alums a pound of woollen ftuff in a folution of two ounces of alum; he makes a bath with an ounce of cochineal, and adds an equal quantity of folution of iron, in which he keeps the ftuff until it has acquired a proper fhade. Lilacs may be dyed with the remainder. If a colour with lefs of a brown caft be required, a fmall quantity of folution of iron is employed, and an ounce of nitre muft be introduced. Brazil-wood, the colour of which has been extracted by means of the aceto-citric or nitro muriatic acid, may alfo be employed in the fame manner.

A puce colour may be obtained from madder, giving a pound of woollen ftuff a boiling in a mixture compofed of two ounces of alum, a certain quantity of vinegar, and folution of iron. After a quarter of an hour's ebullition, it is left twelve hours in the mordant. A bath is made with the decoction of two ounces of white galls poured off clear from the fediment, in which four ounces of good madder are mixed; and when it begins to grow hot, the ftuff is dipped when taken out of the mordant, and fuffered to remain there, gradually increafing the heat, until it has taken the defired colour; it is then boiled for two minutes, wafhed and dried in the fun. The colour obtained by this procefs is very durable. If the alum and vinegar of the mordant be omitted, a deeper brown is produced: after thefe colours the lighter fhades are dyed.

It is alfo found, that brafil and logwood employed in equal quantities, or in other proportions, give different brown colours of tolerable durability, when more or lefs folution of iron is mixed with a decoction of them, and the wool previoufly alumed and galled, is dyed in it; thefe colours have not, however, the durability of the former. Various fhades of mor-doré and capucine may be given to the above colours, by dipping them as foon as taken out of the dye, in a bath compofed of annotta.

A purple violet, without a blue ground, is given to filk in this way by Guhliche; he mixes one part of folution of galls in white wine, with three parts of water, in which he macerates a pound of filk for twelve hours, foaks it in a mordant compofed of two ounces of alum, one ounce of folution of tin, and half an ounce of muriatic acid; after it has been wrung, he dyes it in a bath prepared with two ounces of cochineal and a little folution of iron, until it have taken the defired fhade: for dyeing lighter fhades, the refidua of thefe baths may be ufed, either feparately or in union. Madder is ufed by him in the fame way, macerating for twelve hours a pound of filk in a folution of two ounces of alum mixed with an ounce of muriatic acid, and a certain quantity of folution of iron; when wrung, he dyes it in a bath prepared with eight ounces of madder. If deeper colours are to be obtained to the madder and cochineal baths fome of the folution of galls in white wine is to be added. He alfo dyes filk, foaked in a folution of two ounces of alum and an ounce of muriatic acid, in a bath compofed of equal parts of brafil and logwood juice, with the addition of a certain quantity of folution of iron; and to render the colour deeper, folution of galls muft be put in. In order to make thefe colours incline to mordoré and capucine, folution of tin is to be added to the above baths. Brick colours are made by dipping the filk, prepared with folution of galls mixed with a certain quantity of folution of iron, in a bath compofed of annotta. Various fhades are obtained by the mixture of brafil, logwood, archil, and galls, and by a browning with fulphate of iron; but they are all more or lefs difpofed to fade, though they have a brightnefs which is very pleafing.

The bath which is diftinguifhed by the name of black cafk, is employed to give thread and cotton a great number of dark colours. In order to give a durable violet to thread and cotton, they are fcoured in the ufual way; a mordant is prepared, compofed of two parts of the bath of the black cafk, and four quarts of water for every pound; this is made to boil, and the fcum which forms on its furface is removed; when no more appears, the liquor is poured into a vat, and when it is juft warm, four ounces of fulphate of copper and an ounce of falt petre are diffolved in it; the fkeins are then left in it to foak for ten or twelve hours, wrung and dried. When they are to be maddered, they are carefully wafhed and dipped in a madder bath. If a deep violet be required, two ounces of verdegris are added to the bath; the colour is rendered ftill deeper by galling the thread more or lefs, before it is put into the mordant, and by omitting the falt-petre. But if the proportion of this laft be increafed, and that of the fulphate of copper be diminifhed, the violet inclines more to lilac.

It is evident, that when a ftuff which has received a colour, is dipped in a black bath more or lefs diluted, the effect produced is fimple; it is a fhade of black more or lefs deep, which is united to the primary colour. But this is not the cafe when the coloured ftuff is dipped in a folution of iron; for then, the colouring particles which were attached to the ftuff, act upon the fulphate of iron, take up a part of its oxide, and combine with it and the ftuff: the colour which refults from this union is more or lefs deep, not according to the colour which is proper to the colouring particles, but chiefly, according to the action which they exert on the metallic oxide, agreeably to the principles which have been laid down: thus the brafil and logwood which enter into the compofition of a colour, will produce a much more remarkable effect in the browning, than madder or cochineal; galls and fumach will

produce a ſtill more conſiderable one, though they only affected the original colour by the production of a ſhade of the fawn-coloured kind. If, however, a black bath be prepared, or a black dye produced, either in the mordant, or in the dye bath, the ingredients that are mixed with the colouring ſubſtances will influence the reſult of the operation by the action they exert on the black particles; thus alum, ſolution of tin, and ſolution of indigo, will weaken the effect which the black particles would have produced. All the acids will act in the ſame manner, except the acetous, and perhaps ſome other vegetable acids which have not the property of diſſolving the black particles. Nitre alſo ſeems capable of diſſolving them, as the colours in which it is employed are rendered lighter.

As it is evident, that the beſt colours which can be given to thread and cotton are obtained from madder, the different means mentioned in treating of that ſubſtance for rendering this dye more durable ſhould be attended to, and by different black baths the colour may be made darker. In producing ſome hazels and ſnuff colours, a browning with ſoot is given, after the welding and madder bath, to which galls and fuſtic have been added; ſoot is ſometimes mixed with this bath, and a browning is alſo given with a ſolution of ſulphate of iron; walnut peels are alſo ſometimes ſubſtituted for ſolutions of iron in browning colours. It is evident, therefore, that a great variety of ſhades may be produced by ſlight alterations in the methods and ſubſtances employed in the proceſs of browning.

Dyeing *of Hats*. See Hats.

Dyeing *of Leather*. See Leather.

Dyeing, or *Staining*, of paper, wood, bone, marble, &c. See Bone, Marble, Paper, Wood, &c.

DYNASTY, among ancient hiſtorians, ſignifies a race or ſucceſſion of kings of the ſame line or family. Such were the dynaſties of Egypt. The word is formed from the Greek δυναςεια of δυναςευω, *to be powerful*, or *a king*. The Egyptians reckon 30 dynaſties within the ſpace of 5,300 years; but the generality of chronologers look upon them as fabulous. And it is very certain, that theſe dynaſties are not continually ſucceſſive, but collateral.

DYSÆ, in mythology, inferior goddeſſes among the Saxons, being the meſſengers of the great Woden, whoſe province it was to convey the ſouls of ſuch as died in battle to his abode, called *Valhall*, i. e. the hall of ſlaughter; where they were to drink with him and their other gods *cerevifia*, or a kind of malt liquor, in the ſkulls of their enemies. The *Dyſæ* conveyed thoſe who died a natural death to *Hela*, the goddeſs of hell, where they were tormented with hunger, thirſt, and every kind of evil.

DYSART, a parliament town of Scotland, in the county of Fife, ſituated on the northern ſhore of the frith of Forth, about 11 miles north of Edinburgh.

DYSCRASY, among phyſicians, a term which denotes a bad habit of body, or ſtate of the humours, as in the ſcurvy, jaundice, &c.

DYSENTERY, in medicine, a diarrhœa or flux, wherein the ſtools are mixed with blood, and attended with great pain in the bowels. See Medicine.

DYSOREXY, among phyſicians, denotes a want of appetite, proceeding from a weak ſtomach.

DYSPEPSY, a difficulty of digeſtion. See Medicine.

DYSPNOEA, a difficulty of breathing, uſually called *aſthma*. See Medicine.

DYSURY, in medicine, a difficulty of making urine, attended with a ſenſation of ſcalding and pain. See Medicine.

DYTISCUS, the water-beetle, in zoology, a genus of inſects of the order of coleoptera; the antennæ of which are ſlender and ſetaceous, and the hind feet are hairy, and formed for ſwimming. There are 23 ſpecies, diſtinguiſhed by their antennæ, the colour of the elytra, &c. See Plate 2. The larvæ of the dytiſcus are often met with in water. They are oblong, and have ſix ſcaly feet. The body conſiſts of eleven ſegments. The head is large, with four filiform antennæ and a ſtrong pair of jaws. The laſt ſegments of the body have rows of hairs on the ſides; and the abdomen is terminated by two ſpines charged with the like hairs, forming a kind of plumes. Theſe larvæ are frequently of a greeniſh variegated brown: they are lively, active, and extremely voracious: they devour and feed upon other water-inſects, and often tear and deſtroy each other. The perfect inſect is little inferior to its larvæ in voraciouſneſs, but it can only exerciſe its cruelty on the larvæ; the perfect inſects, like himſelf, being ſheltered by the kind of ſcaly cuiraſs with which they are armed. This creature muſt be touched cautiouſly; for beſides its power of giving a ſevere gripe with its jaws, it has, moreover, under the thorax, another weapon, a long ſharp ſpine, which it will drive into one's fingers by the effort it makes to move backwards. The eggs of the dytiſci are rather large, and are by them incloſed in a kind of ſilky duſkiſh cod, of a ſtrong and thick texture, in form round, and terminated by a long appendix or ſlender tail, of the ſame ſubſtance. Theſe cods are often found in the water, and from them are brought forth the eggs and larvæ of the dytiſci. The ſtrength of theſe cods probably ſerves the inſect to defend their eggs from the voraciouſneſs of ſeveral other aquatic inſects, and even from that of their fellow-dytiſci, who would not ſpare them.

Many ſpecies of the perfect inſect are common in ſtagnated waters, which they quit in the evenings to fly about. They ſwim with incredible agility, making uſe of their hinder legs after the faſhion of oars. The elytra of the females are in general furrowed, and thoſe of the male plain. When they firſt arrive at their perfect ſtate, their elytra are almoſt tranſparent, and in many ſpecies of a beautiful dun colour, mingled with ſhades of a greeniſh brown. The beſt method of catching them is with a hand-net or ſieve; for they are ſo nimble, and exerciſe their defenſive weapons ſo often, and with ſuch painful ſucceſs to thoſe who endeavour to catch them, that they are very often obliged to let them eſcape; the eaſieſt way to kill them, is to let them fall into boiling hot water, which inſtantly deſtroys them.

E.

E, THE fecond vowel, and fifth letter of the alphabet. The letter E is moft evidently derived from the old character ᴲ in the ancient Hebrew and Phœnician alphabets, inverted by the Greeks to this pofition E, and not from the Hebrew He ה. From the fame origin is alfo derived the Saxon *e*, which is the firft letter in their alphabet that differs from the Latin one. It is formed by a narrower opening of the larynx than the letter A ; but the other parts of the mouth are ufed nearly in the fame manner as in that letter.

It has a long and fhort found in moft languages. The fhort found is audible in *bed*, *fret*, *den*, and other words ending in confonants: its long found is produced by a final *e*, or an *e* at the end of words ; as in *glebe*, *here*, *hire*, *fcene*, *fphere*, *interfere*, *revere*, *fincere*, &c. in moft of which it founds like *ee* ; as alfo in fome others by coming after *i*, as in *believe*, *chief*, *grief*, *reprieve*, &c. and fometimes this long found is expreffed by *ee*, as in *bleed*, *beer*, *creed*, &c. Sometimes the final *e* is filent, and only ferves to lengthen the found of the preceding vowel, as in *rag*, *rage*, *flag*, *ftage*, *hug*, *huge*, &c. The found of *e* is obfcure in the following words, *oxen*, *heaven*, *bounden*, *fire*, *maffacre*, *maugre*, &c.

The Greeks have their long and fhort *e*, which they call *epfilon* and *eta*. The French have at leaft fix kinds of *e*'s : the Latins have likewife a long and fhort *e* ; they alfo write *e* inftead of *a*, as *dicem* for *dicam*, &c. and this is no doubt the reafon why *a* is fo often changed into *e* in the preter tenfe, as, *ago*, *egi* ; *facio*, *feci*, &c.

As a numeral, E ftands for 250, according to the verfe,

E, quoque ducentos et quinquaginta tenebit.

In mufic it denotes the tone *e-la-mi*. In the kalendar it is the fifth of the dominical letters ; and in fea-charts it diftinguifhes all the eafterly points : thus, E alone denotes Eaft ; and E. by S. and E. by N. Eaft by South, and Eaft by North.

EACHARD (John), an Englifh divine of great learning and wit in the 17th century, bred at Cambridge, author (in 1670) of *The Grounds and Occafions of the Contempt of the Clergy and Religion enquired into.* In 1675 he was chofen mafter of Catharine hall upon the deceafe of Dr. John Lightfoot ; and the year following was created D. D. by royal mandate. He died in 1696.

Eachard (Laurence), an eminent Englifh hiftorian of the 18th century, nearly related to Dr. John Eachard. He was the fon of a clergyman, who, by the death of his elder brother, became mafter of a good eftate in Suffolk. He was educated in the univerfity of Cambridge, entered into holy orders, and was prefented to the living of Welton and Elkington in Lincolnfhire, where he fpent above twenty years of his life, and diftinguifhed himfelf by his writings, efpecially his Hiftory of England, which was attacked by Dr. Edmund Calamy and by Mr. John Oldmixon. His " General Ecclefiaftical Hiftory from the Nativity of Chrift to the firft Eftablifhment of Chriftianity by Human Laws under the Emperor Conftantine the Great," has paffed through feveral editions. He was inftalled archdeacon of Stowe and prebend of Lincoln in 1712. He died in 1730.

EADMERUS, a popular hiftorian, was an Englifhman ; but his parents, and the particular time and place of his nativity, are not known. He received a learned education, and very early difcovered a tafte for hiftory, by recording every remarkable event that came to his knowledge. Eadmerus is moft worthy of the grateful remembrance of pofterity for his hiftorical works, particularly for his excellent hiftory of the affairs of England in his own time, from A. D. 1066 to A. D. 1122 ; in which he hath inferted many original papers, and preferved many important facts, that are no where elfe to be found. This work hath been highly commended, both by ancient and modern writers, for its authenticity, as well as for regularity of compofition and purity of ftyle. It is indeed more free from legendary tales than any other works of this period ; and it is impoffible to perufe it with attention, without conceiving a favourable opinion of the learning, good fenfe, fincerity, and candour of its author.

EAGLE, in ornithology. See Falco.

Eagle, in heraldry, is accounted one of the moft noble bearings in armoury ; and, according to the learned in this fcience, ought to be given to none but fuch as greatly excel in the virtues of generofity and courage, or for having done fingular fervices to their fovereigns ; in which cafes they may be allowed a whole eagle, or an eagle naiffant, or only the head or other parts thereof, as may be moft conformable to their exploits. The eagle has been borne, by way of enfign or ftandard, by feveral nations. The firft who feem to have affumed the eagle are the Perfians, according to the teftimony of Xenophon. Afterwards, it was taken by the Romans ; who, after a great variety of ftandards, at length fixed on the eagle, in the fecond year of the confulate of C. Marius : till that time, they ufed indifferently wolves, leopards, and eagles, according to the humour of the commander. The Roman eagles, it muft be obferved, were not painted on a cloth or flag ; but were figures in relievo, of filver or gold, borne on the tops of pikes ; the wings being difplayed, and frequently a thunder-bolt in their talons. Under the eagle on the pike, were piled bucklers, and fometimes crowns. Thus much we learn from the medals.

Conftantine is faid to have firft introduced the eagle with two heads, to intimate, that though the empire feemed divided, it was yet only one body. Others fay, that it was Charlemagne who refumed the eagle as the Roman enfign, and added to it a fecond head ; but that opinion is deftroyed, by an eagle with two heads, noted by Lipfius, on the Antonine column ; as alfo by the eagle's only having one head on the feal of the golden bull of the emperor Charles IV. The conjecture, therefore, of F. Meneftrier appears more probable, who maintains, that as the emperors of the Eaft, when there were two on the throne at the fame time, ftruck their coins with the impreffion of a crofs, with a double traverfe, which each of them held in one hand, as being the fymbol of the Chriftians ; the like they did with the eagle in their enfigns ; and inftead of doubling their eagles, they joined them together, and reprefented them with two heads : in which they were followed by the emperors of the Weft. F. Papebroche wifhes that this conjecture of Meneftrier were confirmed by ancient coins ; without which, he rather inclines to think the ufe of the eagle with two heads to be merely arbitrary ; though he grants it probable, that it was firft introduced on occafion of two emperors in the fame throne.

The eagle on medals, according to M. Spanheim, is a fymbol of divinity and providence ; and, according to all other anti-

quities, of empire. The princes on whose medals it is most usually found, are the Ptolemies and the Seleucides of Syria. An eagle with the word CONSECRATIO, expresses the apotheosis of an emperor.

EAGLES, a name found very frequently in the ancient histories of Ireland, and used to express a sort of base money that was current in that kingdom in the first years of the reign of Edward I. that is, about the year 1272. There were, besides the eagles, leonines, rosades, and many other coins of the same sort, named according to the figures they were impressed with. The current coin of the kingdom was at that time a composition of copper and silver, in a determined proportion; but these were so much worse than the standard proportion of that time, that they were not intrinsically worth quite half so much as the others. They were imported out of France and other foreign countries. When this prince had been a few years established on the throne, he set up mints in Ireland for the coining sufficient quantities of good money, and then decried the use of these eagles, and other the like kinds of base coins, and made it death, with confiscation of effects, to import any more of them into the kingdom.

EAGLE, in astronomy, is a constellation of the northern hemisphere, having its right wing contiguous to the equinoctial. See AQUILA. There are also three several stars, particularly denominated among the Arab astronomers, *nasr*, i. e. "eagle." The first, *nasr sohail*, "the eagle of Canopus," called also *sitareh jemen*, the star of Arabia Felix, over which it is supposed to preside; the second, *nasr althair*, the "flying eagle;" and the third, *nasr alvake*, the "resting eagle."

White EAGLE, is a Polish order of knighthood, instituted in 1325 by Uladislaus V. on marrying his son Casimere with a daughter of the great-duke of Lithuania. The knights of this order were distinguished by a gold chain, which they wore on the stomach, whereon hung a silver eagle crowned.

Black EAGLE, was a like order, instituted in 1701 by the elector of Brandenburgh, on his being crowned king of Prussia. The knights of this order wear an orange-coloured ribbon, to which is suspended a black eagle.

EAGLE, in architecture, is a figure of that bird anciently used as an attribute, or cognizance of Jupiter, in the capital and friezes of the columns of temples consecrated to that god.

EAGLE-*flower*. See BALSAMINE.

EAGLE-*stone*, in natural history, a stone, by the Greeks called *ætites*, and by the Italians *pietra d'aquila*, as being supposed to be sometimes found in the eagle's nest. It is of famous traditionary virtue, either for forwarding or preventing the delivery of women in labour, according as it is applied above or below the womb. Matthiolus tells us, that birds of prey could never hatch their young without it, and that they go in search of it as far as the East Indies. Bausch has an express Latin treatise on the subject. See ÆTITES.

EAGLET, a diminutive of eagle, properly signifying a young eagle. In heraldry, when there are several eagles on the same escutcheon, they are termed *eaglets*.

EALDERMAN, or EALDORMAN, among the Saxons, was of like import with earl among the Danes. The word was also used for an elder, senator, or statesman. Hence, at this day, we call those *aldermen* who are associates to the chief officer in the common-council of a city or corporate town.

EAR, in anatomy. See ANATOMY. Several naturalists and physicians have held, that cutting off the ear rendered persons barren and unprolific; and this idle notion was what first occasioned the legislators to order the ears of thieves, &c. to be cut off, lest they should produce their like.

The ear has its beauties, which a good painter ought by no means to disregard; where it is well formed, it would be an injury to the head to be hidden. Suetonius insists, particularly, on the beauties of Augustus's ears; and Ælian, describing the beauties of Aspasia, observes, she had short ears. Martial also ranks large ears among the number of deformities. Among the Athenians, it was a mark of nobility to have the ears bored or perforated. And among the Hebrews and Romans, this was a mark of servitude.

The loss of one ear is a punishment enacted by 5 and 6 Edw. VI. cap. 4. for fighting in a church-yard; and by 2 and 3 Edw. VI. cap. 15. for combinations to raise the price of provisions, labour, &c. if it be the third offence, beside pillory, and perpetual infamy, or a fine of 40l. By a statute of Henry VIII. maliciously cutting off the ear of a person is made a trespass, for which treble damages shall be recovered; and the offender is to pay a fine of ten pounds to the king, 37 Hen. VIII. cap. 6. § 4. In the index to the Statutes at Large, it is said, that this offence may be punished as felony, by 22 and 23 Car. II. cap. 1. § 7. commonly called the *Coventry Act*; but the ear is not mentioned in that statute.

EAR *of Fishes*. See COMPARATIVE *Anatomy*.

EAR, in music, denotes a kind of internal sense, whereby we perceive and judge of harmony and musical sounds. See MUSIC. In music we seem universally to acknowledge something like a distinct sense from the external one of hearing; and call it a *good ear*. And the like distinction we should probably acknowledge in other affairs, had we got distinct names to denote these powers of perception by. Thus a greater capacity of perceiving the beauties of painting, architecture, &c. is called a *fine taste*.

EAR is also used to signify a long cluster of flowers, or seeds, produced by certain plants; usually called by botanists *spica*. The flowers and seeds of wheat, rye, barley, &c. grow in ears. The same holds of the flowers of lavender, &c. We say the stem of the ear, i. e. its tube or straw; the knot of the ear; the lobes or cells wherein the grains are inclosed; the beard of the ear, &c.

EAR-*Pick*, an instrument of ivory, silver, or other metal, somewhat in form of a probe, for cleansing the ear. The Chinese have a variety of these instruments, with which they are mighty fond of tickling their ears; but this practice, Sir Hans Sloane observes, must be very prejudicial to so delicate an organ, by bringing too great a flow of humours on it.

EAR-*Ring*. See PENDENT.

EAR-*Wax*. See CERUMEN.

EARWIG, in zoology. See FORFICULA.

EARING, in sea language, is that part of the bolt-rope which at the four corners of the sail is left open, in the shape of a ring. The two uppermost parts are put over the ends of the yard-arms, and so the sail is made fast to the yard; and into the lower-most earings, the sheets and tacks are seized or bent at the clew.

EARL, a British title of nobility, next below a marquis, and above a viscount. The title is so ancient, that its original cannot be clearly traced out. This much, however, seems tolerably certain, that among the Saxons they were called *ealdormen*, *quasi* elder men, signifying the same with *senior* or *senator* among the Romans; and also *schiremen*, because they had each of them the civil government of a several division or shire. On the irruption of the Danes they changed their names to *eorels*, which, according to Camden, signified the same in their language. In Latin they are called *comites* (a title first used in the empire), from being the king's attendants; *à societate nomen sumpserunt, regis enim tales sibi associant*. After the Norman conquest they were for some time called *counts*, or *countees*, from the French; but they did not long retain that name themselves, though their shires are from thence called *counties* to this day. It is now become a mere title: they have nothing to do with the government of the county; which is

now entirely devolved on the ſheriff, the earl's deputy, or *vicecomes*. In writs, commiſſions, and other formal inſtruments, the king, when he mentions any peer of the degree of an earl, uſually ſtyles him, "truſty and well-beloved *couſin*:" an appellation as ancient as the reign of Henry IV.; who being either by his wife, his mother, or his ſiſters, actually related or allied to every earl in the kingdom, artfully and conſtantly acknowledged that connection in all his letters and other public acts; whence the uſage has deſcended to his ſucceſſors, though the reaſon has long ago failed. An earl is created by cincture of ſword, mantle of ſtate put upon him by the king himſelf, a cap and a coronet put upon his head, and a charter in his hand.

Earl-*Marſhal*. See Marshal.

EARNEST (arrhæ), money advanced to bind the parties to the performance of a verbal bargain. By the civil law, he who recedes from his bargain loſes his earneſt, and if the perſon who received the earneſt give back, he is to return the earneſt double. But with us, the perſon who gave it is in ſtrictneſs obliged to abide by his bargain; and in caſe he decline it, is not diſcharged upon forfeiting his earneſt, but may be ſued for the whole money ſtipulated.

EARTH, among ancient philoſophers, ſignified one of the four elements of which the whole ſyſtem of nature was thought to be compoſed. But at preſent no elementary earth is acknowledged by the chemiſts. See Element.

Earths, in chemiſtry, are defined by Cronſtedt to be ſuch ſubſtances as are not ductile, moſtly indiſſoluble in water or oil, and that preſerve their conſtitution in a ſtrong heat. Mr. Bergman remarks that they are inſipid, and not ſoluble in 1000 times their weight of boiling water; though, by augmenting the heat as in Papin's digeſter, perhaps all the kinds we are yet acquainted with may be found capable of ſolution, eſpecially when precipitated from ſome other menſtruum; their ſurface being then greatly augmented. In the chain of nature they proceed by an inſenſible gradation towards the ſalts, ſo that they cannot be ſeparated but by artificial limits. A moderate heat does not change their form, nor are they diſſipated by a more violent one. Dr. Black defines them to be ſuch bodies as are not ſoluble in water, not inflammable, and their ſpecific gravity not more than four times the weight of water. They are diſtinguiſhed from the ſalts by their inſolubility; from the inflammables, by their want of inflammability; and from the metals, by their deficiency in weight. Some objections have been made to this definition, as not being ſtrictly applicable to thoſe earths which are known to be ſoluble in water: but this objection may be accounted of little weight, when we conſider the extreme diſparity betwixt the ſolubility of the earths and ſalts, a few grains of the earths ſaturating ſome pounds of water; ſo that if they have any ſolubility, they muſt be allowed to poſſeſs but a very ſmall ſhare of it.

Another property, which is not uſually taken into the definition, makes neverthelesſ a remarkable part of the character of earthy bodies, viz their great fixedneſs in the fire. All the other claſſes of bodies ſhow themſelves volatile in more or leſs violent degrees of heat. All the ſalts can be made to evaporate; all the inflammable ſubſtances are volatile; all the metals, gold not excepted, have been converted into vapour; but the earths, as far as we know, have never been volatilized, excepting only two, the diamond and aſbeſtos. Some phenomena attending the volatilization of the diamond give reaſon to ſuſpect that it is not a pure earthy ſubſtance. There is an appearance of inflammation; and it ſeems to be a compound, having an earthy matter for its baſis, and deriving its volatility from other matters. In general, therefore, the earths have been found fixed in any degree of heat of which we have had experience; though there is no doubt a poſſibility, that heat might be raiſed to ſuch an intenſity as to volatilize the moſt fixed body in nature; but till the means of doing ſo ſhall be found out, the earths may be conſidered as abſolutely fixed.

The earths called *primitive* or *ſimple*, becauſe they cannot be decompoſed by any method hitherto known, were by Cronſtedt ſuppoſed to be nine; but later chemiſts have reduced them to five. Some reduce the number ſtill farther; but Mr. Bergman informs us that theſe "reſt their opinions upon fanciful metamorphoſes unſupported by faithful experiments." As experiments teach us that there are five primitive earths, it is evident that the ſpecies ariſing from their mixture cannot exceed 24, viz. ten double, conſiſting of two earths; ſix triple, three quadruple, and the five primitive earths. Even all theſe different mixtures have not been found, though they probably do exiſt in nature. The natural compoſitions of acids with the earths, forming ſubſtances not ſoluble in 1000 times their weight of boiling water, and which may be called *ſaline earths*, are undoubtedly chemical combinations. The five primitive earths are, terra ponderoſa; calx or calcareous earth, capable of being reduced into quicklime; magneſia; argillaceous earth or alumine; and ſiliceous earths. "But though we muſt conſider theſe as the moſt pure of all the earthy bodies, they are never found native in a ſtate of abſolute purity; nor indeed can they be made perfectly pure even by artificial means. Water and aërial acid unite readily with the four firſt; and when expelled by fire, a little of the matter of heat is added, until driven out by a more powerful attraction. But in this ſtate they poſſeſs a degree of purity not to be attained by any other known method. Therefore it is neceſſary to examine them when ſufficiently burnt, in order to diſtinguiſh better what properties depend upon adhering heterogeneous matters."

Bergman at firſt added the earth of gems to the five claſſes already mentioned; but he found afterwards that all kinds of gems are compounded of ſome of the five kinds already mentioned, particularly of the argillaceous kind, inſomuch that they may be ſaid almoſt entirely to belong to this claſs. Still, however, the earth of diamonds ſeems to poſſeſs properties eſſentially diſtinct from the five already mentioned, and therefore may not unjuſtly be reckoned a ſixth claſs, though its characters have as yet been but very imperfectly examined. We ſhall mention,

I. *Terra Ponderoſa*. This was diſcovered in Sweden about the year 1774, and is found in theſe different forms. 1. Combined with aërial acid, called by Dr. Withering *terra ponderoſa aërata*. This ſubſtance has been met with in England. 2. The *ſpar-like gypſum*, marmor metallicum, lapis bononienſis, phoſphorus nativus, baro-ſelenite, &c. is of very conſiderable ſpecific gravity, approaching to that of tin or iron; on which account it has been ſuppoſed to contain ſomething metallic. But no experiments hitherto made have evinced the exiſtence of any metal in it, excepting a few traces of iron, which are to be met with in all the gypſa. It contains about 84 parts of ponderous earth, 13 of the moſt concentrated ſulphuric acid, and three of water. 3. The *marmor metallicum druſicum*, or ponderous druſen ſpar, is found in the lead-mines at Alſtonmoor in Cumberland, regularly cryſtallized in the form of alum, ſolid, and ſemitranſparent. It ſeems to affect the peculiarity of having its cryſtals laminated, as radiating from a centre; but this radiation ſeldom amounts to a whole circle. Their ſpecific gravity is, to water, as 44,745 to 10,000. This ſpecies of cryſtals is found at Auvergne in France. 4. The *lapis hepaticus*, or leberſtein of the Germans and Swedes. Some ſpecimens of this ſtone conſtantly ſmell like liver of ſulphur, but others only when rubbed. It does not efferveſce with acids, and, according to M. Magellan, is a medium between the gypſum and fetid calcareous ſtones, with which it has generally been confounded; but it will not yield any lime, though the latter are more fit for the purpoſe than any other.

The calcareous earth, according to Cronſtedt, is common to all the three kingdoms of nature; exiſting in the ſhells and bones of animals, the aſhes of vegetables; "and conſequently," ſays he, "it muſt have exiſted before any living or vegetable ſubſtance, and is no doubt diſtributed throughout the earth in a quantity proportioned to its general uſe." The uſual forms in which calcareous earth is met with are the ſhells of animals, chalk, limeſtone, and marble; for an account of which ſee theſe different articles; alſo vol. 2, page 423, of the Treatiſe on CHEMISTRY. Its uſes as a manure, and in building, are detailed under the articles CEMENT and HUSBANDRY. Meſſrs. Sage, Romé de l'Iſle, &c. have ſuppoſed the exiſtence of a kind of earth called *abſorbent*, diſtinct from the calcareous; but M. Monnet has ſhown this to be truly calcareous.

III. *Magneſia*, called alſo by ſome writers *terra muriatica*, or magneſia alba. The nature and properties of this earth are deſcribed under the article CHEMISTRY, vol. 2, page 426.

IV. *Argillaceous Earths*, or *Alumine*. See CLAY.

V. *Siliceous Earths*. See CHEMISTRY, vol. 2, page 428, FLINT, GEMS, DIAMOND, EMERALD, SAPPHIRE, &c.

EARTH, in geography, one of the primary planets; being this terraqueous globe which we inhabit, conſiſting of land and ſea. The *coſmogony*, or knowledge of the original formation of the earth, the materials of which it is compoſed, and by what means they were diſpoſed in the order in which we ſee them at preſent, is a ſubject which, though perhaps above the reach of human ſagacity, has exerciſed the wit of philoſophers in all ages. To recount the opinions of all the eminent philoſophers of antiquity upon this ſubject would be very tedious: it may therefore ſuffice to obſerve, that ever ſince the ſubject began to be canvaſſed, the opinions of thoſe who have treated it may be divided into two claſſes. 1. Thoſe who believed the earth and whole viſible ſyſtem of nature to be the Deity himſelf, or connected with him in the ſame manner that a human body is with its ſoul. 2. Thoſe who believed the materials of it to have been eternal, but diſtinct from the Deity, and put into the preſent order by ſome power either inherent to themſelves or belonging to the Deity. Of the former opinion were Zenophanes the founder of the *eleatic* ſect, Strato of Lampſacus, the Peripatetics, &c.

Figure of the EARTH. The ancients had various opinions as to the figure of the earth: ſome, as Anaximander and Leucippus, held it cylindrical, or in form of a drum: but the principal opinion was, that it was flat; that the viſible horizon was the bounds of the earth, and the ocean the bounds of the horizon; that the heavens and earth above this ocean were the whole viſible univerſe: and that all beneath the ocean was Hades: and of this ſame opinion were alſo ſome of the Chriſtian father, as Lactantius, St. Auguſtine, &c. See Lactan. lib. 3, cap. 24; St. Aug. lib. 16, de Civitate Dei; Ariſtotle de Cœlo, lib. 2, cap. 13.

Such of the ancients however as underſtood any thing of aſtronomy, and eſpecially the doctrine of eclipſes, muſt have been acquainted with the round figure of the earth; as the ancient Babylonian aſtronomers, who had calculated eclipſes long before the time of Alexander, and Thales the Grecian, who predicted an eclipſe of the ſun. It is now indeed agreed on all hands, unleſs perhaps by the moſt vulgar and ignorant, that the form of the terraqueous globe is globular, or very nearly ſo.

That the exterior of the earth is round, or rotund, is manifeſt to the moſt common perception, in the caſe of a ſhip ſailing either from the land, or towards it; for when a perſon ſtands upon the ſhore, and ſees a ſhip ſail from the land, out to ſea; at firſt he loſes ſight of the hull and lower parts of the ſhip, next the rigging and middle parts, and laſtly of the tops of the maſts themſelves, in every caſe the rotundity of the ſea between the ſhip and the eye being very viſible: the contrary happens when a ſhip ſails towards us; we firſt ſee the tops of the maſts appear juſt over the rotundity of the ſea: next we perceive the rigging, and laſtly the hull of the ſhip itſelf.

The round figure of the earth is alſo evident from the eclipſes of the ſun and moon; for in all eclipſes of the moon, which are cauſed by the moon paſſing through the earth's ſhadow, that ſhadow always appears circular upon the face of the moon, what way ſoever it be projected, whether eaſt, weſt, north, or ſouth, and howſoever its diameter vary, according to the greater or leſs diſtance from the earth. Hence it follows, that the ſhadow of the earth, in all ſituations, is really conical: and conſequently the body that projects it, i. e. the earth, is at leaſt nearly ſpherical.

The ſpherical figure of the earth is alſo evinced from the riſing and ſetting of the ſun, moon, and ſtars; all which happen ſooner to thoſe who live to the eaſt, and later to thoſe living weſtwardly; and that more or leſs ſo, according to the diſtance and roundneſs of the earth.

So alſo, going or ſailing to the northward, the north pole and northern ſtars become more elevated, and the ſouth pole and ſouthern ſtars more depreſſed; the elevation northerly increaſing equally with the depreſſion ſoutherly; and either of them proportionably to the diſtance gone. The ſame thing happens in going to the ſouthward. Beſides, the oblique aſcenſions, deſcenſions, emerſions, and amplitudes of the riſing and ſetting of the ſun and ſtars in every latitude, are agreeable to the ſuppoſition of the earth's being of a ſpherical form: all which could not happen if it were of any other figure.

Moreover, the roundneſs of the earth is farther confirmed by its having been often ſailed round: the firſt time was in the year 1519, when Ferd. Magellan made the tour of the whole globe in 1124 days. In the year 1557 Francis Drake performed the ſame in 1056 days: in the year 1586, Sir Thomas Cavendiſh made the ſame voyage in 777 days; Simon Cordes, of Rotterdam, in the year 1590, in 1575 days; in the year 1598, Oliver Noort, a Hollander, in 1077 days; Van Schouten, in the year 1615, in 749 days; Jac. Heremites and Joh. Huygens, in the year 1623, in 802 days: and many others have ſince performed the ſame navigation, particularly Anſon, Bougainville, and Cook; ſometimes ſailing round by the eaſtward, ſometimes to the weſtward; till at length they arrived again in Europe, from whence they ſet out; and in the courſe of their voyage, obſerved that all the phenomena, both of the heavens and earth, correſpond to, and evince this ſpherical figure.

The ſame globular figure is likewiſe inferred from the operation of levelling, in which it is found neceſſary to make an allowance for the difference between the apparent and the true level.

The natural cauſe of this ſphericity of the globe is, according to Sir Iſaac Newton, the great principle of attraction, which the Creator has ſtamped on all the matter in the univerſe; and by which all bodies, and all the parts of bodies, mutually attract one another.—And the ſame is the cauſe of the ſphericity of the drops of rain, quickſilver, &c.

What the earth loſes of its ſphericity by mountains and valleys, is nothing conſiderable; the higheſt eminence being ſcarce equivalent to the minuteſt protuberance on the ſurface of an orange. Its difference from a perfect ſphere however is more conſiderable in another reſpect, by which it approaches nearly to the ſhape of an orange, or to an oblate ſpheroid, being a little flatted at the poles, and raiſed about the equatorial parts, ſo that the axis from pole to pole is leſs than the equatorial diameter. What gave the firſt occaſion to the diſcovery of this figure of the earth, were the obſervations of ſome French and Engliſh philoſophers in the Eaſt-Indies, and other

parts, who found that pendulums, the nearer they came to the equator, performed their vibrations ſlower: from whence it follows, that the velocity of the deſcent of bodies by gravity, is leſs in countries nearer to the equator; and conſequently that thoſe parts are farther removed from the centre of the earth, or from the common centre of gravity. See the Hiſtory of the Royal Academy of Sciences, by Du Hamel, p. 110, 156, 206; and l'Hiſt. de l'Acad. Roy. 1700 and 1701.—This circumſtance put Huygens and Newton upon finding out the cauſe, which they attributed to the revolution of the earth about its axis. If the earth were in a fluid ſtate, its rotation round its axis would neceſſarily make it put on ſuch a figure, becauſe the centrifugal force being greateſt towards the equator, the fluid would there riſe and ſwell moſt; and that its figure really ſhould be ſo now, ſeems neceſſary, to keep the ſea in the equinoctial regions from overflowing the earth about thoſe parts. See this curious ſubject well treated by Huygens, in his diſcourſe De Cauſa Gravitatis, p. 154, where he ſtates the ratio of the polar diameter to that of the equator, as 577 to 578. And Newton, in his Principia, firſt publiſhed in 1686, demonſtrates, from the theory of gravity, that the figure of the earth muſt be that of an oblate ſpheroid generated by the rotation of an ellipſe about its ſhorteſt diameter, provided all the parts of the earth were of an uniform denſity throughout, and that the proportion of the polar to the equatorial diameter of the earth, would be that of 689 to 692, or nearly that of 229 to 230, or as ·9956522 to one.

This proportion of the two diameters was calculated by Newton in the following manner: Having found that the centrifugal force at the equator is $\frac{1}{289}$th of gravity, he aſſumes, as an hypotheſis, that the axis of the earth is to the diameter of the equator as 100 to 101, and thence determines what muſt be the centrifugal force at the equator to give the earth ſuch a form, and finds it to be $\frac{4}{505}$ths of gravity: then, by the rule of proportion, if a centrifugal force equal to $\frac{4}{505}$ths of gravity would make the earth higher at the equator than at the poles by $\frac{1}{100}$th of the whole height at the poles, a centrifugal force that is the $\frac{1}{289}$th of gravity will make it higher by a proportional exceſs, which by calculation is $\frac{1}{229}$th of the height at the poles; and thus he diſcovered that the diameter at the equator is to the diameter at the poles, or the axis, as 230 to 229. But this computation ſuppoſes the earth to be every where of an uniform denſity; whereas if the earth is more denſe near the centre, then bodies at the poles will be more attracted by this additional matter being nearer; and therefore the exceſs of the ſemi-diameter of the equator above the ſemi-axis, will be different. According to this proportion between the two diameters, Newton farther computes, from the different meaſures of a degree, that the equatorial diameter will exceed the polar by 34 miles and $\frac{1}{5}$.

Neverthеleſs, Meſſrs Caſſini, both father and ſon, the one in 1701, and the other in 1713, attempted to prove, in the Memoirs of the Royal Academy of Sciences, that the earth was an oblong ſpheroid; and in 1718, M. Caſſini again undertook, from obſervations, to ſhew that, on the contrary, the longeſt diameter paſſes through the poles; which gave occaſion for Mr. John Bernoulli, in his Eſſai d'une Nouvelle Phyſique Celeſte, printed at Paris in 1735, to triumph over the Britiſh philoſopher, apprehending that theſe obſervations would invalidate what Newton had demonſtrated. And in 1720, M. De Mairan advanced arguments ſuppoſed to be ſtrengthened by geometrical demonſtrations, farther to confirm the aſſertions of Caſſini. But in 1735 two companies of mathematicians were employed, one for a northern, and another for a ſouthern expedition, the reſult of whoſe obſervations and meaſurement plainly proved that the earth was flatted at the poles.

The proportion of the equatorial diameter to the polar, as ſtated by the gentlemen employed on the northern expedition for meaſuring a degree of the meridian, is as 1 to 0·9891; by the Spaniſh mathematicians as 266 to 265, or as 1 to 0·99624; by M. Bouguer as 179 to 178, or as 1 to 0·99441.

As to all concluſions however deduced from the length of pendulums in different places, it is to be obſerved that they proceed upon the ſuppoſition of the uniform denſity of the earth, which is a very improbable circumſtance; as juſtly obſerved by Dr. Horſley in his letter to Capt. Phipps: "You finiſh your article, he concludes, relating to the pendulum with ſaying, 'that theſe obſervations give a figure of the earth nearer to Sir Iſaac Newton's computation, than any others that have hitherto been made;' and then you ſtate the ſeveral figures given, as you imagine, by former obſervations, and by your own. Now it is very true, that *if* the meridians be ellipſes, or *if* the figure of the earth be that of a ſpheroid generated by the revolution of an ellipſis, turning on its ſhorter axis, the particular figure, or the ellipticity of the generating ellipſis, which your obſervations give, is nearer to what Sir Iſaac Newton ſaith it ſhould be, if the globe were homogeneous, than any that can be derived from former obſervations. But yet it is not what you imagine. Taking the gain of the pendulum in latitude 79° 50′ exactly as you ſtate it, the difference between the equatorial and the polar diameter is about as much leſs than the Newtonian computation makes it, and the hypotheſis of homogeneity would require, as you reckon it to be greater. The proportion of 212 to 211 ſhould indeed, according to your obſervations, be the proportion of the force that acts upon the pendulum at the poles, to the force acting upon it at the equator. But this is by no means the ſame with the proportion of the equatorial diameter to the polar. If the globe were homogeneous, the equatorial diameter would exceed the polar by $\frac{1}{230}$ of the length of the latter: and the polar force would alſo exceed the equatorial by the like part. But if the difference between the polar and equatorial force be greater than $\frac{1}{230}$, (which may be the caſe in an heterogeneous globe, and ſeems to be the caſe in ours), then the difference of the diameters ſhould, according to theory, be leſs than $\frac{1}{230}$, and vice verſa.

"I confeſs this is by no means obvious at firſt ſight; ſo far otherwiſe, that the miſtake, which you have fallen into, was once very general. Many of the beſt mathematicians were miſled by too implicit a reliance upon the authority of Newton, who had certainly confined his inveſtigations to the homogeneous ſpheroid, and had thought about the heterogeneous only in a looſe and general way. The late Mr. Clairault was the firſt who ſet the matter right, in his elegant and ſubtle treatiſe on the figure of the earth. That work hath now been many years in the hands of mathematicians, among whom I imagine there are none, who have conſidered the ſubject attentively, that do not acquieſce in the author's concluſions.

"In the 2d part of that treatiſe, it is proved, that putting P for the polar force, Π for the equatorial, δ for the true ellipticity of the earth's figure, and ε for the ellipticity of the homogeneous ſpheroid,

$$\frac{P-\Pi}{\Pi} = 2\varepsilon - \delta: \text{therefore } \delta = 2\varepsilon - \frac{P-\Pi}{\Pi};$$

and therefore, according to your obſervation, $\delta = \frac{1}{251}$. This is the juſt concluſion from your obſervations of the pendulum, taking it for granted, that the meridians are ellipſes: which is an hypotheſis, upon which all the reaſonings of theory have hitherto proceeded. But plauſible as it may ſeem, I muſt ſay, that there is much reaſon from experiment to call it in queſtion. If it were true, the increment of the force which actuates the pendulum, as we approach the poles, ſhould be as the ſquare

of the ſine of the latitude: or, which is the ſame thing, the decrement, as we approach the equator, ſhould be as the ſquare of the coſine of the latitude. But whoever takes the pains to compare together ſuch of the obſervations of the pendulum in different latitudes, as ſeem to have been made with the greateſt care, will find that the increments and decrements do by no means follow theſe proportions; and in thoſe which I have examined, I find a regularity in the deviation which little reſembles the mere error of obſervation. The unavoidable concluſion is, that the true figure of the meridians is not elliptical. If the meridians are not ellipſes, the difference of the diameters may indeed, or it may not, be proportional to the difference between the polar and the equatorial force; but it is quite an uncertainty, what relation ſubſiſts between the one quantity and the other; our whole theory, except ſo far as it relates to the homogeneous ſpheroid, is built upon falſe aſſumptions, and there is no ſaying what figure of the earth any obſervations of the pendulum give."

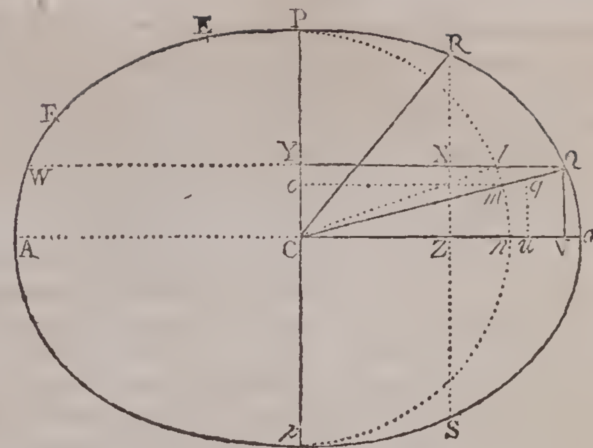
He then lays down the following table, which ſhews the different reſults of obſervations made in different latitudes; in which the firſt three columns contain the names of the ſeveral obſervers, the places of obſervation, and the latitude of each; the 4th column ſhews the quantity of $P-\Pi$ in ſuch parts as Π is 100000, as deduced from comparing the length of the pendulum at each place of obſervation, with the length of the equatorial pendulum as determined by M. Bouguer, upon the ſuppoſition that the increments and decrements of force, as the latitude is increaſed or lowered, obſerve the proportion which theory aſſigns. Only the 2d and the laſt value of $P-\Pi$ are concluded from compariſons with the pendulum at Greenwich and at London, not at the equator. The 5th column ſhews the value of δ correſponding to every value of $P-\Pi$, according to Clairault's theorem:

Obſervers.	*Places.*	*Latitudes.*		$P-\Pi$	δ
Bouguer	Equator	0°	0′		
Bouguer	Porto Bello	9	34	741·8	$\frac{1}{784}$
Green	Otaheitee	17	29	563·2	$\frac{1}{326}$
Bouguer	San Domingo	18	27	591·0	$\frac{1}{358}$
Abbé de la Caille	Cape of Good Hope	33	55	731·5	
- - - -	Paris	48	50	585·1	$\frac{1}{351}$
The Academicians	Pello	66	48	565·9	$\frac{1}{329}$
Capt. Phipps	- - - -	79	50	471·2	$\frac{1}{231}$

"By this table it appears, that the obſervations in the middle parts of the globe, ſetting aſide the ſingle one at the Cape, are as conſiſtent as could reaſonably be expected; and they repreſent the ellipticity of the earth as about $\frac{1}{340}$. But when we come within ten degrees of the equator, it ſhould ſeem that the force of gravity ſuddenly becomes much leſs, and within the like diſtance of the poles much greater than it could be in ſuch a ſpheroid."

The following problem, communicated by Dr. Leatherland to Dr. Pemberton, and publiſhed by Mr. Robertſon, ſerves for finding the proportion between the axis and the equatorial diameter, from meaſures taken of a degree of the meridian in two different latitudes, ſuppoſing the earth an oblate ſpheroid.

Let $APap$ be an ellipſe repreſenting a ſection of the earth through the axis Pp; the equatorial diameter, or the greater axis of the ellipſe, being Aa; let E and F be two places where the meaſure of a degree has been taken; theſe meaſures are proportional to the radii of curvature in the ellipſe at thoſe



places; and if CQ, CR be conjugates to the diameters whoſe vertices are E and F, CQ will be to CR in the ſubtriplicate ratio of the radius of curvature at E to that at F, by cor. 1, prop. 4, part 6 of Milnes's Conic Sections, and therefore in a given ratio to one another; alſo the angles QCP, RCP are the latitudes of E and F; ſo that, drawing QV parallel to Pp, and QXYW to Aa, theſe angles being given, as well as the ratio of CQ to CR, the rectilinear figure CVQXRY is given in ſpecies; and the ratio of VC^2-ZC^2 $(=QX\times XW)$ to RZ^2-QV^2 $=(RX\times XS)$ is given, which is the ratio of CA^2 to CP^2; therefore the ratio of CA to CP is given.

Hence, if the ſine and coſine of the greater latitude be each augmented in the ſubtriplicate ratio of the meaſure of the degree in the greater latitude to that in the leſſer, then the difference of the ſquares of the augmented ſine, and the ſine of the leſſer latitude, will be to the difference of the ſquares of the coſine of the leſſer latitude, and the augmented coſine, in the duplicate ratio of the equatorial to the polar diameter. For Cq being taken in CQ equal to CR, and qv drawn parallel to QV, Cv and vq, CZ and ZR will be the ſigns and coſines of the reſpective latitudes to the ſame radius; and CV, VQ will be the augmentations of Cv and Cq in the ratio named.

Hence, to find the ratio between the two axes of the earth, let E denote the greater, and F the leſſer of the two latitudes, M and N the reſpective meaſures taken in each; and let P denote $\sqrt[3]{\frac{M}{N}}$: then

$$\sqrt{\frac{\text{cof.}^2\,F-P^2\times\text{cof.}^2\,E}{P^2\times\text{ſin.}^2E-\text{ſin.}^2F}}\text{ is }=\frac{\text{leſſer axis}}{\text{greater axis}}.$$

It alſo appears by the above problem, that when one of the degrees meaſured is at the equator, the coſine of the latitude of the other being augmented in the ſubtriplicate ratio of the degrees, the tangent of the latitude will be to the tangent anſwering to the augmented coſine, in the ratio of the greater axis to the leſs. For ſuppoſing E the place out of the equator; then if the ſemi-circle $Plmnp$ be deſcribed, and lC joined, and mo drawn parallel to aC: Co is the coſine of the latitude to the radius CP, and CY that coſine augmented in the ratio beforenamed; YQ being to Yl, that is Ca to Cn or CP, as the tangent of the angle YCQ, the latitude of the point E to the tangent of the angle YCl belonging to the augmented coſine. Thus, if M repreſent the meaſure in a latitude denoted by E, and N the meaſure at the equator, let A denote an angle whoſe meaſure is

$$\text{cof. }E\times\sqrt[3]{\frac{M}{N}}.\text{ Then }\frac{\tan.\,A}{\tan.\,E}\text{ is }=\frac{\text{leſſer axis}}{\text{greater axis}}.$$

But M, or the length of a degree, obtained by actual menſuration in different latitudes, is known from the following table:

Names.	*Latit.* ° ′	*Value of* M. toises	
Maupertuis and Assoc.	66 20	M=57438	
Cassini and {	49 22	M=57074	
La Caille {	45 00	M=57050	
Boscovich	43 00	M=56972	
De la Caille	33 18	M=57037	
Juan and Ulloa	00 00	M=56768	at the
Bouguer	00 00	M=56753	equa-
Condamine	00 00	M=56749	tor.

Now, by comparing the 1st with each of the following ones; the 2d with each of the following; and in like manner the 3d, 4th, and 5th, with each of the following; there will be obtained 25 results, each shewing the relation of the axes or diameters; the arithmetical means of all of which will give that ratio as 1 to 0·9951989.

If the measures of the latitudes of 49° 22′, and of 45°, which fall within the meridian line drawn through France, and which have been re-examined and corrected since the northern and southern expedition, be compared with those of Maupertuis and his associates in the north, and that of Bouguer at the equator, there will result 6 different values of the ratio of the two axes, the arithmetical mean of all which is that of 1 to 0·9953467, which may be considered as the ratio of the greater axis to the less; which is as 230 to 228·92974, or 215 to 214, or very near the ratio as assigned by Newton.

Now, the magnitude as well as the figure of the earth, that is the polar and equatorial diameters, may be deduced from the foregoing problem. For, as half the latus rectum of the greater axis A*a* is the radius of curvature at A, it is given in magnitude from the degree measured there, and thence the axes themselves are given. Thus, the circular arc whose length is equal to the radius being 57·29578 degrees, if this number be multiplied by 56750 toises, the measure of a degree at the equator, as Bouguer has stated it, the product will be the radius of curvature there, or half the latus rectum of the greater axis; and this is to half the lesser axis in the ratio of the less axis to the greater, that is, as 0·9953467 to 1; whence the two axes are 6533820 and 6564366 toises, or 7913 and 7950 English miles; and the difference between the two axes about 37 miles. See Robertson's Navigation, vol. 2, p. 206, &c. See also Suite des Mem. de l'Acad. 1718, p. 247, and Maclaurin's Fluxions, vol. 2, book 1, ch. 14.

And very nearly the same ratio is deduced from the lengths of pendulums vibrating in the same time, in different latitudes; provided it be again allowed that the meridians are real ellipses, or the earth a true spheroid, which however can only take place in the case of an uniform gravity in all parts of the earth.

Thus, in the new Petersburgh Acts, for the years 1788 and 1789, are accounts and calculations of experiments relative to this subject, by M. Krafft. These experiments were made at different times and in various parts of the Russian empire. This gentleman has collected and compared them, and drawn the proper conclusions from them: thus he infers that the length x of a pendulum that swings seconds in any given latitude λ, and in a temperature of 10 degrees of Reaumur's thermometer, may be determined by this equation:

$x = 439{\cdot}178 + 2{\cdot}321 \text{ sine } ^2\lambda$, lines of a French foot,
or $x = 39{\cdot}0045 + 0{\cdot}206 \text{ sine } ^2\lambda$, in English inches,
in the temperature of 53 of Fahrenheit's thermometer.

This expression nearly agrees, not only with all the experiments made on the pendulum in Russia, but also with those of Mr. Graham in England, and those of Mr. Lyons in 79° 50′ north latitude, where he found its length to be 431·38 lines. It also shews the augmentation of gravity from the equator to the parallel of a given latitude λ: for, putting g for the gravity under the equator, G for that under the pole, and y for that under the latitude λ, M. Krafft finds
$y = (1 + 0{\cdot}0052848 \text{ sine } ^2\lambda)\, g$; and therefore $G = 1{\cdot}0052848\, g$.

From this proportion of gravity under different latitudes, the same author infers that, in case the earth is a homogeneous ellipsoid, its oblateness must be $\frac{1}{191}$; instead of $\frac{1}{230}$, which ought to be the result of this hypothesis: but on the supposition that the earth is a heterogeneous ellipsoid, he finds its oblateness, as deduced from these experiments, to be $\frac{1}{297}$; which agrees with that resulting from the measurement of some of the degrees of the meridian. This confirms an observation of M. De la Place, that, if the hypothesis of the earth's homogeneity be given up, then theory, the measurement of degrees of latitude, and experiments with the pendulum, all agree in their result with respect to the oblateness of the earth. See Memoires de l'Acad. 1783, p. 17.

In the Philos. Trans. for 1791, p. 236, Mr. Dalby has given some calculations on measured degrees of the meridian, from whence he infers, that those degrees measured in middle latitudes, will answer nearly to an ellipsoid whose axes are in the ratio assigned by Newton, viz. that of 230 to 229. And as to the deviations of some of the others, viz. towards the poles and equator, he thinks they are caused by the errors in the observed celestial arcs.

Tacquet draws some pretty little inferences, in the form of paradoxes, from the round figure of the earth; as, 1st, That if any part of the surface of the earth were quite plane, a man could no more walk upright upon it, than on the side of a mountain. 2d, That the traveller's head goes a greater space than his feet; and a horseman than a footman; as moving in a greater circle. 3d, That a vessel, full of water, being raised perpendicularly, some of the water will be continually flowing out, yet the vessel still remain full; and, on the contrary, if a vessel of water be let perpendicularly down, though nothing flow out, yet it will cease to be full: consequently there is more water contained in the same vessel at the foot of a mountain, than on the top; because the surface of the water is compressed into a segment of a smaller sphere below than above. Tacq. Astron. lib. 1, cap. 2.

Changes of the EARTH. Mr. Boyle suspects that there are great, though slow internal changes, in the mass of the earth. He argues from the varieties observed in the change of the magnetic needle, and from the observed changes in the temperature of climates. But as to the latter, there is reason to doubt that he could not have diaries of the weather sufficient to direct his judgment. Boyle's Works abr. vol. 1, p. 292, &c.

Magnetism of the EARTH. The notion of the magnetism of the earth was started by Gilbert; and Boyle supposes magnetic effluvia moving from one pole to the other. See his Works abr. vol. 1, p. 285. 290.

Dr. Knight also thinks that the earth may be considered as a great loadstone, whose magnetical parts are disposed in a very irregular manner; and that the south pole of the earth is analogous to the north pole in magnets, that is, the pole by which the magnetical stream enters. See MAGNET.

He observes, that all the phenomena attending the direction of the needle, in different parts of the earth, in great measure correspond with what happens to a needle, when placed upon a large terrella; if we make allowances for the different dispositions of the magnetical parts, with respect to each other, and consider the south pole of the earth as a north pole with regard to magnetism. The earth might become magnetical by

the iron ores it contains, for all iron ores are capable of magnetiſm. It is true, the globe might notwithſtanding have remained unmagnetical, unleſs ſome cauſe had exiſted capable of making that repellent matter producing magnetiſm move in a ſtream through the earth.

Now the doctor thinks that ſuch a cauſe does exiſt. For if the earth revolves round the ſun in an ellipſis, and the ſouth pole of the earth is directed towards the ſun, at the time of its deſcent towards it, a ſtream of repellent matter will thence be made to enter at the ſouth pole, and iſſue out at the north. And he ſuggeſts, that the earth's being in its perihelion in winter may be one reaſon why magnetiſm is ſtronger in this ſeaſon than in ſummer.

This cauſe here aſſigned for the earth's magnetiſm muſt continue, and perhaps improve it, from year to year. Hence the doctor thinks it probable, that the earth's magnetiſm has been improving, ever ſince the creation, and that this may be one reaſon why the uſe of the compaſs was not diſcovered ſooner. See Dr. Knight's Attempt to demonſtrate, that all the phenomena in nature may be explained by Attraction and Repulſion, prop. 87.

Magnitude and Conſtitution of the EARTH. This has been variouſly determined by different authors, both ancient and modern. The uſual way has been, to meaſure the length of one degree of the meridian, and multiply it by 360, for the whole circumference. See DEGREE. Diogenes Laertius informs us, that Anaximander, a ſcholar of Thales, who lived about 550 years before the birth of Chriſt, was the firſt who gave an account of the circumference of the ſea and land; and it ſeems his meaſure was uſed by the ſucceeding mathematicians, till the time of Eratoſthenes. Ariſtotle, at the end of lib. 2 De Cœlo, ſays, the mathematicians who have attempted to meaſure the circuit of the earth, make it 40000 ſtadiums: which it is thought is the number determined by Anaximander.

Eratoſthenes, who lived about 200 years before Chriſt, was the next who undertook this buſineſs; which, as Cleomedes relates, he performed by taking the ſun's zenith diſtances, and meaſuring the diſtance between two places under the ſame meridian; by which he deduced for the whole circuit about 250000 ſtadiums, which Pliny ſtates at 31500 Roman miles, reckoning each at 1000 paces. But this meaſure was accounted falſe by many of the ancient mathematicians, and particularly by Hipparchus, who lived 100 years afterwards, and who added 25000 ſtadiums to the circuit of Eratoſthenes.

Poſſidonius, in the time of Cicero and Pompey the Great, next meaſured the earth, viz. by means of the altitudes of a ſtar, and meaſuring a part of a meridian; and he concluded the circumference at 240000 ſtadiums, according to Cleomedes, but only at 180000 according to Strabo.

Ptolomy, in his Geography, ſays that Marinus, a celebrated geographer, attempted ſomething of the ſame kind; and, in lib. 1, cap. 3, he mentions that he himſelf had tried to perform the buſineſs in a way different from any other before him, which was by means of places under different meridians: but he does not ſay how much he made the number, for he ſtill made uſe of the 180000, which had been found out before him.

Snellius relates, from the Arabian Geographer Abelfedea, who lived about the 1300th year of Chriſt, that about the 800th year of Chriſt, Almaimon, an Arabian king, having collected together ſome ſkilful mathematicians, commanded them to find out the circumference of the earth. Accordingly theſe made choice of the fields of Meſopotamia, where they meaſured under the ſame meridian from north to ſouth, till the pole was depreſſed one degree lower: which meaſure they found equal to 56 miles, or $56\frac{1}{2}$: ſo that, according to them, the circuit of the earth is 20160 or 20340 miles.

It was a long time after this before any more attempts were made in this buſineſs. At length, however, the ſame Snell, above mentioned, profeſſor of mathematics at Leyden, about the year 1620, with great ſkill and labour, by meaſuring large diſtances between two parallels, found one degree equal to 28500 perches, each of which is 12 Rhinland feet, amounting to 19 Dutch miles, and ſo the whole periphery 6840 miles; a mile being, according to him, 1500 perches, or 18000 Rhinland feet. See his treatiſe called *Eratoſthenes Batavus.*

The next that undertook this meaſurement, was Richard Norwood, who, in the year 1635, by meaſuring the diſtance from London to York with a chain, and taking the ſun's meridian altitude, June 11th old ſtyle, with a ſextant of about 5 feet radius, found a degree contained 367200 feet, or 69 miles and a half and 14 poles; and thence the circumference of a great circle of the earth is a little more than 25036 miles, and the diameter a little more than 7966 miles. See the particulars of this meaſurement in his *Seaman's Practice.*

The meaſurement of the earth by Snell, though very ingenious and troubleſome, and much more accurate than any of the ancients, being ſtill thought by ſome French mathematicians as liable to certain ſmall errors, the buſineſs was renewed, after Snell's manner, by Picard and other mathematicians, by the king's command; uſing a quadrant of $3\frac{1}{6}$ French feet radius; by which they found a degree contained 342360 French feet. See Picard's treatiſe, *La Meſure de la Terre.*

M. Caſſini the younger, in the year 1700, by the king's command alſo, renewed the buſineſs with a quadrant of 10 feet radius, for taking the latitude, and another of $3\frac{1}{8}$ feet for taking the angles of the triangles; and found a degree, from his calculation, containing 57292 toiſes, or almoſt $69\frac{1}{2}$ Engliſh miles.

The reſults of many other meaſurements are upon record; from the mean of all which, the following dimenſions may be taken as near the truth:

the circumference	25000 miles,
the diameter	$7957\frac{3}{4}$ miles,
the ſuperficies	198944206 ſquare miles,
the ſolidity	263930000000 cubic miles.

Alſo the ſeas and unknown parts of the earth, by a meaſurement of the beſt maps, contain 160522026 ſquare miles; the inhabited parts 38922180; of which Europe contains 4456065; Aſia, 10768823; Africa, 9654807; and America, 14110874.

It is now generally granted that the terraqueous globe has two motions, beſides that on which the preceſſion of the equinoxes depends; the one diurnal around its own axis in the ſpace of 24 hours, which conſtitutes the natural day or nycthemeron; the other annual, about the ſun, in an elliptical orbit or track, in 365 days 6 hours, conſtituting the year. From the former ariſe the diverſities of night and day; and from the latter, the viciſſitudes of ſeaſons, ſpring, ſummer, autumn, winter.

The terraqueous globe is diſtinguiſhed into three parts or regions, viz. 1ſt, The external part or cruſt, being that from which vegetables ſpring and animals are nouriſhed. 2d, The middle, or intermediate part, which is poſſeſſed by foſſils, extending farther than human labour ever yet penetrated. 3d, The internal or central part, which is utterly unknown to us, though by many authors ſuppoſed of a magnetic nature; by others, a maſs or ſphere of fire; by others, an abyſs or collection of waters, ſurrounded by the ſtrata of earth; and by others, a hollow, empty ſpace, inhabited by animals, that have their ſun, moon, planets, and other conveniences within.

the ſame. But others divide the body of the globe into two parts, viz. the external part, called the cortex, including the internal, which they call the nucleus, being of a different nature from the former, and poſſeſſed by fire, water, or more probably by a conſiderable portion of metals, as it has been found, by calculation, that the mean denſity of the whole earth is near double the denſity of common ſtone. See Hutton's determination of it, Philoſ. Tranſ. 1778, p. 781.

The external part of the globe either exhibits inequalities, as mountains and valleys ; or it is plane and level ; or dug in channels, fiſſures, beds, &c. for rivers, lakes, ſeas, &c. Theſe inequalities in the face of the earth moſt naturaliſts ſuppoſe have ariſen from a rupture or ſubverſion of the earth, by the force either of the ſubterraneous fires or waters. The earth, in its natural and original ſtate, it has been ſuppoſed by Des Cartes, and after him, Burnet, Steno, Woodward, Whiſton, and others, was perfectly round, ſmooth, and equable ; and they account for its preſent rude and irregular form, principally from the great deluge.

In the external, or cortical part of the earth, there appear various ſtrata, ſuppoſed the ſediments of ſeveral floods ; the waters of which, being replete with matters of various kinds, as they dried up, or oozed through, depoſited theſe different ſubſtances, which in time hardened into ſtrata of ſtone, ſand, coal, clay, &c.

Dr. Woodward has conſidered the circumſtances of theſe ſtrata with great attention, viz. their order, number, ſituation with reſpect to the horizon, depth, interſections, fiſſures, colour, conſiſtence, &c. He aſcribes the origin and formation of them all, to the great flood or cataclyſmus. At that terrible revolution he ſuppoſed that all ſorts of terreſtrial bodies had been diſſolved and mixed with the waters, forming all together a chaos or confuſed maſs. This maſs of terreſtrial particles, intermixed with water, he ſuppoſes was at length precipitated to the bottom ; and that generally according to the order of gravity, the heavieſt ſinking firſt, and the lighteſt afterwards. By ſuch means were the ſtrata formed of which the earth conſiſts ; which, attaining their ſolidity and hardneſs by degrees, have continued ſo ever ſince. Theſe ſediments, he farther concludes, were at firſt parallel and concentrical ; and the ſurface of the earth formed of them ; perfectly ſmooth and regular ; but that in courſe of time, divers changes happening, from earthquakes, volcanos, &c. the order and regularity of the ſtrata was diſturbed and broken, and the ſurface of the earth by ſuch means brought to the irregular form in which it now appears.

M. De Buffon ſurmiſes that the earth, as well as the other planets, are parts ſtruck off from the body of the ſun by the colliſion of comets ; and that when the earth aſſumed its form, it was in a ſtate of liquefaction by fire. But that could not be the method of producing the planets ; for if they were ſtruck off from the body of the ſun, they would move in orbits that would always paſs through the ſun, inſtead of having the ſun for their focus, or centre, as they are now found ; ſo that having been ſtruck off they would fall down into the ſun again, terminating their career as it were after one revolution only. See farther the articles Geography, Astronomy, Mines, Strata, &c.

Earth, *in Aſtronomy*. See Astronomy.

Bread made of Earth. See *Earth*-Bread.

Earth-*Flax*. See Amianthus.

Earth-*Nuts*, or *Ground Nuts*, the roots of the Arachis *hypogæa* of Linnæus. They are compoſed of ſeveral ſmall round bulbs or knobs ; whence they were termed by Dodonæus, *terræ glandes*, or *earth-nuts*. They are eſteemed an excellent food by the Siberians. In Holland, likewiſe, they are ſold in the markets and uſed for food. The native country of this plant ſeems to be Africa ; though, at preſent, all the American ſettlements abound with it ; but many perſons who have reſided in that country affirm that it was originally brought by the ſlaves from Africa. The plant multiplies very faſt in a warm country ; but being very impatient of cold, it cannot be propagated in the open air in Britain. The ſeeds muſt therefore be planted in a hot-bed in the ſpring of the year ; and when the weather proves warm, they may be expoſed to the open air by degrees. The branches of the plant trail upon the ground ; and the flowers, which are yellow, are produced ſingle upon long footſtalks ; and as ſoon as the flower begins to decay, the germen is thruſt under ground, where the pod is formed and ripened ; ſo that unleſs the ground is opened, they never appear : the roots are annual, but the nuts or ſeeds ſufficiently ſtock the ground in a warm country where they are not carefully taken up.

Earth-*Nuts*, or *Pig-Nuts*. See Bunium.

Earth-*Pucerons*, in natural hiſtory, a name given by authors to a ſpecies of puceron very ſingular in its place of abode. In the month of March, if the turf be raiſed in ſeveral places in any dry paſture, there will be found, under ſome parts of it, cluſters of ants ; and, on a farther ſearch, it will be uſually found, that theſe animals are gathered about ſome pucerons of a peculiar ſpecies. Theſe are large, and of a greyiſh colour, and are uſually found in the midſt of the cluſters of ants. The common abode of the ſeveral other ſpecies of pucerons is on the young branches or leaves of trees : as their only food is the ſap or juice of vegetables, probably theſe *earth* kinds draw out thoſe juices from the roots of the graſſes, and other plants, in the ſame manner that the others do from the other parts. The ants that conduct us to theſe, are alſo our guides where to find the greater part of the others : the reaſon of which is, that as theſe creatures feed on the ſaccharine juices of plants, they are evacuated from their bodies in a liquid form, very little altered from their original ſtate ; and the ants, who love ſuch food, find it ready prepared for them in the excrements which theſe little animals are continually voiding. See Aphis. It has been ſuppoſed by ſome, that theſe were the common pucerons of other kinds, which had crept into the earth to preſerve themſelves from the rigour of the winter. But this does not appear to be the caſe ; for they are uſually met with in places very diſtant from trees or plants, on which they ſhould be ſuppoſed before to have fed ; and it is very certain, that though many of theſe inſects are killed by the cold, yet many eſcape, and are found very early in the ſpring, ſucking the buds of the peach-tree. There is no doubt of theſe creatures being in a feeding condition when under ground ; becauſe otherwiſe the ants would have no temptation to follow them : and it is equally certain, that the ſeveral ſpecies of the pucerons, like thoſe of the caterpillar kinds, have each their peculiar herbs on which they feed, as many of them will die of hunger rather than feed on any others ; and it is not at all likely, that theſe earth pucerons had been uſed to feed on leaves of trees and plants, and had left that food for the roots of graſs.

Earth-*Worms*. See Lumbricus.

EARTHQUAKE, in natural hiſtory, a ſudden and violent concuſſion of the earth, generally attended with ſtrange noiſes under ground or in the air ; often deſtroying whole cities at once, throwing down rocks, altering the courſe of rivers, and producing the moſt terrible devaſtations. Though there is hardly any country known in which ſhocks of an earthquake have not at ſome time or other been felt, yet there are ſome much more ſubject to them than others. It hath been obſerved, that northern countries in general are leſs ſubject to earthquakes than thoſe ſituated near the equator, or in the ſouthern

latitudes ; but this does not hold univerfally. The iflands of Japan, which are fituated pretty far north, are neverthelefs exceedingly liable to thefe deftructive phenomena. Iflands, in general, are alfo more fubject to earthquakes than continents ; but neither does this hold without exceptions. Some particular parts of continents, and fome particular iflands, are more fubject to them than others lying in the neighbourhood, and differing very little from them in external appearance. Thus, Portugal is more fubject to earthquakes than Spain, and the latter much more than France ; Mexico and Peru more than the other countries of America, and Jamaica more than the other Caribbee iflands. Earthquakes are frequent, though not often violent, in Italy ; but in Sicily they are often terribly deftructive. Afia Minor has been remarkably fubject to them from the remoteft antiquity ; and the city of Antioch in particular hath fuffered more from earthquakes than any other in that country. The fame phenomena are faid alfo to occur very frequently in the north-eaftern extremities of Afia, even in very high latitudes.

Though there are no phenomena in nature more calculated to imprefs the human mind with terror, and confequently to be well remembered and taken notice of, than earthquakes ; yet the philofophy of them is but lately arrived at any degree of perfection ; and even at this day, the hiftory of earthquakes is very incomplete. The deftruction occafioned by them engroffes the mind too much to admit of philofophical fpeculations at the time they happen : the fame thing prevents the attentive confideration of the alterations that take place in the atmofphere after the earthquake is over, and which might probably throw fome light on the caufes which produced it ; and the fuddennefs of its coming on prevents an exact attention to thofe flight appearances in the earth or air, which, if carefully obferved, might ferve as warnings to avoid the deftruction.

From what obfervations have been made, however, the following phenomena may be deduced, and reckoned pretty certain : 1. Where there are any volcanos or burning mountains, earthquakes may reafonably be expected more frequently than in other countries. 2. If the volcano hath been for a long time quiet, a violent earthquake is to be feared, and *vice verfa*. But to this there are many exceptions. 3. Earthquakes are generally preceded by long droughts ; but they do not always come on as foon as the drought ceafes. 4. They are alfo preceded by electrical appearances in the air ; fuch as the aurora borealis, falling ftars, &c. but this does not hold univerfally. 5. A fhort time before the fhock, the fea fwells up and makes a great noife ; fountains are troubled, and fend forth muddy water ; and the beafts feem frighted, as if fenfible of an approaching calamity. 6. The air at the time of the fhock is generally calm and ferene ; but afterwards commonly becomes obfcure and cloudy. 7. The fhock comes on with a rumbling noife, fometimes like that of carriages ; fometimes a rufhing noife like wind, and fometimes explofions like the firing of cannon are heard. Sometimes the ground heaves perpendicularly upwards, and fometimes rolls from fide to fide. Sometimes the fhock begins with a perpendicular heave, after which the other kind of motion commences. A fingle fhock is but of very fhort duration, the longeft fcarcely lafting a minute ; but they frequently fucceed each other at fhort intervals for a confiderable length of time. 8. During the fhock, chafms are made in the earth ; from which fometimes flames, but oftener great quantities of water, are difcharged. Flame and fmoke are alfo emitted from parts of the earth where no chafms can be perceived. Sometimes thefe chafms are but fmall ; but, in violent earthquakes, they are frequently fo large, that whole cities fink down into them at once. 9. The water of the ocean is affected even more than the dry land. The fea fwells to a prodigious height ; much more than we could fuppofe it raifed by the mere elevation of its bottom by the fhock. Sometimes it is divided to a confiderable depth ; and quantities of air, flames, and fmoke, are difcharged from it. The like irregular agitations happen to the waters of ponds, lakes, and even rivers. 10. The fhock is felt at fea as well as on land. Ships are affected by a fudden ftroke, as if they had run aground or ftruck upon a rock. 11. The effects of earthquakes are not confined to one particular diftrict or country, but often extend to very diftant regions ; though no earthquake hath yet been known extenfive enough to affect the whole globe at one time. In thofe places alfo where the fhock is not felt on dry land, the irregular agitation of the waters above mentioned is perceived very remarkably.

All thefe pofitions are verified by the accounts of thofe earthquakes which have been particularly defcribed by witneffes of the beft character. But above all, the great earthquake which happened on the 1ft of November 1755, affords the cleareft example of all the phenomena we have mentioned ; having been felt violently in many places both on land and at fea, and extended its effects to the waters in many other places where the fhocks were not perceived. At Lifbon in Portugal its effects were moft fevere. In 1750, there had been a fenfible trembling of the earth felt in that city : for four years afterwards, there had been an exceffive drought ; infomuch that fome fprings, formerly very plentiful of water, were dried and totally loft. The predominant winds were north and north-eaft, accompanied with various, though very fmall, tremors of the earth. The year 1755 proved very wet and rainy ; the fummer cooler than ufual ; and for 40 days before the earthquake, the weather was clear, but not remarkably fo. The laft day of October, the fun was obfcured, with a remarkable gloominefs in the atmofphere. The firft of November, early in the morning, a thick fog arofe, which was foon diffipated by the heat of the fun ; no wind was ftirring ; the fea was calm ; and the weather as warm as in June or July in this country. At 35 minutes after nine, without the leaft warning, except a rumbling noife not unlike the artificial thunder in our theatres, a moft dreadful earthquake fhook, by fhort but quick vibrations, the foundations of all the city, fo that many buildings inftantly fell. Then, with a fcarce perceptible paufe, the nature of the motion was changed, and the houfes were toffed from fide to fide, with a motion like that of a waggon violently driven over rough ftones. This fecond fhock laid almoft the whole city in ruins, with prodigious flaughter of the people. The earthquake lafted in all about fix minutes. At the moment of its beginning, fome perfons on the river, near a mile from the city, heard their boat make a noife as if it had run aground, though they were then in deep water ; and at the fame time they faw the houfes falling on both fides of the river. The bed of the river Tagus was in many places raifed to its furface. Ships were driven from their anchors, and joftled together with great violence ; nor did their mafters know whether they were afloat or aground. A large new quay funk to an unfathomable depth, with feveral hundreds of people who were upon it ; nor was one of the dead bodies ever found. The bar was at firft feen dry from fhore : but fuddenly the fea came rolling in like a mountain ; and about Belem Caftle the water rofe 50 feet almoft in an inftant. About noon there was another fhock ; when the walls of feveral houfes that yet remained were feen to open from top to bottom more than a quarter of a yard, and afterwards clofed again fo exactly that fcarce any mark of the injury was left.

At Colares, about 20 miles from Lifbon, and two miles from the fea, on the laft day of October, the weather was clear, and uncommonly warm for the feafon. About four o'clock in the afternoon there arofe a fog, which came from

the ſea, and covered the valleys; a thing very unuſual at that ſeaſon of the year. Soon after, the wind changing to the eaſt, the fog returned to the ſea, collecting itſelf, and becoming exceeding thick. As the fog retired, the ſea roſe with a prodigious roaring. The firſt of November, the day broke with a ſerene ſky, the wind continuing at eaſt; but about nine o'clock the ſun began to grow dim; and about half an hour after was heard a rumbling noiſe like that of chariots, which increaſed to ſuch a degree, that it became equal to the exploſions of the largeſt cannon. Immediately a ſhock of an earthquake was felt, which was quickly ſucceeded by a ſecond and third; and at the ſame time ſeveral light flames of fire iſſued from the mountains, reſembling the kindling of charcoal. In theſe three ſhocks, the walls of the buildings moved from eaſt to weſt. In another ſituation, from whence the ſea coaſt could be diſcovered, there iſſued from one of the hills called the *Fojo* a great quantity of ſmoke, very thick, but not very black. This ſtill increaſed with the fourth ſhock, and afterwards continued to iſſue in a greater or leſs degree. Juſt as the ſubterraneous rumblings were heard, the ſmoke was obſerved to burſt forth at the Fojo; and the quantity of ſmoke was always proportioned to the noiſe. On viſiting the place from whence the ſmoke was ſeen to ariſe, no ſigns of fire could be perceived near it.

At Oporto (near the mouth of the river Douro), the earthquake began about 40 minutes paſt nine. The ſky was very ſerene; when a dreadful hollow noiſe like thunder, or the rattling of coaches at a diſtance, was heard, and almoſt at the ſame inſtant the earth began to ſhake. In the ſpace of a minute or two, the river roſe and fell five or ſix feet, and continued to do ſo for four hours. It ran up at firſt with ſo much violence, that it broke a ſhip's hawſer. In ſome parts the river opened, and ſeemed to diſcharge vaſt quantities of air; and the agitation in the ſea was ſo great about a league beyond the bar, that air was ſuppoſed to have been diſcharged there alſo.

St. Ubes's, a ſea-port town about 20 miles ſouth of Liſbon, was entirely ſwallowed up by the repeated ſhocks and the vaſt ſurf of the ſea. Huge pieces of rock were detached at the ſame time from the promontory at the weſt end of the town, which conſiſts of a chain of mountains containing fine jaſper of different colours.

The ſame earthquake was felt all over Spain, except in Catalonia, Arragon, and Valencia.—At Ayamonte (near where the Guadiana falls into the Bay of Cadiz), a little before 10 o'clock on the firſt of November, the earthquake was felt; having been immediately preceded by a hollow ruſhing noiſe. Here the ſhocks continued for 14 or 15 minutes, damaged almoſt all the buildings, throwing down ſome, and leaving others irreparably ſhattered. In little more than half an hour after, the ſea and river, with all the canals, overflowed their banks with great violence, laying under water all the coaſts of the iſlands adjacent to the city and its neighbourhood, and flowing into the very ſtreets. The water came on in vaſt black mountains, white with foam at the top, and demoliſhed more than one half of a tower at the bar named *De Canala*. In the adjacent ſtrands every thing was irrecoverably loſt; for all that was overflowed ſunk, and the beach became a ſea, without the leaſt reſemblance of what it was before. Many perſons periſhed; for although they got aboard ſome veſſels, yet part of theſe foundered; and others being forced out to ſea, the unhappy paſſengers were ſo terrified, that they threw themſelves overboard. The day was ſerene, and not a breath of wind ſtirring.

At Cadiz, ſome minutes after nine in the morning, the earthquake began, and laſted about five minutes. The water of the ciſterns under ground waſhed backwards and forwards, ſo that a great froth aroſe. At ten minutes after eleven, a wave was ſeen coming from the ſea, at eight miles diſtance, at leaſt 60 feet higher than uſual. It daſhed againſt the weſt part of the town, which is very rocky. Though theſe rocks broke a good deal of its force, it at laſt came upon the city walls, beat in the breaſt-work, and carried pieces of the building of eight or ten ton weight to the diſtance of 40 or 50 yards. When the wave was gone, ſome parts that are deep at low water, were left quite dry; for the water returned with the ſame violence with which it came. At half an hour after 11 came a ſecond wave, and after that four other remarkable ones; the firſt at ten minutes before twelve; the ſecond, half an hour before one; the third, ten minutes after one; and the fourth, ten minutes before two. Similar waves, but ſmaller, and gradually leſſening, continued with uncertain intervals till the evening.

At Gibraltar, the earthquake was not felt till after ten. It began with a tremulous motion of the earth, which laſted about half a minute. Then followed a violent ſhock; after that, a trembling of the earth for five or ſix ſeconds; then another ſhock not ſo violent as the firſt, which gradually went off as it began. The whole laſted about two minutes. Some of the guns on the battery were ſeen to riſe, others to ſink, the earth having an undulating motion. Moſt people were ſeized with giddineſs and ſickneſs, and ſome fell down; others were ſtupefied; and many that were walking or riding felt no motion in the earth, but were ſick. The ſea roſe ſix feet every 15 minutes; and then fell ſo low, that boats and all the ſmall craft near the ſhore were left aground, as were alſo numbers of ſmall fiſh. The flux and reflux laſted till next morning, having decreaſed gradually from two in the afternoon. At Madrid, the earthquake came on at the ſame time as at Gibraltar, and laſted about ſix minutes.

In Africa, the earthquake was felt almoſt as ſeverely as it had been in Europe. Great part of the town of Algiers was deſtroyed. At Arzilla (a town in the kingdom of Fez), about ten in the morning, the ſea ſuddenly roſe with ſuch impetuoſity, that it lifted up a veſſel in the bay, and dropped it with ſuch force on the land, that it was broke to pieces; and a boat was found two muſket-ſhot within land from the ſea. At Fez and Mequinez, great numbers of houſes fell down, and a multitude of people were buried in the ruins. At Morocco, by the falling down of a great number of houſes, many people loſt their lives: and at Salle, a great deal of damage alſo was done. At Tangier, the earthquake began at ten in the morning, and laſted 10 or 12 minutes. At Tetuan, the earthquake began at the ſame time, but laſted only ſeven or eight minutes. There were three ſhocks ſo extremely violent, that it was feared the whole city would be deſtroyed.

In the city of Funchal, in the iſland of Madeira, a ſhock of this earthquake was firſt perceived at 38 minutes paſt nine in the morning. It was preceded by a rumbling noiſe in the air, like that of empty carriages paſſing haſtily over a ſtone pavement. The obſerver felt the floor immediately to move with a tremulous motion, vibrating very quickly. The ſhock continued more than a minute; during which ſpace, the vibrations, though continual, were weakened and increaſed in force twice very ſenſibly. The increaſe after the firſt remiſſion of the ſhock was the moſt intenſe. The noiſe in the air accompanied the ſhock during the whole of its continuance, and laſted ſome ſeconds after the motion of the earth had ceaſed; dying away like a peal of diſtant thunder rolling through the air. At three quarters paſt eleven, the ſea, which was quite calm, it being a fine day, and no wind ſtirring, retired ſuddenly ſome paces; then riſing with a great ſwell without the leaſt noiſe, and as ſuddenly advancing, overflowed the ſhore, and entered the city. It roſe 15 feet perpendicular above the high-water mark, although the tide, which flows there ſeven feet, was

then at half ebb. The water immediately receded; and after having fluctuated four or five times between high and low water-mark, it subsided, and the sea remained calm as before. In the northern part of the island the inundation was more violent, the sea there retiring above 100 paces at first, and suddenly returning, overflowed the shore, forcing open doors, breaking down the walls of several magazines and storehouses, leaving great quantities of fish ashore and in the streets of the village of Machico. All this was the effect of one rising of the sea, for it never afterwards flowed high enough to reach the high-water mark. It continued, however, to fluctuate here much longer before it subsided than at Funchal; and in some places farther to the westward, it was hardly, if at all, perceptible.

These were the phenomena with which this remarkable earthquake was attended in those places where it was violent. The effects of it, however, reached to an immense distance; and were perceived chiefly by the agitations of the waters, or some slight motion of the earth. The utmost boundaries of this earthquake to the south are unknown; the barbarity of the African nations rendering it impossible to procure any intelligence from them, except where the effects were dreadful. On the north, however, we are assured, that it reached as far as Norway and Sweden. In the former, the waters of several rivers and lakes were violently agitated. In the latter, shocks were felt in several provinces, and all the rivers and lakes were strongly agitated, especially in Dalecarlia. The river Dala suddenly overflowed its banks, and as suddenly retired. At the same time a lake at the distance of a league from it, and which had no manner of communication with it, bubbled up with great violence. At Fahlun, a town in Dalecarlia, several strong shocks were felt.

In many places of Germany the effects of the earthquake were very perceptible; but in Holland, the agitations were still more remarkable. At Alphen on the Rhine, between Leyden and Woerden, in the afternoon of the first of November, the waters were agitated to such a violent degree, that buoys were broken from their chains, large vessels snapped their cables, smaller ones were thrown out of the water upon the land, and others lying on land were set afloat. At Amsterdam, about 11 in the forenoon, the air being perfectly calm, the waters were suddenly agitated in their canals, so that several boats broke loose; chandeliers were observed to vibrate in the churches; but no motion of the earth, or concussion of any building, was observed. At Haerlem, in the forenoon, for near four minutes together, not only the water in the rivers, canals, &c. but also all kinds of fluids in smaller quantities, as in coolers, tubs, backs, &c. were surprisingly agitated, and dashed over the sides, though no motion was perceptible in the vessels themselves. In these small quantities also the fluid apparently ascended prior to its turbulent motion; and in many places, even the rivers and canals rose 12 inches perpendicular.

The agitation of the waters was also perceived in various parts of Great Britain and Ireland. At Barlborough in Derbyshire, between 11 and 12 in the forenoon, in a boat-house on the west side of a large body of water called *Pibley Dam*, supposed to cover at least 30 acres of land, was heard a surprising and terrible noise; a large swell of water came in a current from the south, and rose two feet on the sloped dam-head at the north end of the water. It then subsided; but returned again immediately, though with less violence. The water was thus agitated for three quarters of an hour; but the current grew every time weaker and weaker, till at last it entirely ceased.

At Busbridge in Surrey, at half an hour after 10 in the morning, the weather being remarkably still, without the least wind, in a canal near 700 feet long and 58 feet broad, with a small spring constantly running through it, a very unusual noise was heard at the east end, and the water there observed to be in great agitation. It raised itself in a heap or ridge in the middle; and this heap extended lengthwise about 30 yards, rising between two or three feet above the usual level. After this, the ridge heeled or vibrated towards the north side of the canal with great force, and flowed above eight feet over the grass walk on that side. On its return back into the canal, it again ridged in the middle, and then heeled with yet greater force to the south side, and flowed over its grass walk. During this latter motion, the bottom on the north side was left dry for several feet. This appearance lasted for about a quarter of an hour, after which the water became smooth and quiet as before. During the whole time, the sand at the bottom was thrown up and mixed with the water; and there was a continual noise like that of water turning a mill. At Cobham in Surrey, Dunstall in Suffolk, Earsy Court in Berkshire, Eaton-bridge, Kent, and many other places, the waters were variously agitated.

At Eyam-bridge, Derbyshire (in the Peak), the overseer of the lead-mines sitting in his writing-room about 11 o'clock, felt a sudden shock, which very sensibly raised him up in his chair, and caused several pieces of plaster to drop from the sides of the room. The roof was so violently shaken, that he imagined the engine shaft had been falling in. Upon this he immediately ran to see what was the matter, but found every thing in perfect safety. At this time two miners were employed in carting, or drawing along the drifts of the mines, the ore and other materials to be raised up at the shafts. The drift in which they were working was about 120 yards deep, and the space from one end to the other 50 yards or upwards. The miner at the end of the drift had just loaded his cart, and was drawing it along; but he was suddenly surprised by a shock, which so terrified him, that he immediately quitted his employment, and ran to the west end of the drift to his partner, who was no less terrified than himself. They durst not attempt to climb the shaft, lest that should be running in upon them: but while they were consulting what means they should take for their safety, they were surprised by a second shock more violent than the first; which frightened them so much, that they both ran precipitately to the other end of the drift. They then went down to another miner who worked about 12 yards below them. He told them that the violence of the second shock had been so great, that it caused the rocks to grind upon one another. His account was interrupted by a third shock, which, after an interval of four or five minutes, was succeeded by a fourth; and, about the same space of time after, by a fifth; none of which were so violent as the second. They heard, after every shock, a loud rumbling in the bowels of the earth, which continued about half a minute, gradually decreasing, or seeming to remove to a greater distance.

At Shireburn castle, Oxfordshire, a little after ten in the morning, a very strange motion was observed in the water of a moat which encompasses the house. There was a pretty thick fog, not a breath of air, and the surface of the water all over the moat as smooth as a looking-glass, except at one corner, where it flowed into the shore, and retired again successively, in a surprising manner. In what manner it began to move is uncertain, as nobody observed the beginning of its motion. The flux and reflux, when seen, were quite regular. Every flood began gently; its velocity increased by degrees, when at last it rushed in with great impetuosity, till it had attained its full height. Having remained for a little time stationary, it then retired, ebbing gently at first, but afterwards sinking away with great swiftness. At every flux, the whole body of water seemed to be violently thrown against the bank; but neither during the time of the flux nor that of the reflux

did there appear even the leaſt wrinkle of a wave on the other parts of the moat. Lord Parker, who had obſerved this motion, being deſirous to know whether it was univerſal over the moat, ſent a perſon to the other corner of it, at the ſame time that he himſelf ſtood about 25 yards from him, to examine whether the water moved there or not. He could perceive no motion there, or hardly any: but another, who went to the north-eaſt corner of the moat, diagonally oppoſite to his lordſhip, found it as conſiderable there as where he was. His lordſhip imagining, that in all probability the water at the corner diagonally oppoſite to where he was would ſink as that by him roſe, he ordered the perſon to ſignify by calling out, when the water by him began to ſink, and when to riſe. This he did; but, to his lordſhip's great ſurpriſe, immediately after the water began to riſe at his own end, he heard his voice calling that it began to riſe with him alſo; and in the ſame manner he heard that it was ſinking at his end, ſoon after he perceived it to ſink by himſelf. A pond juſt below was agitated in a ſimilar manner; but the riſings and ſinkings of it happened at different times from thoſe at the pond where lord Parker ſtood.

At White Rock in Glamorganſhire, about two hours ebb of the tide, and near three quarters after ſix in the evening, a vaſt quantity of water ruſhed up with a prodigious noiſe; floated two large veſſels, the leaſt of them above 200 tons; broke their moorings, drove them acroſs the river, and had like to have overſet them. The whole riſe and fall of this extraordinary body of water did not laſt above ten minutes, nor was it felt in any other part of the river, ſo that it ſeemed to have guſhed out of the earth at that place.

Similar inſtances occurred at Loch Lomond and Loch Neſs in Scotland. At Kinſale in Ireland, and all along the coaſt to the weſtward, many ſimilar phenomena were obſerved.

Shocks were alſo perceived in ſeveral parts of France; as at Bayonne, Bourdeaux, and Lyons; and commotions of the waters were obſerved at Angouleſme, Bleville, Havre de Grace, &c. but not attended with the remarkable circumſtances above mentioned.

Theſe are the moſt ſtriking phenomena with which the earthquake of Nov. 1, 1755, was attended on the ſurface of the earth. Thoſe which happened below ground cannot be known but by the changes obſerved in ſprings, &c. which were in many places very remarkable.—At Colares, on the afternoon of the 31ſt of October, the water of a fountain was greatly decreaſed: on the morning of the firſt of November it ran very muddy; and, after the earthquake, returned to its uſual ſtate both as to quantity and clearneſs. On the hills, numbers of rocks were ſplit; and there were ſeveral rents in the ground, but none conſiderable. In ſome places where formerly there had been no water, ſprings burſt forth, which continued to run.—Some of the largeſt mountains in Portugal were impetuouſly ſhaken as it were from their foundation; moſt of them opened at their ſummits, ſplit and rent in a wonderful manner, and huge maſſes of them were thrown down into the ſubjacent valleys.—From the rock called *Pedra de Alvidar*, near the hill Fojo, a kind of parapet was broken off, which was thrown up from its foundation in the ſea.—At Varge, on the river Macaas, at the time of the earthquake, many ſprings of water burſt forth, ſome ſpouted to the height of 18 or 20 feet, throwing up ſand of various colours, which remained on the ground. A mountainous point, ſeven or eight leagues from St. Ube's, cleft aſunder, and threw off ſeveral vaſt maſſes of rock.—In Barbary, a large hill was rent in two; the two halves fell different ways, and buried two large towns. In another place, a mountain burſt open, and a ſtream iſſued from it as red as blood. At Tangier, all the fountains were dried up, ſo that there was no water to be had till night.—A very remarkable change was obſerved on the medicinal waters of Toplitz, a village in Bohemia famous for its baths. Theſe waters were diſcovered in the year 762; from which time the principal ſpring of them had conſtantly thrown out hot water in the ſame quantity, and of the ſame quality. On the morning of the earthquake, between 11 and 12 in the forenoon, the principal ſpring caſt forth ſuch a quantity of water, that in the ſpace of half an hour all the baths ran over. About half an hour before this great increaſe of the water, the ſpring flowed turbid and muddy; then having ſtopped entirely for a minute, it broke forth again with prodigious violence, driving before it a conſiderable quantity of reddiſh ochre. After this it became clear, and flowed as pure as before. It ſtill continues to do ſo; but the water is in greater quantity, and hotter, than before the earthquake. At Angouleſme in France, a ſubterraneous noiſe like thunder was heard; and preſently after the earth opened, and diſcharged a torrent of water mixed with red ſand. Moſt of the ſprings in the neighbourhood ſunk in ſuch a manner, that for ſome time they were thought to be quite dry. In Britain, no conſiderable alteration was obſerved in the earth, except that, near the lead mine above mentioned in Derbyſhire, a cleft was obſerved about a foot deep, ſix inches wide, and 150 yards in length.

At ſea, the ſhocks of this earthquake were felt moſt violently. Off St. Lucar, the captain of the Nancy frigate felt his ſhip ſo violently ſhaken, that he thought ſhe had ſtruck the ground; but, on heaving the lead, found ſhe was in a great depth of water. Captain Clark from Denia, in N. lat. 36. 24. between nine and ten in the morning, had his ſhip ſhaken and ſtrained as if ſhe had ſtruck upon a rock, ſo that the ſeams of the deck opened, and the compaſs was overturned in the binacle. The maſter of a veſſel bound to the American iſlands, being in N. lat. 25°, W. long. 40°, and writing in his cabin, heard a violent noiſe, as he imagined, in the ſteerage; and while he was aſking what the matter was, the ſhip was put into a ſtrange agitation, and ſeemed as if ſhe had been ſuddenly jerked up and ſuſpended by a rope faſtened to the maſt-head. He immediately ſtarted up with great terror and aſtoniſhment; and looking out at the cabin-window, ſaw land, as he took it to be, at the diſtance of about a mile. But, coming upon the deck, the land was no more to be ſeen, but he perceived a violent current croſs the ſhip's way to the leeward. In about a minute, this current returned with great impetuoſity, and at a league's diſtance he ſaw three craggy-pointed rocks throwing up waters of various colours reſembling fire. This phenomenon, in about two minutes, ended in a black cloud, which aſcended very heavily. After it had riſen above the horizon, no rocks were to be ſeen; though the cloud, ſtill aſcending, was long viſible, the weather being extremely clear.—Between nine and ten in the morning, another ſhip, 40 leagues weſt of St. Vincent, was ſo ſtrongly agitated, that the anchors, which were laſhed, bounced up, and the men were thrown a foot and a half perpendicularly up from the deck. Immediately after this, the ſhip ſunk in the water as low as the main chains. The lead ſhowed a great depth of water, and the line was tinged of a yellow colour, and ſmelt of ſulphur. The ſhock laſted about ten minutes, but they felt ſmaller ones for the ſpace of 24 hours.

Such were the phenomena of this very remarkable and deſtructive earthquake, which extended over a tract of at leaſt four millions of ſquare miles. The earthquakes, however, which in the year 1783 ruined a great part of Italy and Sicily, though much more confined in their extent, ſeem to have been not at all inferior in violence. From the moſt authentic accounts received by his Sicilian majeſty's ſecretary of ſtate, it was learned, that the part of Calabria which had been moſt affected by this heavy calamity, is that comprehended between

the 38th and 39th degree of latitude: that the greateſt force of the earthquake ſeemed to have exerted itſelf from the foot of thoſe mountains of the Apennines called the Monte Dijo, Monte Sacro, and Monte Caulene, extending weſtward to the Tyrrhene ſea: that the towns, villages, and farm-houſes neareſt theſe mountains, ſituated either on the hills or the plain, were totally ruined by the ſhock of the 5th of February about noon: that as the towns and villages were at a greater diſtance from this centre, the damage they received was leſs conſiderable; but that even theſe more diſtant towns had been greatly damaged by the ſubſequent ſhocks of the earthquakes, and effectually by thoſe of the 7th, 26th, and 28th of February, and that of the 1ſt of March; that from the firſt ſhock of the 5th of February, the earth had been in a continual tremor; and that the ſhocks were more ſenſibly felt at times in ſome parts of the afflicted provinces than at others; that the motion of the earth had been either whirling like a vortex, horizontal, or by pulſations, or by beatings from the bottom upwards. This variety of motions increaſed the apprehenſions of the miſerable inhabitants, who expected every moment that the earth would open under their feet, and ſwallow them up. It was ſaid alſo that the rains had been continued and violent, frequently accompanied with irregular and furious guſts of wind; and that from all theſe cauſes, the face of that part of Calabria comprehended between the 38th and 39th degrees was entirely altered, particularly on the weſtern ſide of the mountains above mentioned: that many openings and cracks had been made in thoſe parts; ſome hills had been much lowered, and others entirely ſwallowed up; deep chaſms had been made, by which many roads were rendered impaſſable; huge mountains were ſaid to have been ſplit aſunder, and the parts of them driven to a conſiderable diſtance: deep valleys to have been filled up by the concourſe of the mountains which formed them before; the courſe of rivers altered; many ſprings of water dried up, and new ones formed in their place, &c. A ſingular phenomenon was ſaid to have been obſerved at Laureana in Calabria Ultra; viz. that two whole tenements, with large plantations of olive and mulberry trees, ſituated in a valley perfectly level, had been detached by the earthquake, and tranſplanted, with the trees ſtill remaining in their places, to the diſtance of about a mile from their firſt ſituations; and that from the ſpot on which they formerly ſtood, hot water had ſprung up to a conſiderable height, mixed with ſand of a ferruginous nature: that near this place alſo ſome countrymen and ſhepherds had been ſwallowed up, with their teams of oxen, and their flocks of goats and ſheep. The number of lives loſt was eſtimated at 32,367; but Sir William Hamilton is of opinion, that, including ſtrangers, it could not be leſs than 40,000.

The fate of the inhabitants of Scylla was extremely affecting. On the firſt ſhock of the earthquake February 5th, they had fled along with their prince to the ſea-ſhore, where they hoped for ſafety; but in the night time a furious wave (ſaid to have been boiling hot, and by which many people were alleged to have been ſcalded) overflowed the land for three miles, ſweeping off in its return 2473 of the inhabitants, among whom was the prince himſelf, who were at that time either on the ſtrand or in boats near the ſhore. But the moſt ſingular of all the phenomena enumerated in theſe accounts was, that a hill, about 500 palms in height, and 1300 in circumference at its baſis, jumped to the diſtance of about four miles from the place where it formerly ſtood. At the ſame time the hill on which the town of Oppido ſtood, which extended about three miles, parted in two; and as its ſituation was between two rivers, both of theſe were of courſe ſtopped up; two great lakes were formed, and by their continual increaſe threatened to infect the air by their noxious exhalations.

Such were the accounts at firſt propagated and univerſally believed; but Sir William Hamilton, who made a tour through the ruined country that ſame year, found that, though the effects in general were very dreadful, ſtill there had been great exaggeration in ſeveral particulars, as, from the events laſt mentioned, might very well be conjectured.

To explain the phenomena of earthquakes, various hypotheſes have been invented. Till lately, thoſe of modern philoſophers were much the ſame with thoſe of the ancients. Anaxagoras ſuppoſed the cauſe of earthquakes to be ſubterraneous clouds burſting out into lightning, which ſhook the vaults that confined them. Others imagined, that the arches, which had been weakened by continual ſubterraneous fires, at length fell in. Others derived theſe accidents from the rarefied ſteam of waters, heated by ſome neighbouring fires; and ſome, among whom was Epicurus, and ſeveral of the Peripatetic ſchool, aſcribed theſe terrible accidents to the ignition of certain inflammable exhalations.

This laſt hypotheſis has been adopted by many of the moſt celebrated moderns, as Gaſſendus, Kircher, Schottus, Varenius, Des Cartes, Du Hamel, Honorius, Fabri, &c. The philoſopher laſt mentioned indeed ſuppoſed, that waters prodigiouſly rarefied by heat might ſometimes occaſion earthquakes. The others ſuppoſed, as their hypotheſis neceſſarily requires, that there are many and vaſt cavities under ground which have a communication with one another: ſome of which abound with waters; others with vapours and exhalations, ariſing from inflammable ſubſtances, as nitre, bitumen, ſulphur, &c. Theſe combuſtible exhalations they ſuppoſed to be kindled by a ſubterraneous ſpark, or by ſome active flame gliding through a narrow fiſſure from without, or by the fermentation of ſome mixture; and when this happened, they muſt neceſſarily produce pulſes, tremors, and ruptures at the ſurface, according to the number and diverſity of the cavities, and the quantity and activity of the inflammable matter. This hypotheſis is illuſtrated by a variety of experiments, ſuch as mixtures of iron-filings and brimſtone buried in the earth, gunpowder confined in pits, &c. by all which a ſhaking of the earth will be produced.

Though none of theſe hypotheſes were ſufficient for explaining the phenomena of earthquakes in a ſatisfactory manner, one or other of them continued to be adopted by almoſt all philoſophers till the year 1749. In the month of March in that year, an earthquake was felt at London and ſeveral other places in Britain. Dr. Stukeley, who had been much engaged in electrical experiments, began to ſuſpect that phenomena of this kind ought to be attributed not to vapours or fermentations generated in the bowels of the earth, but to electricity. In a paper publiſhed by him on this ſubject, he rejects all the abovementioned hypotheſes for reaſons which appear to be very convincing and deciſive; and on comparing all circumſtances, he concludes, that an earthquake is a ſhock of the ſame kind as thoſe which commonly occur in electrical experiments.

This hypotheſis indeed is confirmed by the phenomena attending earthquakes; particularly thoſe of 1749 and 1750, which gave riſe to his publication. The weather, for five or ſix months before, had been uncommonly warm; the wind ſouth and ſouth-weſt, without rain; ſo that the earth muſt have been in a ſtate peculiarly ready for an electrical ſhock. The flat country of Lincolnſhire had been under an exceeding great drought. The uncommonneſs of the firſt of theſe circumſtances, he remarks, is the reaſon why earthquakes are leſs frequently experienced in the northern than in the ſouthern regions of the world, where the warmth and drynefs of the air, ſo neceſſary to electricity, are more uſual: And the latter

shows how fit the dry surface was for an electrical vibration; and (which is of great importance) that earthquakes reach but little below the surface of the earth. Before the earthquake at London, all vegetables had been uncommonly forward; and electricity is well known to quicken vegetation. The aurora borealis had been frequent about that time; and just before the earthquake, had been twice repeated in such colours as had never been seen before. It had also removed southerly, contrary to what is common in England; so that the Italians, and those among whom earthquakes were frequent, actually foretold the earthquake. The year had been remarkable for fire-balls, lightning, and coruscations; and these are rightly judged to be meteors of an electrical nature. In these circumstances of the earth and air, nothing, he says, is wanting to produce an earthquake, but the touch of some non-electric body; which must necessarily be had *ab extra* from the region of the air or atmosphere. Hence he infers, that if a non-electric cloud discharge its contents upon any part of the earth, in that highly electrical state, an earthquake must necessarily ensue. As the discharge from an excited tube produces a commotion in the human body, so the discharge of electric matter from the compass of many miles of solid earth must needs be an earthquake; and the snap from the contact, the horrid uncouth noise attending it. As to the manner in which the earth and atmosphere are put into this state, which prepares them to receive such a shock, and whence the electric matter comes, the Doctor does not pretend to determine; but thinks it as difficult to be accounted for as magnetism, gravitation, and many other secrets of nature.

The same hypothesis was advanced by Signor Beccaria, without knowing any thing of Dr. Stukeley's discoveries. But this learned Italian imagined the electric matter which occasions earthquakes to be lodged deep in the bowels of the earth, agreeably to his hypothesis concerning lightning. Dr. Priestley also, in his History of Electricity, contends for the agency of the electrical fluid in the production of earthquakes; and, from the doctrines advanced by Stukeley and Beccaria, frames a third hypothesis of his own.

All these, it is true, agree in the main; but if a particular solution of the phenomena is required, perhaps every one of them will be found deficient; nor shall we in this place, therefore, enter minutely into the arguments which each of these learned philosophers has brought in support of his opinion.

Besides the earthquakes above described, of which the cause seems to depend entirely on a collection of electric matter in the bowels of the earth, there are others frequently felt in the neighbourhood of volcanos, which are plainly owing to the efforts of the burning matter to discharge itself. These, however, are but slight, and seldom extend to any considerable distance from the burning mountain. For a particular account of them, see the article VOLCANO.

EASEL PIECES, among painters, such smaller pieces, either portraits or landscapes, as are painted on the easel, *i. e.* the stand whereon the canvas is placed.—They are thus called, to distinguish them from larger pictures drawn on walls, ceilings, &c.

EASEMENT, in law, a privilege or convenience which one neighbour has of another, whether by charter or prescription, without profit: such are a way through his lands, a sink, or the like. These, in many cases, may be claimed.

EASING, in the sea-language, signifies the slackening a rope or the like. Thus, to ease the bow-line or sheet, is to let them go slacker; to ease the helm, is to let the ship go more large, more before the wind, or more larboard.

EAST, one of the four cardinal points of the world; being that point of the horizon where the sun is seen to rise when in the equinoctial. The word *east* is Saxon. In Italy, and throughout the Mediterranean, the east wind is called the *levante*; in Greek, ανατολη and απηλιωτης, because it comes from the side of the sun, απ' ηλιυ; in Latin, *eurus*.

EASTER, a festival of the Christian church, observed in memory of our Saviour's resurrection. The Greeks call it *pasga*, the Latins *pascha*, an Hebrew word signifying *passage*, applied to the Jewish feast of the passover. It is called *Easter* in English, from the goddess Eostre, worshipped by the Saxons with peculiar ceremonies in the month of April. The Asiatic churches kept their Easter upon the very same day the Jews observed their passover, and others on the first Sunday after the first full moon in the new year. This controversy was determined in the council of Nice; when it was ordained that Easter should be kept upon one and the same day, which should always be a Sunday, in all Christian churches in the world. For the method of finding Easter by calculation, see CHRONOLOGY, page 524.

EASTER-*Island*, an Island in the S. Pacific Ocean, about 12 leagues in circuit. It has a hilly and stony surface, and an iron-bound shore. The hills are of such a height, as to be seen 15 or 16 leagues. It affords neither safe anchorage, fresh water, nor wood for fuel. It is the same that was seen by Davis in 1686: it was next visited by Roggewein in 1722, and again by Captain Cook in 1774. The country is naturally barren, and without wood: what little it yields must be raised by cultivation. Rats are the only quadrupeds, and there are but few birds. The ears of these people are long beyond proportion, and their bodies are scarcely a resemblance of the human figure. Lon. 109. 46. W. Lat. 27. 5. S.

EAU *de Luce*, a volatile spirit prepared with oil of amber, and employed by some as a smelling-bottle.

EAVES, in architecture, the margin or edge of the roof of an house; being the lowest tiles, slates, or the like, that hang over the walls, to throw off water to a distance from the wall.

EAVES-Droppers, are such persons as stand under the eaves, or walls, and windows of an house, by night or day, to hearken after news, and carry it to others, and thereby cause strife and contention in the neighbourhood. They are called *evil members of the commonwealth* by the stat. of West. 1, c. 33. They may be punished either in the court-leet by way of presentment and fine, or in the quarter-sessions by indictment and binding to good behaviour.

EBBING OF THE TIDES. See TIDE.

EBDOMARIUS, in ecclesiastical writers, an officer formerly appointed weekly to superintend the performance of divine service in cathedrals, and prescribe the duties of each person attending in the choir, as to reading, singing, praying, &c. To this purpose the ebdomary, at the beginning of his week, drew up in form, a bill or writing of the respective persons, and their several offices, called *tabula*, and the persons there entered were styled *intabulati*.

EBDOME, Ἑβδομη, in antiquity, a festival kept on the seventh of every lunar month, in honour of Apollo, to whom all seventh days were sacred, because one of them was his birth-day; whence he was sometimes called *Ebdomagenes*. For the ceremonies of this solemnity see *Potter's Archæol. Græc.* lib. ii. cap. 20.

EBENUS, the EBONY TREE; a genus of the decandria order, belonging to the diadelphia class of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The segments of the calyx are the length of the corolla, and the latter has scarce any alæ: there is one rough seed. There is but one species, the cretica, a native of the island of Crete, and some others in the Archipelago. It rises with a shrubby

stalk three or four feet high; which puts out several side-branches garnished with hoary leaves at each joint, composed of five narrow spear-shaped lobes, which join at their tails to the footstalk, and spread out like the fingers of a hand. The branches are terminated by thick spikes of large purple flowers, which are of the butterfly or pea-bloom kind. The plants may be propagated from seeds sown in the autumn. In this country the plants must be protected during the winter, as they are unable to bear the cold.

EBION, the author of the heresy of the EBIONITES, was a disciple of Cerinthus, and his successor. He improved upon the errors of his master, and added to them new opinions of his own. He began his preaching in Judea: he taught in Asia, and even at Rome. His tenets infected the isle of Cyprus. St. John opposed both Cerinthus and Ebion in Asia; and it is thought that this apostle wrote his gospel, in the year 97, particularly against this heresy.

EBIONITES, ancient heretics, who rose in the church in the very first age thereof, and formed themselves into a sect in the second century, denying the divinity of Jesus Christ. Origen takes them to have been so called from the Hebrew word *ebion*, which in that language signifies *poor*; because, says he, they were poor in sense, and wanted understanding. But it is more probable, that the Jews gave this appellation to the Christians in general out of contempt; because in the first times there were few but poor people that embraced the Christian religion. The Ebionites are little else than a branch of the Nazarenes; only that they altered and corrupted, in many things, the purity of the faith held among those first adherents to Christianity. For this reason, Origen distinguishes two kinds of Ebionites, in his answer to Celsus: the one believed that Jesus Christ was born of a virgin; and the other, that he was born after the manner of other men. They differed from the Nazarenes, however, in several things, chiefly as to what regards the authority of the sacred writings.

EBONY OF CRETE. See EBENUS.

EBONY-*Wood* is brought from the Indies, exceedingly hard and heavy, susceptible of a very fine polish, and on that account used in mosaic and inlaid works, toys, &c. There are many kinds of ebony: the most usual among us are black, red, and green, all of them the product of the island of Madagascar, where the natives call them indifferently *hazon mainthi*, q. d. *black wood*. The island of St. Maurice, belonging to the Dutch, likewise furnishes part of the ebonies used in Europe.

Authors and travellers give very different accounts of the tree that yields the black ebony. By some of their descriptions, it should be a sort of palm-tree; by others, a cytisus, &c. The most authentic of them is that of M. Flacourt, who resided many years in Madagascar as governor. He assures us, that it grows very high and big, its bark being black, and its leaves resembling those of our myrtle, of a deep dusky green colour. Tavernier assures us, that the islanders always take care to bury their trees, when cut down, to make them the blacker, and to prevent their splitting when wrought. F. Plumier mentions another black ebony-tree, discovered by him at St. Domingo, which he calls *spartium portulacæ foliis aculeatum ebeni materiæ*. Candia also bears a little shrub, known to the botanists under the name of EBENUS *Cretica*, above described.

Pliny and Dioscorides say the best ebony comes from Ethiopia, and the worst from India; but Theophrastus prefers that of India. Black ebony is much preferred to that of other colours. The best is a jet black, free of veins and rind, very massive, astringent, and of an acrid pungent taste. Its rind, infused in water, is said to be antiscorbutic, and to cure venereal disorders; whence Matthiolus took guaiacum for a sort of ebony. It yields an agreeable perfume when laid on burning coals: when green, it readily takes fire from the abundance of its fat. If rubbed against a stone, it becomes brown. The Indians make statues of their gods, and sceptres for their princes, of this wood. It was first brought to Rome by Pompey, after he subdued Mithridates. It is now much less used among us than formerly; since the discovery of so many ways of giving other hard woods a black colour. As to the green ebony, besides Madagascar and St. Maurice, it likewise grows in the Antilles, and especially in the isle of Tobago. The tree that yields it is very bushy; its leaves are smooth, and of a fine green colour. Under its bark is a white substance, about two inches thick; all beneath which, to the very heart, is a deep green, approaching towards a black, though sometimes streaked with yellow veins. Its use is not confined to mosaic work: it is likewise useful in dyeing, as yielding a fine green tincture. As to red ebony, called also *grenadilla*, we know little of it more than the name. The cabinet-makers, inlayers, &c. make pear-tree and other woods pass for ebony, by giving them the same black colour. This some do by a few washes of a strong decoction of galls, to which is added a small quantity of vitriolated iron.

EBRO, anciently IBERUS, a large river of Spain, which, taking its rise in Old Castile, runs through Biscay and Arragon, passes by Saragosa, and, continuing its course through Catalonia, discharges itself with great rapidity into the Mediterranean, about twenty miles below the city of Tortosa.

ECALESIA, Εκαλησια, in antiquity, a festival kept in honour of Jupiter, surnamed *Hecalus*, or *Hecalesius*, from *Hecale*, one of the borough-towns in Attica.

ECASTOR, in antiquity, an oath wherein Castor was invoked. It was a custom for the men never to swear by Castor, nor the women by Pollux.

ECATÆA, Εκαταια, in antiquity, statues erected to the goddess Hecate, for whom the Athenians had a great veneration, believing that she was the overseer of their families, and that she protected their children.

ECATESIA, Εκατησια, in antiquity, an anniversary solemnity, observed by the Stratonicensians, in honour of Hecate. The Athenians likewise had a public entertainment or supper every new moon, in honour of the same goddess. The supper was provided at the charge of the richer sort; and was no sooner brought to the accustomed place but the poor people carried all off, giving out that Hecate had devoured it. For the rest of the ceremonies observed on this occasion, see *Pott. Arch. Græc.* lib. ii. cap. 20.

ECATOMBÆON, Εκατομβαιων, in chronology, the first month of the Athenian year. It consisted of thirty days, and began the first new moon after the summer solstice, and consequently answered to the latter part of our June and beginning of July. The Bœotians called it *Hippodromus*, and the Macedonians *Lous*. The word is a derivative from the Greek εκατομβη, *a hecatomb*, because of the great number of hecatombs sacrificed in it.

ECAVESSADE, in the manege, is used for a jerk of the cavesson.

ECCENTRICITY. See EXCENTRICITY.

ECCHELLENSIS (Abraham), a learned Maronite, whom the president Le Jai employed in the edition of his Polyglott Bible. Gabriel Sionita, his countryman, drew him to Paris, in order to make him his fellow-labourer in publishing that bible. They fell out: Gabriel complained to the parliament, and cruelly defamed his associate; their quarrel made a great noise. The congregation *de propaganda fide* associated him, 1636, with those whom they employed in making an Arabic translation of the scripture. They recalled him from Paris, and he laboured in that translation at Rome in the year 1652. While he was professor of the Oriental languages at Rome, he was

pitched upon by the great duke Ferdinand II. to tranſlate from Arabic into Latin the 5th, 6th, and 7th books of Apollonius's Conics; in which he was aſſiſted by John Alphonſo Borelli, who added commentaries to them. He died at Rome in 1664.

ECCHYMOSIS, from εκχυω to *pour out*, or from εξ, *out of*, and χυμος, *juice*; an effuſion or eſcape of the blood into the cellular membrane. It is commonly ſeen in the caſe of a bruiſe; where a blackneſs is produced on the ſkin; but if the quantity of blood be not conſiderable, the abſorbents carry it off without any ſuppuration being produced.

ECCLAIRCISSEMENT. See Esclaircissement.

ECCLESIASTES, a canonical book of the Old Teſtament, the deſign of which is to ſhow the vanity of all ſublunary things. It was compoſed by Solomon; who enumerates the ſeveral objects on which men place their happineſs, and then ſhows the inſufficiency of all worldly enjoyments. The Talmudiſts made king Hezekiah to be the author of it; Grotius aſcribes it to Zorobabel, and others to Iſaiah; but the generality of commentators believe this book to be the produce of Solomon's repentance, after having experienced all the follies and pleaſures of life.

ECCLESIASTICAL, an appellation given to whatever belongs to the church: thus we ſay, eccleſiaſtical polity, juriſdiction, hiſtory, &c.

Ecclesiastical *Courts*. In the time of the Anglo-Saxons, Judge Blackſtone obſerves, there was no ſort of diſtinction between the lay and the eccleſiaſtical juriſdiction: the county-court was as much a ſpiritual as a temporal tribunal: the rights of the church were aſcertained and aſſerted at the ſame time, and by the ſame judges, as the rights of the laity. For this purpoſe the biſhop of the dioceſe, and the alderman, or in his abſence the ſheriff of the county, uſed to ſit together in the county-court, and had there the cognizance of all cauſes as well eccleſiaſtical as civil; a ſuperior deference being paid to the biſhop's opinion in ſpiritual matters, and to that of the lay-judges in temporal. At length, by the artifices of the Court of Rome, with whoſe views this rational and moderate plan was inconſiſtent, ſpiritual cauſes were prohibited from being tried in the ſecular courts. But king Henry I. at his acceſſion, among other reſtorations of the laws of king Edward the Confeſſor, revived this of the union of the civil and eccleſiaſtical courts; which was, according to Sir Edward Coke, only a reſtitution of the ancient law of England. This however was ill reliſhed by the Popiſh clergy, who, under the guidance of that arrogant prelate archbiſhop Anſelm, very early diſapproved of a meaſure that put them on a level with the prophane laity, and ſubjected ſpiritual men and cauſes to the inſpection of the ſecular magiſtrates: and therefore, in their ſynod at Weſtminſter, 3 Hen. I. they ordained, that no biſhop ſhould attend the diſcuſſion of temporal cauſes: which ſoon diſſolved this newly effected union. And when, upon the death of king Henry I. the uſurper Stephen was brought in and ſupported by the clergy, we find one article of the oath which they impoſed upon him was, that eccleſiaſtical perſons and eccleſiaſtical cauſes ſhould be ſubject only to the biſhop's juriſdiction. And as it was about that time that the conteſt and emulation began between the laws of England and thoſe of Rome, the temporal courts adhering to the former, and the ſpiritual adopting the latter, as their rule of proceeding; this widened the breach between them, and made a coalition afterwards impracticable; which probably would elſe have been effected at the general reformation of the church.

Eccleſiaſtical Courts are various; as the Archdeacon's, the Consistory, the Court of Arches, the Peculiars, the Prerogative, and the great court of appeal in all eccleſiaſtical cauſes, viz. the Court of Delegates. See thoſe articles.

As to the method of proceeding in the ſpiritual courts, ſays Blackſtone, it muſt, in the firſt place, be acknowledged to their honour, that though they continue to this day to decide many queſtions which are properly of temporal cognizance, yet juſtice is in general ſo ably and impartially adminiſtered in thoſe tribunals (eſpecially of the ſuperior kind), and the boundaries of their power are now ſo well known and eſtabliſhed, that no material inconvenience at preſent ariſes from this juriſdiction ſtill continuing in the ancient channel. And, ſhould any alteration be attempted, great confuſion would probably ariſe, in overturning long eſtabliſhed forms, and new-modelling a courſe of proceedings that has now prevailed for ſeven centuries.

The eſtabliſhment of the civil-law proceſs in all the eccleſiaſtical courts was indeed a maſter-piece of papal diſcernment, as it made a coalition impracticable between them and the national tribunals, without manifeſt inconvenience and hazard. And this conſideration had undoubtedly its weight in cauſing this meaſure to be adopted, though many other cauſes concurred. In particular, it may be here remarked, that the pandects, or collections of civil law, being written in the Latin tongue, and referring ſo much to the will of the prince and his delegated officers of juſtice, ſufficiently recommended them to the court of Rome, excluſive of their intrinſic merit. To keep the laity in the darkeſt ignorance, and to monopolize the little ſcience which then exiſted entirely among the monkiſh clergy, were deep-rooted principles of papal policy. And as the biſhops of Rome affected in all points to mimic the imperial grandeur, as the ſpiritual prerogatives were moulded on the pattern of the temporal, ſo the canon-law proceſs was formed on the model of the civil-law; the prelates embracing, with the utmoſt ardour, a method of judicial proceedings, which was carried on in a language unknown to the bulk of the people, which baniſhed the intervention of a jury (that bulwark of Gothic liberty), and which placed an arbitrary power of deciſion in the breaſt of a ſingle man.

The proceedings in the eccleſiaſtical courts are therefore regulated according to the practice of the civil and canon laws; or rather to a mixture of both, corrected and new-modelled by their own particular uſages, and the interpoſition of the courts of common law. For, if the proceedings in the ſpiritual court be ever ſo regularly conſonant to the rules of the Roman law, yet if they be manifeſtly repugnant to the fundamental maxims of the municipal laws, to which, upon principles of ſound policy, the eccleſiaſtical proceſs ought in every ſtate to conform (as if they require two witneſſes to prove a fact, where one will ſuffice at common law); in ſuch caſes, a prohibition will be awarded againſt them. But, under theſe reſtrictions, their ordinary courſe of proceeding is, firſt, by *citation*, to call the party injuring before them. Then by *libel* (*libellus*, "a little book"), or by articles drawn out in a formal *allegation*, to ſet forth the complainant's ground of complaint. To this ſucceeds the *defendant's anſwer* upon oath; when, if he denies or extenuates the charge, they proceed to *proofs* by witneſſes examined, and their depoſitions taken down in writing by an officer of the court. If the defendant has any circumſtances to offer in his defence, he muſt alſo propound them in what is called his *defenſive allegation*, to which he is intitled in his turn to the *plaintiff's anſwer* upon oath, and may from thence proceed to *proofs* as well as his antagoniſt. The canonical doctrine of *purgation*, whereby the parties were obliged to anſwer upon oath to any matter, however criminal, that might be objected againſt them (though long ago over-ruled in the court of chancery, the genius of the Engliſh law having bro-

ken through the bondage impofed on it by its clerical chancellors, and afferted the doctrines of judicial as well as civil liberty), continued till the middle of the laft century, to be upheld by the fpiritual courts; when the legiflature was obliged to interpofe, to teach them a leffon of fimilar moderation. By the ftatute of 13 Car. II. c. 12. it is enacted, that it fhall not be lawful for any bifhop, or ecclefiaftical judge, to tender or adminifter to any perfon whatfoever, the oath ufually called the oath *ex officio*, or any other oath whereby he may be compelled to confefs, accufe, or purge himfelf of any criminal matter or thing, whereby he may be liable to any cenfure or punifhment. When all the pleadings and proofs are concluded, they are referred to the confideration, not of a jury, but of a fingle judge; who *takes information* by hearing advocates on both fides, and thereupon forms his *interlocutory decree* or *definitive fentence*, at his own difcretion: from which there generally lies an *appeal*, in the feveral ftages mentioned in the articles above referred to; though if the fame be not appealed from him in fifteen days, it is final, by the ftatute 25 Hen. VIII. c. 19.

But the point in which thefe jurifdictions are the moft defective, is that of enforcing their fentences when pronounced; for which they have no other procefs but that of *excommunication*; which would be often defpifed by obftinate or profligate men, did not the civil law ftep in with its aid. See Excommunication.

Ecclesiastical *Corporations*, are where the members that compofe them are *fpiritual* perfons. They were erected for the furtherance of religion and perpetuating the rights of the church. See Corporations.

Ecclesiastical *State*. See Clergy.

ECCLESIASTICUS, an apocryphal book, generally bound up with the fcriptures, fo called, from its being read in the church, *ecclefia*, as a book of piety and inftruction, but not of infallible authority. The author of this book was a Jew, called *Jefus the fon of Sirach*. The Greeks call it the *Wifdom of the fon of Sirach*.

ECCOPROTICS, in medicine, laxative or loofening remedies, which purge gently. The word is compofed of the Greek particle εκ, and κοπρος, *excrement*.

ECDICI, Εκδικοι, among the ancients, patrons of cities, who defended their rights, and took care of the public money. Their office refembled that of the modern fyndics.

ECHAPE, in the manege, a horfe begot between a ftallion and a mare of different breeds and countries.

ECHAPER, in the manege, a gallicifm ufed in the academies, implying to give a horfe his head, or to put him on at full fpeed.

ECHENEIS, the Remora, in ichthyology; a genus belonging to the order of thoracici. See Plate 4. The head is fat, naked, depreffed, and marked with a number of tranfverfe ridges; it has ten rays in the branchioftege membrane; and the body is naked. There are two fpecies, viz. 1. The remora, or fucking-fifh, with a forked tail, and 18 ftriæ on the head. It is found in the Indian ocean. 2. The neucrates, with an undivided tail, and 16 ftriæ on the head. It is likewife a native of the Indian ocean. Thefe fifhes are often found adhering fo ftrongly to the fides of fharks and other great fifh, by means of the ftructure of its head, as to be got off with difficulty. This fifh was believed, by all the ancients, to have moft wonderful powers, and to be able, by adhering to the bottom, to arreft the motion of a fhip in its fulleft courfe; and in love affairs, to deaden the warmeft affections of both fexes. (*Plin.* lib. ix. c. 25.)

ECHEVIN, in the French and Dutch polity, a magiftrate elected by the inhabitants of a city or town, to take care of their common concerns, and the decoration and cleanlinefs of the city. Formerly, at Paris, there was a prevot and four echevins; in other towns, a mayor and two echevins. At Amfterdam, there are nine echevins; and at Rotterdam, feven. In France, before the eftablifhment of the Republic, the echevins took cognizance of rents, taxes, and the navigation of rivers, &c. In Holland, they judge of civil and criminal caufes; and if the criminal confeffes himfelf guilty, they can fee their fentence executed without appeal.

ECHINATE, or Echinated, an appellation given to whatever is prickly, thereby refembling the hedgehog.

ECHINITES, in natural hiftory, the name by which authors call the foffile centronia, frequently found in our chalk-pits. See Centronia.

ECHINOPHORA, in botany; a genus of the digynia order, belonging to the pentandria clafs of plants; and in the natural method ranking under the 45th order, *Umbellatæ*. The male florets are lateral, with the central one hermaphrodite; there is one feed, funk into an indurated involucrum.

ECHINOPS, in botany; a genus of the polygamia fegregatæ order, belonging to the fyngenefia clafs of plants; and in the natural method ranking under the 49th order, *Compofitæ*. The calyx is uniflorous; the corollulæ tubulated, and hermaphrodite; the receptacle briftly; the pappus indiftinct.

ECHINUS, in zoology, a genus of infects belonging to the order of vermes mollufca. The body is roundifh, covered with a bony cruft, and often befet with moveable prickles; and the mouth is below, and confifts of five valves. 1. The efculentus, or eatable echinus, is of a hemifpherical form, covered with fharp ftrong fpines, above half an inch long; commonly of a violet colour; moveable; adherent to fmall tubercles elegantly difpofed in rows. Thefe are their inftruments of motion by which they change their place. This fpecies is taken in dredging, and often lodges in cavities of rocks juft within low water-mark. They are eaten by the poor in many parts of England, and by the better fort abroad. In old times they were a favourite difh. They were dreffed with vinegar, honied wine or mead, parfley or mint; and thought to agree with the ftomach. They were the firft difh in the famous fupper of Lentulus, when he was made *flamen Martialis*, or prieft of Mars. By fome of the concomitant difhes, they feem to have been defigned as a whet for the fecond courfe, to the holy perfonages, priefts and veftals invited on that occafion. Many fpecies of fhell-fifh made part of that entertainment. 2. The lacunofus, or oval echinus, is of an oval depreffed form; on the top it is of a purple colour, marked with a quadrefoil, and the fpaces between tuberculated in waved rows; the lower fide ftudded, and divided by two fmooth fpaces. Length, four inches. When clothed, it is covered with fhort thickfet briftles mixed with very long ones. There are 15 other fpecies, all natives of the fea. See two fpecimens reprefented in Plate 4.

Echinus, in architecture, a member or ornament near the bottom of the Ionic, Corinthian, and Compofite capitals.

ECHITES, in botany; a genus of the monogynia order, belonging to the pentandria clafs of plants; and in the natural method ranking under the 30th order, *Contortæ*. There are two long and ftraight follicles; the feeds pappous; the corolla funnel-fhaped, with the throat naked. The corymbofa, a fpecies of this genus, is fuppofed to yield the elaftic gum, according to Jacquin. See Caoutchouc.

ECHIUM, viper's bugloss, in botany; a genus of the monogynia order, belonging to the pentandria clafs of plants; and in the natural method ranking under the 41ft order, *Afperifoliæ*. The corolla is irregular, with the throat naked There are feven fpecies, three of which are natives of Britain. None of them have any remarkable property, except that the

flowers of one ſpecies (the vulgare) are very grateful to bees. It is a native of many parts of Britain. The ſtem is rough with hairs and tubercles. The leaves are ſpear-ſhaped, and rough with hair. The flowers come out in lateral ſpikes. They are firſt red, afterwards blue; ſometimes purple or white.—Cows and ſheep are not fond of this plant; horſes and goats refuſe it.

ECHO, or Eccho, a ſound reflected or reverberated, from a ſolid concave body, and ſo repeated to the ear. See Acoustics, p. 28. The word is formed from the Greek ηχος, *ſound*, which comes from the verb ηχεω, *ſono*. The ancients being wholly unacquainted with the true cauſe of the echo, aſcribed it to ſeveral cauſes ſufficiently whimſical. The poets, who were not the worſt of their philoſophers, imagined it to be a perſon of that name metamorphoſed, and that ſhe affected to take up her abode in particular places; for they found by experience, that ſhe was not to be met with in all. But the moderns, who know ſound to conſiſt in a certain tremor or vibration in the ſonorous body communicated to the contiguous air, and by that means to the ear, give a more conſiſtent account of echo. For a tremulous body, ſtriking on another ſolid body, it is evident, may be repelled without deſtroying or diminiſhing its tremor; and conſequently a ſound may be redoubled by the reſilition of the tremulous body, or air. But a ſimple reflexion of the ſonorous air is not enough to ſolve the echo: for then every plain ſurface of a ſolid hard body, as being fit to reflect a voice or ſound, would redouble it; which we find is not the caſe.

To produce an echo, therefore, it ſhould ſeem that a kind of concameration or vaulting were neceſſary, in order to collect, and by collecting to heighten and increaſe, and afterwards reflect, the ſound; as we find is the caſe in reflecting the rays of light, where a concave mirror is required. In effect, as often as a ſound ſtrikes perpendicularly on a wall, behind which is any thing of a vault or arch, or even another parallel wall; ſo often will it be reverberated in the ſame line, or other adjacent ones. For an echo to be heard, therefore, it is neceſſary the ear be in the line of reflection: for the perſon who made the ſound to hear its echo, it is neceſſary he be perpendicular to the place which reflects it: and for a manifold or tautological echo, it is neceſſary there be a number of walls, and vaults or cavities, either placed behind or fronting each other. A ſingle arch or concavity, &c. can ſcarce ever ſtop and reflect all the ſound; but if there be a convenient diſpoſition behind it, part of the ſound propagated thither, being collected and reflected as before, will preſent another echo: or, if there be another concavity, oppoſed at a due diſtance to the former, the ſound reflected from the one upon the other will be ſent back again by this latter.

Many of the phenomena of echos are well conſidered by the biſhop of Leighs, &c. who remarks, that any ſound, falling either directly or obliquely on any denſe body of a ſmooth, whether plain or arched, ſuperficies, is reflected, or echoes, more or leſs. The ſurface, ſays he, muſt be ſmooth; otherwiſe the air, by reverberation, will be put out of its regular motion, and the ſound thereby broken and extinguiſhed. He adds, that it echoes more or leſs, to ſhow, that when all things are as before deſcribed, there is ſtill an echoing, though it be not always heard; either becauſe the direct ſound is too weak to beat quite back again to him that made it; or that it does return to him, but ſo weak, that it cannot be diſcerned; or that he ſtands in a wrong place to receive the reflected ſound, which paſſes over his head, under his feet, or on one ſide of him; and which therefore may be heard by a man ſtanding in the place where the reflected ſound does come, provided no interpoſed body intercepts it, but not by him that firſt made it.

At Milan, in Italy, is an echo which reiterates the report of a piſtol 56 times; and if the report is very loud, upwards of 60 reiterations may be counted. The firſt 20 echos are pretty diſtinct; but as the noiſe ſeems to fly away, and anſwer at a greater diſtance, the reiterations are ſo doubled, that they can ſcarce be counted.

Echo, in architecture, a term applied to certain kinds of vaults and arches, moſt commonly of the elliptic and parabolic figures, uſed to redouble ſounds, and produce artificial echos.

Echo, in poetry, a kind of compoſition wherein the laſt words or ſyllables of each verſe contain ſome meaning, which, being repeated apart, anſwer to ſome queſtion or other matter contained in the verſe; as in this beautiful one from Virgil:

> Crudelis mater magis, an puer improbus ille?
> Improbus ille puer, crudelis tu quoque mater.

The elegance of an echo conſiſts in giving a new ſenſe to the laſt words; which reverberate, as it were, the motions of the mind, and by that means affect it with ſurpriſe and admiration.

Echo, in fabulous hiſtory, a daughter of the Air and Tellus, who chiefly reſided in the vicinity of the Cephiſus. She was once one of Juno's attendants, and became the confident of Jupiter's amours. Her loquacity however diſpleaſed Jupiter, and ſhe was deprived of the power of ſpeech by Juno, and only permitted to anſwer to the queſtions which were put to her. Pan had formerly been one of her admirers, but he never enjoyed her favours. Echo, after ſhe had been puniſhed by Juno, fell in love with Narciſſus; but being deſpiſed by him, pined herſelf to death, having nothing but her voice left.

ECHOMETER, among muſicians, a kind of ſcale or rule, with ſeveral lines on it, ſerving to meaſure the duration and length of ſounds, and to find their intervals and ratios.

ECHOUERIES. See the article Trichecus.

ECKIUS (John), an eminent and learned divine, profeſſor in the univerſity of Ingoldſtadt, memorable for the oppoſition he gave to Luther, Melancthon, Caraloſtadius, and other leading Proteſtants in Germany. He wrote many polemical tracts; and among the reſt, a *Manual of Controverſies*, printed in 1535, in which he diſcourſes upon moſt of the heads conteſted between the Proteſtants and Papiſts. He was a man of uncommon learning, parts, and zeal, and died in 1543.

ECLECTICS (*eclectici*), a name given to ſome ancient philoſophers, who, without attaching themſelves to any particular ſect, took what they judged good, and ſolid, from each. Hence their denomination; which, in the original Greek, ſignifies, "that may be choſen," or "that chooſes;" of the verb εκλεγω, *I chooſe*.—Laertius notes, that they were alſo, for the ſame reaſon, denominated *analogetici*; but that they call themſelves *Philalethes*, i. e. lovers of truth. The chief or founder of the electici was one Potamon of Alexandria, who lived under Auguſtus and Tiberius; and who, weary of doubting of all things with the Sceptics and Pyrrhonians, formed the eclectic ſect; which Voſſius calls the *eclective*. Towards the cloſe of the ſecond century a ſect aroſe in the Chriſtian church under the denomination of *Eclectics*, or modern *Platonics*. They profeſſed to make truth the only object of their enquiry, and to be ready to adopt from all the different ſyſtems and ſects, ſuch tenets as they thought agreeable to it. However, they preferred Plato to the other philoſophers, and looked upon his opinions concerning God, the human ſoul, and things inviſible, as conformable to the ſpirit and genius of the Chriſtian doctrine. One of the principal patrons of this ſyſtem was Ammonius Saccas, who at this time laid the foundation of that ſect, afterwards diſtinguiſhed by the name of the new *Platonics*, in the Alexandrian ſchool. See Ammonius and Platonists.

Eclectics were alſo a certain ſet of phyſicians among the

ancients, of whom Archigenes, under Trajan, was the chief, who ſelected from the opinions of all the other ſects, that which appeared to them beſt and moſt rational; hence they were called *eclectics*, and their preſcriptions *medicina eclectica*.

ECLIPSE, in aſtronomy, the deprivation of the light of the ſun, or of ſome heavenly body, by the interpoſition of another heavenly body between our ſight and it. See ASTRONOMY.

ECLIPTA, in botany; a genus of the polygamia ſuperflua order, belonging to the ſyngeneſia claſs of plants. The receptacle is chaffy; there is no pappus, and the corollulæ of the diſk are quadrifid.

ECLIPTIC, in aſtronomy, a great circle of the ſphere, ſuppoſed to be drawn through the middle of the zodiac, making an angle with the equinoctial of about 23° 30′, which is the ſun's greateſt declination; or, more ſtrictly ſpeaking, it is that path or way among the fixed ſtars, that the earth appears to deſcribe to an eye placed in the ſun. See ASTRONOMY. Some call it *via Solis*, "the way of the ſun;" becauſe the ſun in his apparent annual motion never deviates from it, as all the other planets do more or leſs.

ECLIPTIC, in geography, a great circle on the terreſtrial globe, not only anſwering to, but falling within, the plane of the celeſtial ecliptic. See GEOGRAPHY.

ECLOGUE, in poetry, a kind of paſtoral compoſition, wherein ſhepherds are introduced converſing together. The word is formed from the Greek εκλογη, *choice*; ſo that, according to the etymology, *eclogue* ſhould be no more than a ſelect or choice piece; but cuſtom has determined it to a farther ſignification, viz. a little elegant compoſition in a ſimple natural ſtyle and manner. Idyllion and eclogue, in their primary intention, are the ſame thing: thus, the idyllia, ειδυλλια, of Theocritus, are pieces written perfectly in the ſame vein with the *eclogæ* of Virgil. But cuſtom has made a difference between them, and appropriated the name *eclogue* to pieces wherein ſhepherds are introduced ſpeaking; *idyllion*, to thoſe written like the eclogue, in a ſimple natural ſtyle, but without any ſhepherds in them.

ECLUSE, a ſmall but ſtrong town of the Dutch Low Countries, in Flanders, with a good harbour and ſluices. The Engliſh beſieged it in vain in 1405, and the people of Bruges in 1436. But the Dutch, commanded by Count Maurice of Naſſau, took it in 1644. It is defended by ſeveral forts, and ſtands near the ſea. E. long. 3. 10. N. lat. 50. 25.

ECPHRACTICS, in medicine, remedies which are ſuppoſed to attenuate and remove obſtructions. See ATTENUANTS, and DEOBSTRUENTS.

ECSTATICI, Εκςατικοι, from εξιςημι, *I am entranced*, in antiquity, a kind of diviners who were caſt into trances or ecſtacies, in which they lay like dead men, or aſleep, deprived of all ſenſe and motion; but, after ſome time, returning to themſelves, gave ſtrange relations of what they had ſeen and heard.

ECTHESIS, in church-hiſtory, a confeſſion of faith, in the form of an edict, publiſhed in the year 639, by the emperor Heraclius, with a view to pacify the troubles occaſioned by the Eutychian hereſy in the eaſtern church. However, the ſame prince revoked it, on being informed that pope Severinus had condemned it, as favouring the Monothelites; declaring at the ſame time, that Sergius, patriarch of Conſtantinople, was the author of it.

ECTHLIPSIS, among Latin grammarians, a figure of proſody whereby the *m* at the end of a word, when the following word begins with a vowel, is elided, or cut off, together with the vowel preceding it, for the ſake of the meaſure of the verſe. thus they read *mult' ille*, for *multum ille*.

ECTROPIUM, in ſurgery, is when the eye-lids are inverted, or retracted, ſo that they ſhow their internal or red ſurface, and cannot ſufficiently cover the eye.

ECTYLOTICS, in ſurgery, remedies proper for conſuming callous tumours or excreſcences.

ECU, or ESCU, a French crown; for the value of which, ſee MONEY.

EDDA, in antiquities, is a ſyſtem of the ancient Icelandic or Runic mythology, containing many curious particulars of the theology, philoſophy, and manners of the northern nations of Europe; or of the Scandinavians, who had migrated from Aſia, and from whom our Saxon anceſtors were deſcended. Mr. Mallet apprehends that it was originally compiled, ſoon after the Pagan religion was aboliſhed, as a courſe of poetical lectures, for the uſe of ſuch young Icelanders as devoted themſelves to the profeſſion of a *ſcald* or poet. It conſiſts of two principal parts; the *firſt* containing a brief ſyſtem of mythology, properly called the *Edda*; and the *ſecond* being a kind of art of poetry, and called *ſcalda* or *poetics*. The moſt ancient Edda was compiled by Soemund Sigfuſſon, ſurnamed the *Learned*, who was born in Iceland about the year 1057. This was abridged, and rendered more eaſy and intelligible about 120 years afterwards, by Snorro Sturleſon, who was ſupreme judge of Iceland in the years 1215 and 1222; and it was publiſhed in the form of a dialogue. He added alſo the ſecond part in the form of a dialogue, being a detail of different events tranſacted among the divinities. The only three pieces that are known to remain of the more ancient Edda of Soemund, are the Voluſpa, the Havamaal, and the Runic chapter.

EDDISH, or EADISH, the latter paſture or graſs that comes after mowing or reaping; otherwiſe called *eagraſs* or *earſh*, and *etch*.

EDDOES, or EDDERS, in botany; the American name of the ARUM *eſculentum*.

EDDY (Saxon), of *ed* "backward," and *ea* "water," among ſeamen, is where the water runs back contrary to the tide; or that which hinders the free paſſage of the ſtream, and ſo cauſes it to return again. That eddy water which falls back, as it were, on the rudder of a ſhip under ſail, the ſeamen call the *dead water*.

EDDY-*Wind* is that which returns or is beat back from a ſail, mountain, or any thing that may hinder its paſſage.

EDELINCK (Gerard), a famous engraver, born at Antwerp, where he was inſtructed in drawing and engraving. He ſettled at Paris, in the reign of Louis XIV. who made him his engraver in ordinary. Edelinck was alſo counſellor in the Royal Academy of Painting. His works are particularly eſteemed for the neatneſs of the engraving, their brilliant caſt, and the prodigious eaſe apparent in the execution; and to this is owing the great number of plates we have of his; among which are excellent portraits of a great number of illuſtrious men of his time. Among the moſt admired of his prints, the following may be ſpecified as holding the chief place: 1. A Battle between four Horſemen, with three figures lying ſlain upon the ground, from Leonardo da Vinci. 2. A holy Family, with Elizabeth, St. John, and two Angels, from the famous picture of Raphael in the king of France's collection. The firſt impreſſions are before the arms of M. Colbert were added at the bottom of the plate; the ſecond are with the arms; and in the third the arms are taken out, but the place where they had been inſerted is very perceptible. 3. Mary Magdalen bewailing her ſins, and trampling upon the riches of the world, from Le Brun. The firſt impreſſions are without the narrow border which ſurrounds the print. 4. Alexander entering into the Tent of Darius, a large print on two plates, from Le Brun. This engraving belongs to the three battles, and triumphal entry of Alexander into Babylon, by Girard Audran, and

completes the fet. The firft impreffions have the name of *Goyton* the printer at the bottom. 5. Alexander entering into the Tent of Darius (finifhed by P. Drevet), from Peter Mignard. Edelinck died in 1707, in an advanced age, at the Hotel Royal at the Gobelins, where he had an apartment. He had a brother named *John*, who was a fkilful engraver, but died young.

EDGINGS, in gardening, the feries of fmall but durable plants, fet round the edges or borders of flower-beds, &c. The beft and moft durable of all plants for this ufe, is box; which, if well planted, and rightly managed, will continue in ftrength and beauty for many years. The feafons for planting this, are the autumn, and very early in the fpring: and the beft fpecies for this purpofe is the dwarf Dutch box.

EDHILING, Edhilingus, an ancient appellation of the nobility among the Anglo-Saxons. The Saxon nation, fays Nathard (Hift. lib. iv.) is divided into three orders or claffes of people; the *edhilingi*, the *frilingi*, and the *lazzi*; which fignify the nobility, the freemen, and the vaffals or flaves. Inftead of *edhiling*, we fometimes meet with *atheling*, or *ætheling*; which appellation was likewife given to the king's fon, and the prefumptive heir of the crown. See Atheling.

EDICT, in matters of policy, an order or inftrument, figned and fealed by a prince, to ferve as a law to his fubjects. We find frequent mention of the edicts of the prætor, the ordinances of that officer in the Roman law. In the former French law, the edicts were of feveral kinds: fome importing new laws or regulations; others, the erection of new offices; eftablifhments of duties, rents, &c.; and fometimes articles of pacification. In defpotic countries an edict is much the fame as a proclamation is with us: but with this difference, that the former has the authority of a law in itfelf, from the power which iffues it; whereas the latter is only the declaration of a law, and has no power in itfelf.

EDILE, or Ædile. See Ædile.

EDINBURGH, the capital of Scotland, fituated in a county of the fame name, on three hills, or ridges, which run from E. to W. in a direction almoft parallel. On the middle ridge, which is narrow and fteep, ftands the Old Town. The North Town is feated on an elevated plain, gently floping on every fide; and the S. part of the city ftands alfo on a fimilar floping eminence. The fituation of the Old Town is very peculiar and ftriking. A fine ftreet, a mile in length, and generally 90 feet broad, extends from the caftle on the W. fummit of the hill, to Holyrood Houfe. It is called the high ftreet. On each fide of this fteep hill, the houfes form narrow lanes, which are called clofes, and extend N. and S. Many of them are very lofty, but fo crowded, and as it were piled upon each other, that they are far from being diftinguifhed either for elegance or cleanlinefs. The form of the Old Town refembles that of a turtle; the caftle being the head; the high ftreet, the ridge of the back; the clofes, the fhelving fides; and Holyrood Houfe, the tail. On each fide of this hill was once a lake. The S. valley, drained of its waters, is occupied by Cowgate-ftreet. The N. valley is alfo drained; but a difagreeable morafs remains, which is ftill called the N. Loch. The ancient caftle (the origin of which no hiftorian can trace) is feated on a high, craggy, and precipitous rock, with a drawbridge on the only fide that is acceffible. In former times, therefore, it was deemed impregnable. The vifitors to this caftle are here fhewn the apartment in which was born James VI. of Scotland, afterwards James I. of England. On the S. fide of the High-ftreet is the ancient church of St. Giles, a fine Gothic ftructure, which has four churches under its roof. Near this is the building in which the Scotch parliaments were ufually convened. It is now occupied by the courts of juftice; and its magnificent lofty hall merits particular attention. The palace of Holyrood Houfe forms a grand quadrangle, with a court in the centre furrounded by piazzas. The N. W. towers were built by James V. and the whole was completed in the reign of Charles II. A fpacious gallery here is hung with the pictures of 111 monarchs, from Fergus I. to James VI. the greateft part of them imaginary. In the N. W. tower is fhown the chamber where Queen Mary fat at fupper, when Rizzio was dragged from her fide and murdered, and the private ftaircafe by which Ruthven entered with the affaffins, to perpetrate the ruthlefs deed. Adjoining are the magnificent ruins of an abbey, founded by David I. in 1128, and converted by Charles II. into a royal chapel. The communication between the N. and S. parts of Edinburgh is by two noble bridges; the N. one built in 1763, and the S. in 1785. The N. Town has many new fquares and ftreets, adorned with uniform and elegant houfes. The buildings of the S. Town are likewife elegant and extenfive, though not equal to thofe of the N. But, in this part, the New College will foon form a very ftriking object. It was begun in 1789, on the elegant plan of the late Mr. Robert Adam. The moft liberal fubfcriptions from perfons of all ranks, and even from the E. Indies, have been procured for this important work. Of the univerfity of Edinburgh it will be fufficient to obferve, that it is celebrated in all quarters of the world; and its medical fchool, in particular, is entitled to the firft rank. Of the other buildings in Edinburgh, a few only can be mentioned; namely, the Royal Exchange, built in 1753; the Regifter Office; the Phyficians Hall; Heriot's Hofpital, a beautiful Gothic ftructure, founded in 1628, for the education of 140 poor boys; Watfon's Hofpital, for the fupport of the fons of decayed merchants; two hofpitals for girls; three charity work-houfes; an alms-houfe; an hofpital for orphans; a Royal Infirmary, incorporated by charter in 1736; and the public difpenfary. The churches, both prefbyterian and epifcopal, and other places of worfhip, of various denominations, are numerous. The public places of amufement are, the Affembly Rooms, the Concert Hall, the Hall for the Royal Archers, the Theatre Royal, and the Equeftrian Circus. Edinburgh, with its dependences, is fuppofed to contain 200,000 inhabitants. It is fupplied with water, conveyed in caft-iron pipes, from Comifton, four miles to the W. It is governed by a lord provoft, four bailies, and a common council, and fends one member to parliament. It is two miles S. of Leith, 54. W. N. W. of Berwick upon Tweed, and 389 N. by W. of London. Lon. 3. 7. W. Lat. 35. 58. N. See Leith.

EDITOR, a perfon of learning, who corrects and has the care of an impreffion of any literary work, whether of an ancient or modern author. Erafmus was a great editor; the Louvain doctors, Scaliger, bifhop Walton, Mr. Hearne, Mr. Ruddiman, &c. were likewife famous editors.

EDOM, or Esau, the fon of Ifaac and brother of Jacob. The name of Edom, which fignifies *red*, was given him, either becaufe he fold his birth-right to Jacob for a mefs of red pottage, or by reafon of the colour of his hair and complexion. Idumea derives its name from Edom, and is often called in fcripture the land of Edom.

EDUCATION;

THAT feries of means by which the human underftanding is gradually enlightened, and the difpofitions of the human heart are formed and called forth between earlieft infancy and the period when we confider ourfelves as qualified to take a part in active life.

This comprehends the circumftances of the child in regard to local fituation, and the manner in which the neceffaries and conveniences of life are fupplied to him; the degree of care and tendernefs with which he is nurfed in infancy; the examples fet before him by parents, preceptors, and companions; the degree of reftraint or licentioufnefs to which he is accuftomed; the various bodily exercifes, languages, arts, and fciences, which are taught him, and the method and order in which they are communicated; and the moral and religious principles to be inftilled into his mind.

In different periods of fociety, in different climates, and under different forms of government, various inftitutions have naturally prevailed in the education of youth; and even in every different family, the children are educated in a different manner, according to the differences in the fituation, difpofitions, and abilities, of the parents. The education of youth being an object of the higheft importance, has not only engaged the anxious care of parents, but has likewife often attracted the notice of legiflators and philofophers. Among the latter we recognife the names of fome of the moft illuftrious. Our fublime poet Milton wrote a treatife on education, as did the great Mr. Locke, and fome others. But that which profeffes moft immediately *to follow nature*, and to which therefore, notwithftanding the many fingularities of opinion for which it is remarkable, we cannot but give a preference, is the Treatife on Education, by Rouffeau, well known under the Englifh title of Emilius, from which we propofe to draw much of the matter of the prefent treatife. It cannot but be owned indeed, that the fubject has been greatly advanced by many modern authors, and of thefe we mean alfo to avail ourfelves wherever their remarks may feem more to our purpofe.

All that man is not poffeffed of at his birth, and which he requires when grown up, is beftowed on him by education. This education we receive from nature, from men, or from circumftances. The conftitutional exertion of our organs and faculties is the education of *nature*: the ufes we are taught to make of that exertion, conftitute the education given us by *men*; and in the acquifitions made by our own experience, on the objects that furround us, confifts our education from *circumftances*. We are formed, therefore, by three kinds of mafters. The pupil, in whom the effects of their different leffons are contradictory, is badly educated, and can never be confiftent with himfelf. He in whom they are perfectly confonant, and always tend to the fame point, hath only attained the end of a complete education. His life and actions demonftrate this, and that he alone is well brought up.

Of thefe three different kinds of education, that of nature depends not on ourfelves; and but in a certain degree that of circumftances. The third, which belongs to men, is that only we have in our power. And even of this we are mafters only in imagination; for who can flatter himfelf, he will be able entirely to govern the difcourfe and actions of *thofe who are about* a child? No fooner, then, doth education become an art, or profeffion, than it is almoft impoffible it fhould fucceed, as the concurrent circumftances neceffary to its fuccefs are not to be depended on. All that can be done, with our utmoft folicitude, is to *approach as near* as poffible the end we aim at, attributing it to good fortune if it be attained.

If it be afked, what is this end? It may be anfwered, that of *nature*, which has been already proved. For, fince the concurrence of three kinds of education is neceffary to its perfection, it is by that one which is entirely independent of us, we muft regulate the two others.

According to the order of fociety, in which the refpective places of individuals are fixed, every one ought to be educated for that which he is to fill. A man formed for one place, if taken out of it, would be fit for no other, and confequently good for nothing. In this ftate, education is ufeful only as fortune feconds the intentions of parents; in every other cafe it would be hurtful to the pupil, were it only on account of the prejudices it might inftil. In Egypt, where the fon was obliged to follow the occupation or profeffion of his father, education had at leaft a determinate end; but among us, where rank and profeffion are only permanent, and perfons continually changing, a father would not know whether, in bringing up his child to his own profeffion, he might be doing him good or ill.

According to the order of nature, all men being equal, their common vocation is the profeffion of humanity; and whoever is well educated to difcharge the duties of a man, cannot be badly prepared to fill up any of thofe offices that have a relation to him. It matters little to us, whether the pupil be defigned for the army, the bar, or the pulpit. Nature has deftined us to the offices of human life, antecedent to the deftination of our parents concerning the part we are to act in fociety. To live is the profeffion we would teach him. When we have done with him, it is true, he will be neither a lawyer, a foldier, nor a divine. Let him firft be a man; he will on occafion as foon become any thing elfe, that a man ought to be, as any other perfon whatever. Fortune may remove him from one rank to another, as fhe pleafes, he will be always found in his place.

Our chief ftudy is that of human life; the good and evil of which he that is beft able to fupport, is the beft educated; and hence it follows that true education confifts lefs in precept than *action*. We begin to inftruct ourfelves as we begin to live; our education commencing with our being, and our firft preceptor the nurfe. Thus the word *education* had, among the ancients, a different fignification to that which is now given it; being ufed to exprefs fimply nutriment. *Educit obftetrix*, fays Varro, *educat nutrix, inftituit pædagogus, docet magifter*. According to this diftinction, education, inftitution, and inftruction are three things as different, as the nurfe, the preceptor, and the mafter. But thefe diftinctions not being well underftood, a child, in order to be well conducted, fhould follow but one guide.

We muft therefore generalize our views, and confider our pupil as *man in the abftract*; as expofed to all the various accidents of human life. If men were born infeparably attached to the foil of one country, if one feafon lafted the whole year, if individuals were incapable of changing their fituation in life, the cuftoms already eftablifhed would be in fome refpects commendable; a child brought up to, and never removed from one certain ftation, would not be expofed to the inconveniences of

another. But, confidering the inftability of human affairs, with that reftlefs and buftling fpirit of the age which turns every thing upfide down, in every new generation; can any method of education be more abfurd than that of bringing up a child, as if he were never to fet his foot out of the nurfery, or was to be perpetually furrounded by attendants? If the helplefs creature makes but one flip on the ground, or defcends one ftep of the ftairs, he is infallibly ruined. It is not enough to teach him to *bear* pain, he fhould be *inured to the fenfe* of it.

In general, little more is thought of in the education of a child than to preferve his being: this is not enough: he ought to learn how to preferve himfelf when he is grown up to manhood; to fupport the fhocks of fortune, to bear riches or poverty, and to live, if occafion require, either amidft mountains of ice in Greenland, or on the burning rocks of Malta. You may take what precaution you will to preferve his life; he muft inevitably die; and though his death may not be juftly charged to your folicitude, your pains will be in a great meafure thrown away. It is lefs needful to preferve your child from death than to teach him how to live. To live is not merely to breathe; it is to act, to make a proper ufe of our organs, our fenfes, our faculties, and of all thofe parts of the human frame which contribute to the confcioufnefs of our exiftence. The man who has lived moft, is not he who hath furvived the greateft number of years, but he who has experienced *moft* of life. A man may be buried at an hundred years of age, who died in his cradle. Such a one would have been a gainer by dying young, at leaft if he had lived, in our fenfe of the word, till the time of his deceafe.

All our wifdom confifts in fervile prejudice; all our cuftoms are nothing but fubjection, confinement, and reftraint. Civilifed man is born, lives, and dies in flavery: at his birth he is bound up in fwaddling-cloths, and at his death nailed down in his coffin. As long as he wears the appearance of the human form, he is confined by our inftitutions. It is faid fome midwives pretend, in moulding the heads of new born infants, to give them a more proper form; and their pretenfions are admitted. Strange infatuation! Our heads are very ill conftructed by the author of our being; we are therefore to have them new-modelled on the outfide by the midwives, and within by the philofophers!

Sect. I. *Of the Management of Children in Infancy.*

"With us," fays M. Buffon, "an infant no fooner leaves the womb of its mother, and has hardly enjoyed the liberty of moving and ftretching its limbs, than it is clapped again into confinement. It is fwathed, its head fixed, its legs ftretched out at full length, and its arms placed ftraight down by the fide of its body. In this manner it is bound tight with cloths and bandages, fo that it cannot ftir a limb; indeed it is fortunate if the poor thing be not fo muffled up as to be unable to breathe; or, if fo much precaution be taken as to lay it on its fide, in order that the fluid excretions voided at the mouth may defcend of themfelves; for the helplefs infant is not at liberty to turn its head to facilitate their difcharge."

Hence the impulfive force of thofe internal parts of the body difpofed to increafe, finds an unfurmountable obftacle to the movements required to accelerate their growth. The infant is continually making fruitlefs efforts, which wafte its powers or retard their progrefs. More compreffed, more confined, and lefs at eafe in its fwaddling-cloths than in its mother's womb, it is not eafy to conceive what it has gained by its birth. In countries where no fuch extravagant precautions are taken, the people are tall, robuft, and well-proportioned. On the contrary, thofe where infants are thus treated, fwarm with hunch-backed, crooked-legged, lame, rickety, and deformed perfons of every kind. Left their bodies fhould not grow diftorted from their being at liberty to move freely, we are always in hafte to diftort them effectually by putting them into a prefs. We voluntarily deprive them of the ufe of their limbs, for fear they fhould by accident hurt or maim themfelves. May not fuch cruel reftraint have an effect upon their difpofition alfo, as well as their temperament? Their firft fenfations are thofe of uneafinefs and pain; they find an obftacle oppofed to every motion they are inclined to; more unhappy than a criminal in chains, they are continually making vain efforts, till their patience is exhaufted, and they vent their anxiety in cries.

Whence comes this irrational, this unnatural cuftom? Ever fince mothers have taken upon them to defpife their principal obligation, and give up the nurfing of their own children, it has been neceffary to commit them to the care of women hired for that purpofe; who, thus become the temporary mothers of children in whofe favour nature is filent, have ftudied only to fave themfelves trouble. An infant whofe arms and legs are at liberty, muft be continually watched; but when it is faft bound, it may be thrown into any corner, without troubling yourfelf about its cries. Provided there are no other proofs of the nurfe's negligence, if the child break not a leg or an arm, what fignifies it to her whether it die, or remain a cripple the reft of its life? Its limbs are preferved at the expence of its whole body, and whatever may happen, the nurfe is excufed.

Do thofe polite mothers, who, unnaturally difengaged from the trouble of fuckling their children, indulge themfelves in the amufements of the town, know the treatment their harmlefs infants may, at the fame time, receive in the country? How often is the little innocent, when its nurfe is in the leaft hurry, hung up on a peg, like a bundle of clouts, there to remain crucified, till other bufinefs be leifurely difpatched? It is pretended that children unfwathed would be fubject to various accidents from their reftleffnefs, deftructive to the perfect conformation of their limbs. This is one of the futile arguments of our falfe reafoning, and which has never been confirmed by experience. To the honour of modern times, however, this abfurd and cruel treatment of the infant part of our fpecies is daily getting into difufe; and we fhall therefore dwell on the fubject no farther. An error of an oppofite nature indeed it is highly neceffary we fhould notice.

The obvious paths of nature are forfaken, though in a different manner, when, inftead of neglecting the duties of a mother, a woman carries them to excefs; when fhe makes an idol of her child; increafes its weaknefs, by preventing its fenfe of it; and, as if fhe could emancipate him from the laws of nature, prevents every approach of pain or diftrefs; without thinking, that, for the fake of preferving him at prefent from a few trifling inconveniences, fhe is accumulating on his head a diftant load of anxieties and misfortunes; without thinking that it is a barbarous caution to enervate and indulge the child at the expence of the man. Thetis, fays the fable, in order to render her fon invulnerable, plunged him into the waters of Styx. This is an expreffive and beautiful allegory. The cruel mothers I am fpeaking of act directly contrary: By plunging their children in foftnefs and effeminacy, they render them more tender and vulnerable; they lay open, as it were, their nerves to every fpecies of afflicting fenfations, to which they will certainly fall a prey as they grow up.

Obferve nature, and follow the track fhe has delineated. She continually exercifes her children, and fortifies their conftitution by experiments of every kind; inuring them betimes to grief and pain. In cutting their teeth they experience the

fever; griping colics throw them into convulfions; the hooping-cough fuffocates, and worms torment them; furfeits corrupt their blood, and the various fermentations their humours are fubject to, cover them with dangerous eruptions. Almoft the whole period of childhood is ficknefs and danger, half the children that are born dying before they are eight years old. In paffing through this courfe of experiments, the child gathers ftrength and fortitude, and, as foon as he is capable of living, the principles of life become lefs precarious.

This is the rule of nature. Why fhould you act contrary to it? Do not you fee, that, by endeavouring to correct her work, you fpoil it, and prevent the execution of her defigns? Act you from without as fhe does within. This, according to you, would increafe the danger; on the contrary, it will create a diverfion, and leffen it. Experience fhows, that children delicately educated die in a greater proportion than others. Provided you do not make them exert themfelves beyond their powers, lefs rifque is run by exercifing, than indulging them in eafe. Inure them therefore by degrees to thofe inconveniences they muft one day fuffer. Harden their bodies to the intemperance of the feafons, climates, and elements; to hunger, thirft, and fatigue; in a word, dip them in the waters of Styx. Before the body hath acquired a fettled habit, we may give it any we pleafe without danger; but when it is once arrived to its full growth and confiftence, every alteration is hazardous. A child will bear thofe viciffitudes which to a man would be infupportable. The foft and pliant fibres of the former readily yield to impreffion; thofe of the latter are more rigid, and are reduced only by violence to recede from the forms they have affumed. We may therefore bring up a child robuft and hearty, without endangering either its life or health; and though even fome rifk were run in this refpect, it would not afford fufficient caufe of hefitation. Since they are rifks infeparable from human life, can we do better than to run them during that period of it wherein we take them at the leaft difadvantage?

The life of a child becomes the more valuable as he advances in years. To the value of his perfon, muft be added the coft and pains attending his education; to the lofs of life, alfo, may be annexed his own fenfe and apprehenfions of death. We fhould, therefore, particularly direct our views to the future in his prefent prefervation; we ought to arm him againft the evils of youth, before he arrives at that period. For if the value of his age increafes, till he attain the age in which it is ufeful, what a folly is it to protect him from a few evils in his infancy, to multiply his fufferings when he comes to years of difcretion! Can fuch be the inftructions of a mafter of his profeffion?

Man is born to fuffer in every ftage of his exiftence. Even felf-prefervation is attended with fome degree of pain. Happy are we that in our infancy we are fufceptible only of phyfical evils!—evils much lefs cruel, much lefs terrible than others, and more feldom capable of reconciling us to death. Men never deftroy themfelves to get rid of the gout; the anguifh of the mind only is productive of defpair. We lament the ftate of infants, whereas it is our own that is moft to be lamented. Our greateft evils are derived from ourfelves.

A child as foon as it is born begins to cry; great part of its earlieft infancy being fpent in tears. Sometimes we dance it about and footh it; at others threaten and beat it, in order to make it filent. We always either do that which is pleafing to the child, or exact of it what pleafes ourfelves; either fubmitting to its humours, or obliging it to fubmit to ours. There is no medium; it muft either command or obey. Hence the firft ideas it acquires, are thofe of tyranny and fervitude. Before it can fpeak, it learns to command, and before it can act it is taught obedience; nay, fometimes it is punifhed before it be confcious of a fault, at leaft before it can commit one. Thus it is we early inftil into their tender minds thofe paffions which we afterwards impute to nature; and after having taken fuch pains to make them vicious, complain that we found them fo.

SECT II. *Of the Importance of Early Education.*

In common nurferies, the phyfical part of education only is regarded. Provided the child lives, and does but *thrive*, as it is called, all is well; nothing more is regarded. But according to our fyftem, wherein the care of a child's education *commences with its being*, the infant becomes at its birth the difciple, not indeed directly of his governor, but of nature. The governor does nothing more than ftudy her fuperior precepts, and endeavour to prevent them from being thrown away. It is his province to have an eye over, to obferve and attend his pupil; to watch as diligently the firft dawning of his feeble underftanding, as the Mahometans look for the rifing of the new moon.

We are born with a capacity for acquiring knowledge; but without knowing any thing. The foul, confined in half-formed and imperfect organs, poffeffes not even the fenfe of its own exiftence.

The emotions and cries of a new-born infant, are effects purely mechanical, void of fenfe or will.

Let us fuppofe a child, at its birth, poffeffed of the ftrength and ftature of a man; taken from his mother's womb, as one may fay, armed at all points, like Pallas iffuing from the brain of Jove. This adult infant would be a perfect idiot, an automaton, an immoveable and almoft infenfible ftatue. He would fee nothing, underftand nothing, know nothing; nay he would not be able to turn his eyes toward the object he might have occafion to fee. He would not only be incapable of perceiving external objects; he would not be able to perceive them in the refpective organs of perception. Colours would not appear to be painted on the retina; founds would feem not to ftrike on the ear; the bodies in contact with him would not appear to touch his own; nay, he would not be fenfible of his having any body at all. The feeling of his hands would feem to exift in the brain; all his fenfations would be generalized into one; he would feem to exift only in the common *fenforium*; he would have but one idea, *i. e.* that of a *felf*, in which all his feelings would be abforbed; and this idea, or rather fenfation, would conftitute the only difference between fuch a fuppofed being and a common child. This being, alfo, thus formed on a fudden, would be as little capable of ftanding on his legs. It would require a long time for him to learn how to keep his body in equilibrio. Perhaps he would not even attempt it; and you would fee this tall robuft animal fixed in one place like a ftock or a ftone, or crawling and tumbling about like a puppy.

He would perceive uneafinefs occafioned by his wants, without knowing what he wanted, or dreaming of any means to gratify them. There is no immediate communication between the mufcles of the ftomach and thofe of the legs and arms, that, fuppofing him ravenous with hunger and furrounded with victuals, would make him take one ftep to approach, or reach out his hand to lay hold of them; fo that, his body having none of the natural propenfities to growth, nor any of thofe conftant emotions which actuate children on that account, he would die of hunger before he would move to feek any thing for his fubfiftence. If we reflect ever fo little on the order and progrefs of our acquirements, we fhall not be able to deny, that a man muft be nearly in fuch a fituation of primitive ignorance and ftupidity, before he has acquired any thing of the experience of his fellow-creatures.

The point, therefore, is known, or may be known, from which we all ſet out to arrive at common underſtanding. But who is there can tell how diſtant is the other extremity of the line? Every one advances more or leſs according to his genius, taſte, neceſſities, talents, zeal, and the opportunities afforded him. There is no philoſopher who hath been raſh enough to preſcribe the limits of our knowledge, and to ſay, Thus far, O man, ſhalt thou go, and no farther. We are ignorant of the extent of the human capacity, nor hath any one as yet meaſured the utmoſt poſſible diſtance between that of one man and another. Where is the mind ſo baſe as never to have been elevated by this reflection?, Where is the man who does not ſometimes ſay, in the pride of his heart, "How many men have I "already ſurpaſſed! How many may not I yet overtake? Why ſhould my equal go farther than myſelf?"

The education of a man, as we have already ſaid, commences *at his birth*. Before he can ſpeak, before he can underſtand, he is already inſtructed. Experience is the forerunner of precept; the moment he knows the features of his nurſe, he may be ſaid to have acquired conſiderable knowledge. Trace the progreſs of the moſt ignorant of mortals, from his birth to the preſent hour, and you will be aſtoniſhed at the knowledge he has acquired. If we divide all human ſcience into two parts, the one conſiſting of that which is common to all men, and the other of what is peculiar to the learned, the latter will appear inſignificant and trifling in compariſon with the other. But we think nothing of general acquiſitions, becauſe they are made inſenſibly, and even before we arrive at the age of reaſon; knowledge becomes conſpicuous only in its difference on compariſon; juſt as in working algebraic equations, common quantities are ſtruck out and ſtand for nothing.

Even brutes themſelves have their acquirements. They have organs of ſenſe, and muſt learn to make uſe of them; they have wants which they muſt learn to provide for; they muſt learn to ſwim, to walk, and to fly. Quadrupeds are not capacitated to walk merely becauſe their legs are able to ſupport them. As ſoon as they are brought forth, the firſt eſſays they make are very hobbling and uncertain. A ſinging-bird, eſcaped from the cage in which it was bred, will not know how to fly, becauſe it has never flown. Senſible and animated beings owe every thing to inſtruction. If trees and plants had a progreſſive loco-motion, they muſt have been endued with ſenſes, and have acquired knowledge, otherwiſe their ſpecies would have been ſoon extinct.

Sect. III. *Of Habit.*

The firſt ſenſations of children are thoſe which are merely affecting; they perceive nothing for ſome time but pleaſure and pain. Being unable to walk about, or lay hold of any thing, they require a good deal of time to form to themſelves, by degrees, thoſe repreſentative ſenſations, which make objects appear to have an external exiſtence. In the mean time, and while ſuch objects are extending themſelves, retreating as it were from the eye, and aſſuming forms and dimenſions, the return of the affecting ſenſations begins to ſubmit to the influence of habit. The eyes of children are turned conſtantly toward the light, and, if it come from one ſide, they imperceptibly take that direction; ſo that care ſhould always be taken to ſet them facing the light, leſt they ſhould become ſquint-eyed, or accuſtom themſelves to look croſſwiſe. They ſhould alſo be early accuſtomed to the abſence of light, otherwiſe they will be apt to cry when they find themſelves in the dark.

Sleep and nutriment, when too exactly proportioned, become neceſſary to them at the end of ſtated intervals, and after a time their propenſities thereto ariſe, not from phyſical neceſſity, but habit; or rather, habit produces an additional neceſſity to thoſe of nature. This muſt, by all means, be prevented.

The only habit in which a child ſhould be indulged, is that of contracting none; he ſhould not be permitted to exerciſe one arm more than the other; we ſhould not accuſtom him to preſent his right hand oftener than his left, or to make uſe of one more than the other; he ſhould not be uſed to eat, ſleep, or do any thing, at ſtated hours, or not to be left alone, whether in the day or night. Prepare early for his enjoyment of liberty, and the exerciſe of his natural abilities, by leaving him in full poſſeſſion of them unreſtrained by artificial habits, and by putting him in a ſituation to be always maſter of himſelf, and to do whatever his reſolution prompts him, as ſoon as he is able to form one.

As ſoon as a child begins to diſtinguiſh objects, a proper choice ſhould be made in thoſe which are preſented to it. Every new object is naturally intereſting to a child. It finds itſelf ſo weak and feeble that it is fearful of every thing it is not acquainted with. But familiarity, which renders objects unaffecting, deſtroys this timidity. We ſee that children, educated in neat houſes, where cobwebs are carefully ſwept away, are always afraid of ſpiders, and retain the ſame diſguſt for them as they grow up. What peaſant, either man or woman, was ever afraid of a *ſpider?*

The education of a child, therefore, evidently begins before it can ſpeak or underſtand, ſince even the choice of objects, preſented to its view, is ſufficient to render it either timid or courageous. They ſhould be habituated then to new objects, to ugly, diſguſtful, and uncommon animals; beginning with them, however, at a diſtance, and letting them approach by degrees; or till, being uſed to ſee others handle them, they will venture to handle them themſelves. If a child, during his infancy, hath been uſed to regard toads, ſerpents, or cray-fiſh, with indifference, he will look without horror, as he grows up, on any animal whatever. No object is frightful to ſuch as are daily accuſtomed to frightful objects.

All children are terrified at a maſk. We ſhould begin to reconcile our pupil to maſks, by ſhowing him firſt an agreeable one. Somebody ſhould afterwards put it on, at the ſight of which the company ſhould laugh, and the child would then laugh with the reſt. By degrees, you ſhould uſe him to others leſs agreeable; and laſtly, to the moſt hideous and frightful. By artful management he will thus be brought to laugh, and be as much pleaſed with the laſt as the firſt; nor will he ever after be terrified at a maſk. When Hector was going to take leave of Andromache, his child Aſtyanax, frightened at the nodding plume of his father's helmet, did not know him, but ſhrunk, crying, into the boſom of his nurſe, and drew a ſmile from his weeping mother. What ſhould have been done to cure the infant of his fears? Certainly the very thing which Hector did, in taking off his helmet and embracing the child, without it. Nor ſhould this have been all: at ſome other opportunity, he ſhould have been brought to handle, and play with the feathers, after which his nurſe ſhould have taken the helmet and put it, laughing, on her head; if it may be preſumed a woman might dare to make ſo free with the arms of Hector. Children are ſeldom afraid of thunder, unleſs the claps are exceſſively loud, and really hurt the drum of the ear. They have otherwiſe no ſuch fear, till they have learned that it is ſometimes hurtful and even mortal. The fears thus inſtilled by reaſon ſhould be eradicated by habit: while, by ſlow and artful means, both children and men would acquire intrepidity, and be afraid of nothing.

In a ſtate of infancy, wherein the memory and imagination

are as yet inactive, a child is attentive to nothing but what actually affects his fenfes with pain or pleafure. His fenfations being thus the original materials of his ideas, to regulate the formation of thofe ideas agreeable to the order of things, is to prepare his memory to prefent them, hereafter, in the fame order, to his underftanding; but as while fo young he is only capable of attending to his fenfations, it is fufficient at firft, to make him fenfible of the connection between thefe fenfations and the objects that excite them. He is curious to touch and handle every thing he fees; he fhould be indulged in the gratification of this curiofity; it fuggefts to him a very neceffary courfe of experiments. Hence it is he muft learn to feel heat and cold, the hardnefs, foftnefs, and weight of bodies; to judge of their magnitude, figure, and other fenfible qualities, by looking, touching, hearing, and particularly by comparing the fight with the touch, and judging, by means of the eye, of the fenfation acquired by the fingers.

It is by motion only that we difcover any thing to exift out of ourfelves; and it is by our own motion that we acquire the idea of extenfion. It is, becaufe a child has no fuch idea, that it will ftretch out its hand, in the fame manner, to lay hold of an object within its reach, or at an hundred yards diftance. This effort appears to you only a token of command, an order to the object to come to him, or to you to fetch it; but it is in fact no fuch thing. It is made, becaufe the objects which a child firft perceives to exift in the brain, and afterwards in the eye, appear now to exift at arm's length; and he has no conception of any extenfion beyond his reach. Care fhould be taken, therefore, to walk him about often, to have him carried about from one place to another, where he choofes to go, in order to give him juft ideas of local relations, and teach him to judge of diftances. When he begins, however, once to know thefe, your method muft be changed, and you muft let him go, or carry him, only where you pleafe; not where he pleafes: for when his fenfes no longer deceive him in this refpect, the efforts I have been fpeaking of change their caufe. This change is fo remarkable, that it may require fome explanation.

Sect. IV. *Of the Language of Infants.*

The uneafinefs occafioned by our wants, is expreffed by figns, when the affiftance of others is required to relieve them. Hence the cries of infants. They are almoft perpetually in tears. And indeed fo they muft be. As all their fenfations are of the affecting kind; when thefe are agreeable, they enjoy them in filence; but, when painful, they naturally exprefs themfelves in their *own language*, and demand relief. Now, while they are awake, they feldom are in a ftate of indifference. They are generally afleep, or fome how or other affected with uneafy fenfations.

To the language of the tongue, we may alfo add that of gefture, equally expreffive. By gefture I do not mean any motion of the feeble hands of fuch young children; the gefture of infants lies in the mufcles of their face. It is aftonifhing to fee fuch ftrength of expreffion in their half-formed phyfiognomies. Their features are continually varying, with inconceivable rapidity of tranfition.

As man, in his firft ftage of life, is a wretched and helplefs being, fo his firft mode of expreffion is that of *tears* and complaint. An infant is fenfible of his wants, and incapable of fatisfying them; he therefore implores the affiftance of thofe about him, by his cries. If he be hungry or have thirft, he cries; if too cold or too hot, if he want to move, or to be held ftill, he cries. If he want to fleep or to be danced about, he has no other method to exprefs himfelf but by crying. The lefs he is in a fituation to help himfelf, the more frequently he requires affiftance, to vary his circumftances or pofition. He has but one kind of language, becaufe he knows, in fact, but one kind of inconvenience. In the prefent imperfection of his organs, he is incapable of diftinguifhing their different impreffions; all the different caufes of his uneafinefs form but one fenfation of pain. Thus from the tears of children, which one is apt to think fo little worthy of attention, arifes the firft fenfe of the relation which man bears to the objects that furround him. Here is forged the firft link of that extenfive chain which forms the bond of fociety.

When a child cries, it is evidently uneafy, it hath fome want that requires to be fatisfied; we look, we examine what it is, find it out, and relieve it. If this be not the cafe, and the caufe of uneafinefs cannot be found, its tears continue to flow, and it begins to grow outrageous. We foothe it, to make it quiet, rock it, or endeavour to fing it afleep. If this does not fucceed, we grow impatient and threaten it; nay fometimes a brutal nurfe will beat the poor innocent in thefe circumftances. Strange leffons thefe, furely, at our firft entrance into life!

"I fhall never forget," fays M. Rouffeau," "that I once faw a crying child thus beaten by its nurfe; on which it became immediately filent, and, as I thought, intimidated. I reflected upon this occafion, what a fervile mind that muft be, on which nothing would operate but rigour. I was, however, deceived; the little wretch was almoft fuffocated with choler; it loft its breath, and I faw it growing black in the face. In a moment after it fet up the moft piercing cries; expreffing all the figns of refentment, fury, and defpair, adapted to its age. I was even apprehenfive it would expire under the violence of its agitation. This example alone would have convinced me, if I could ever have doubted it, of an innate fenfe of right and wrong being implanted in the human heart. I am very certain, had a burning coal fallen by accident on the hand of the child, it would have been lefs agitated than by this flight blow, given with manifeft intention to hurt it."

This difpofition in children to paffion, and exceffive anger, requires very nice management. We fhould be careful, therefore, to keep them from fervants, who are continually teafing and provoking them. While infants are croffed only by the refiftance of *things*, and not by *perfons*, they will never grow fractious nor paffionate. Tears are the *petitions* of young children; if they be not looked on as fuch, they will foon become *commands*. Infants would begin by praying our affiftance, and go on to command our fervice. Thus from their own weaknefs, whence at firft arifes the fenfe of their dependence, follows the notion of domineering and command. This idea, however, is lefs excited by their wants than by our affiduities; and here we begin to perceive thofe moral effects, whofe immediate caufe doth not exift in nature. At the fame time, we fee how neceffary it is, *to difcover the fecret motives* of the cries of children even in their earlieft infancy.

When a child fometimes holds out its hand, without any other emotion, it thinks to reach the object, becaufe it cannot eftimate the diftance of it. It is here only miftaken: but when, in reaching out its hand, it cries, or manifefts other figns of impatience, it is not deceived in the diftance of the object, but is either commanding it to approach, or you to fetch it. In the firft cafe, therefore, it is proper to undeceive the child, by carrying it gently toward the object; and in the laft not to appear to mind it; but the louder it cries, the lefs notice to take of it. It is of confequence to check children betimes, in ufurping the command over perfons who are not in their power, or over things which they are not fufficiently acquainted with. For the latter reafon, it is better, when a child defires any thing that may be proper to give him, to carry him to the object, than to bring the object to the child; as, by this means,

he deduces a conclusion adapted to his tender years, and which there is no other way of suggesting to him.

Sect. V. *Of Indulgence and Restraint.*

Reason only teaches us to know good from evil. Conscience, which excites us to love the one and hate the other, although independent on the reason, cannot discover one from the other without it. Before we come to be capable of reasoning, we do good and ill without knowing it; and there is no morality in our actions, though there may, and frequently is, in our sentiments concerning the actions of others relative to us. A child will often put things into disorder, will break every thing it comes near, will grasp a sparrow, as it would a stone, and kill it, without knowing what it is doing. And why? The drooping activity of the vital principle is concentrated in the heart of age; in that of infancy it overflows and diffuses itself; in the excess of its vivacity, a child seems to have life enough to animate every thing around it. Whether it makes or mars it is all one to a child, provided the situation of things be changed; as every change necessarily implies action. If it seem to have a propensity to destroy things, it is not from a vicious principle; but because the action, necessary to make or compose any thing, is tedious and slow, whereas that of spoiling and breaking things to pieces, being quicker, agrees better with its natural alertness and vivacity.

At the same time, however, that the Author of Nature hath given to children this active principle, he hath taken care to prevent its being hurtful, by giving them as little strength in proportion to indulge it. But no sooner are they misled to conceive the persons about them as instruments which they themselves are to put in action, than they make use of them to assist their weakness in pursuing their inclinations. Hence it is they become importunate, tyrannical, imperious, mischievous, and intractable; a progress that doth not arise from a natural spirit of domineering, but is *the effect of wrong education*: for it requires no great experience to perceive how agreeable it is to act by means of others, and to have occasion only to speak in order to put the world in motion.

As it grows up, a child acquires strength, and becomes less active and restless; it contracts its powers more within itself. The body and soul, if I may say so, keep each other in equilibrio; and nature requires no greater quantity of motion than is necessary to our preservation. But the desire of command doth not cease with the motives that gave rise to it; the notion of superiority is flattering to self-love, and is increased by habit: thus caprice succeeds to necessity, and the force of prejudice and opinion takes root in the mind. The principle once known, we see clearly the track wherein we begin to deviate from nature: let us enquire then, what must be done, in order to prevent our going astray. So far from being endued with superfluous abilities, children have at first hardly sufficient for the purposes nature requires; *it is requisite therefore to leave them at full liberty to employ those she hath given them, and which they cannot abuse.* This should be our first maxim. *It is our duty to assist them, and supply their deficiencies, whether of body or mind, in every circumstance of physical necessity:* second maxim.

Every assistance afforded them should be confined to real utility, without administering any thing to the indulgence of their caprice or unreasonable humours; for they will never be capricious unless through neglect, or in some particular circumstance depending on their constitution: third maxim.

The meaning of their language and signs ought to be carefully studied, in order to be able to distinguish, in an age when they know not how to dissemble, between those inclinations that arise immediately from nature, and what are only fantastical: fourth maxim. The design and tendency of these rules are, to give children more real liberty and less command; to leave them more to do of themselves than to require of others. Thus, by being early accustomed to confine their desires to their abilities, they will be little affected with the want of what is out of their power.

Here we have a new and very important reason for leaving their body and limbs at full liberty; with this precaution, however, that we remove them from the danger of falling down, and put every thing out of their reach whereby they may wound or hurt themselves. It cannot be doubted that an infant, whose body and arms are at liberty, will cry less than another bolstered up in swaddling-clothes. The child, who is liable to suffer none but natural inconveniencies, will cry only when it feels pain; which is a great advantage in its education; for then we are certain to know when it stands in real want of assistance, and this should be afforded it, if possible, immediately. But if it be out of our power to relieve it, we should take no notice, nor make any fruitless attempts to quiet it: kisses and caresses will not cure its colic; yet it will remember the methods taken to sooth it; and when it once knows how to employ you at its pleasure, it is become your master, and all is over. Being less restrained in their efforts to move, children would cry less; if we were less importuned with their tears, it would require less trouble to quiet them; threatened and soothed more seldom, they would become less timid and obstinate, and would retain more of their natural temper and disposition. It is less from letting children cry unnoticed, than from striving to appease them, that they get falls: our proof of this is, that those which are most neglected are the least subject to such accidents. We are far, however, from recommending that children should, for this reason, be neglected: on the contrary, so much care must be taken of them as to prevent accidents of this kind, so that their cries shall not give the first notice of them. Neither should a nurse be over solicitous about trifles. Why should she think it so great a hardship on the child, to let it cry a little, when she sees on how many occasions its tears are useful and salutary? When children come to be sensible of the great value you set on their silence, they will take care you shall not have too much of it.

The long fits of crying in a child, who is neither confined, sick, nor in real want of any thing, are only fits of habit and obstinacy. They are not to be attributed to nature, but to the nurse, who, from not knowing how to bear such importunity, only increases it, without reflecting that, in making the child quiet to-day, she is only encouraging it to cry the more to-morrow. The only way to cure, or prevent this habit, is to *take no notice* of a child in such circumstances. Nobody cares, not even children, to take fruitless pains. They may for a while persevere in their trials; but, if you have more patience than they have obstinacy, they will be disgusted at the experiment, and repeat it no more. This is the method to prevent their tears, and to use them to cry only when they are really in pain.

When they are possessed of these fits of caprice and obstinacy, a certain way to quiet them is, to divert their attention by some agreeable and striking object, that may make them forget their motive for crying. Most nurses excel in practising this expedient; and, if artfully managed, it is very useful: but it is of the utmost consequence that the child should not *perceive* this intention of diverting him, but that he should imagine we are *amusing ourselves* without thinking of him: in this respect, however, all nurses are very inexpert, and perversely do a right thing the wrong way.

Sect. VI. *Of Speech.*

Children are accustomed to listen to sounds from their birth: we not only talk to them before they understand the meaning of what is said, but before they can mimic the sounds repeated in their hearing. Their organs of speech, as yet in a

ſtate of incapacity, are brought by ſlow degrees to the imitation of ſounds; and, indeed, we are not well aſſured, that theſe make as diſtinct impreſſions on their organs of hearing as on ours. No one can diſapprove the nurſe's amuſing her child with *ſinging*, and other very ſprightly and cheerful notes; but by no means ſuffer her to ſtun it perpetually with a confuſed heap of uſeleſs words, of which the child comprehends nothing but the tone in which they are ſpoken. *The firſt words repeated in the hearing of an infant, ſhould be few, eaſy, and diſtinct:* they ſhould alſo be repeated often, and be only ſuch as ſerve to expreſs ſenſible objects, which may at the ſame time be pointed out to its view. Our unhappy readineſs to content ourſelves with words we do not underſtand, takes place earlier than may be imagined. The ſchool boy liſtens to the gibbling uſher of his claſs, with the ſame ſtupid attention as he did to the prattle of his nurſe. Hence it appears to be a very uſeful mode of inſtruction, to bring up children to hear nothing of it.

A thouſand conſiderations preſent themſelves, when we come to reflect on the formation of the language, and the firſt attempts of children. Whatever pains or method we take, they will all learn to ſpeak in the ſame manner, ſo that philoſophical ſpeculations are entirely uſeleſs. They have, as it were, a grammar adapted to their age, the rules of whoſe ſyntax are more general than thoſe of ours; and if we conſider it attentively, we ſhall be ſurpriſed to ſee the exactneſs with which they purſue certain analogies; very miſtaken ones, if you will; but very regular, and exceptionable only from their uncouth turn, or contrariety to common practice. It is an intolerable, and very ſuperfluous piece of pedantry to think of correcting in children ſuch little treſpaſſes againſt the cuſtoms of ſpeech, as theſe, of which they infallibly correct themſelves in time. Speak always correctly yourſelf, in their preſence: behave ſo that they ſhall be better pleaſed with your company than that of others; and be aſſured their language will grow inſenſibly correct and pure as your own.

An abuſe of another kind, though of equal importance, and not leſs eaſy to prevent, is our being *too earneſt to teach them to ſpeak;* as if we were afraid they would never learn it of themſelves. This imprudent forwardneſs is productive of an effect directly contrary to the end deſigned; and occaſions them to talk leſs early and more indiſtinct: the extreme attention which is paid to every thing they attempt to ſay, makes it needleſs for them to pronounce their words diſtinctly; hence, taking the trouble only juſt to open their mouths, many of them retain during life a vicious mode of pronunciation, and a confuſed manner of ſpeech, that renders them almoſt unintelligible. The reaſon of this is, that children educated in town, being chiefly confined to the nurſery, and for ever under the wing of their governeſs, have occaſion only to mumble out their words to be underſtood. They no ſooner move their lips, than every one is attentive to what they have to ſay; the words they cannot pronounce, or pronounce ill, are ſaid for them; and thus, by dint of attention, and by having the ſame people always about them, the meaning of what they would ſay is rather gueſſed at, than of what they actually do ſay, underſtood. In the country it is quite different. The nurſe is not perpetually at hand, and the child is obliged to learn to ſpeak diſtinctly and loud what he wants to have underſtood. There the children rambling about the fields, at a diſtance from their father, mother, or playfellows, are habituated to make themſelves heard a great way off, and to adapt the efforts of their voice to their diſtance from thoſe they would make to hear them.

Children who are preſſed too much to ſpeak, have neither time allowed them to learn to pronounce diſtinctly what they ſay, nor to comprehend perfectly what they hear: whereas, if left to themſelves, they would begin to practiſe upon words of the moſt eaſy pronunciation, annexing to them ſome ſignification, which they would make underſtood by their geſtures; they would give you their own words before they received yours, and make uſe of the latter only as they ſhould underſtand them: for not being preſſed to it, they would firſt obſerve the ſenſe you yourſelf ſhould give them, which when they were certain of, they would adopt them accordingly.

But the greateſt evil attending this precipitation, is not that our firſt diſcourſe to children, and the firſt language they ſpeak, are to them void of meaning; but that, with reſpect to them, they convey a meaning different from ours, without our knowing it, or being able to find it out; ſo that, in ſometimes appearing to anſwer us very pertinently, they ſpeak without having underſtood us, and without our underſtanding them. It is at ſuch equivocal expreſſions we are ſometimes ſo much ſurpriſed, when we annex ideas to their words to which they themſelves are ſtrangers. This inattention, on our part, to the true ſenſe that words convey to children, appears to be the grand cauſe of the firſt errors they fall into, and which, even after they are undeceived, continue to influence their turn of mind during the reſt of their lives. The vocabulary of a child, therefore, ſhould be as confined as poſſible. It is a very great inconvenience for him to have *more words than ideas*, to know how to talk about things of which he is yet incapable of thinking. One reaſon, perhaps, why perſons who live in the country, have generally more clear underſtandings than thoſe who reſide in town, is, that their dictionary is leſs extenſive. They have few ideas, but they compare, and reaſon on them very juſtly.

In the firſt development of the ſeveral organs and faculties of a child, they nearly accompany each other. He begins to talk, to eat, to walk almoſt at the ſame time. This may be properly called the firſt epoch of human life. Before this period, he is little better than he was in the womb of his mother: he has no ſentiments, no ideas, nay hardly any ſenſations; he is even inſenſible of his own exiſtence. "*Vivit, et eſt vitæ neſcius ipſe ſuæ.*"

Sect. VII. *Of the State of Puerility.*

We are come now to the ſecond period of life, at which the ſtate of infancy, properly ſpeaking, ends, and that of *puerility* begins: for the words *infans* and *puer* are by no means ſynonymous. The firſt is comprehended in the other, and ſignifies a child *who cannot ſpeak;* hence we find, in Valerius Maximus, the expreſſion *puerum infantem.* We ſhall continue, notwithſtanding, to make uſe of the word *children*, agreeably to its modern acceptation.

When a child begins to talk, it weeps leſs. This progreſſion is natural; one language being only ſubſtituted for another. As ſoon as he can complain in expreſs terms, why ſhould he do it by tears? If a child be of a delicate conſtitution, extremely ſuſceptible, and naturally apt to cry for nothing, we ſhould dry up the ſource of his tears, by rendering them fruitleſs. So long as he continues crying, no one ought to go near him; but run to him immediately on his becoming ſilent. By this means, his manner of calling us to his aſſiſtance would be by his ſilence, or, at moſt, by giving only one cry. It is from the perceptible effect of ſigns, that children judge of their meaning; they ſee no other relation between them. Whatever miſchief a child may have done itſelf, it is very rare for it to cry, when alone, at leaſt if it hath no hopes of being heard.

If a child get a fall, a bump on his forehead, make his noſe bleed, or cut his fingers; inſtead of running to him with an air of apprehenſion, we ſhould remain quite ſtill, at leaſt for ſome time. The miſchief is done, and there is a neceſſity for his bearing the pain of it; our over-ſolicitude would only ſerve to

frighten him the more, and increase his sensibility. In fact, it is less the pain than the fright which affects children on these occasions. We should spare him, at least, the anxiety of the latter; for he will certainly judge of his misfortune in a great degree as we do. If he sees us alarmed, run eagerly to his relief, console and pity him, he will think himself undone: but if he sees us apparently indifferent, and make light of it, he will soon make as light of it himself, and think himself cured as soon as the smart is over. It is at this age children acquire their *first principles of courage;* and, by being inured to slight inconveniences, learn by degrees to support greater.

So far also from being anxious to prevent a child from cutting or hurting himself, it is better that this should sometimes happen; and that he should not grow up without feeling pain. The first thing we ought to learn, and that which is of the greatest consequence for us to know, is to suffer. It seems as if children were formed little and feeble only to learn this important lesson without danger. If they fall down, or run against any thing, they neither break a leg nor an arm: if they wound themselves with any sharp instrument, the wound is hardly ever fatal, or very deep. We know, in short, scarcely any instance of a child, when left at liberty, having killed, maimed, or done itself any considerable damage; unless, indeed, where it has been imprudently exposed to tumble down from some high place, to fall into the fire, or within the reach of some deadly weapon. How useless and pernicious, therefore, is that magazine of implements, with which a child is armed at all points against pain; and is hence exposed to it, when he grows up, without experience, and without courage; so that he is apt to think himself mortally wounded by the prick of a pin, and to faint away at the sight of his own blood!

Our pedantic method of instruction is, always to teach children what they would learn better of themselves, and to neglect what we only are capable of teaching them. Is there any thing more ridiculous than the pains we take to teach them to walk, as if we had ever seen a child, through the negligence of its nurse, ignorant of it when he is grown up? On the contrary, how many persons do we see walk badly all their lives, because they were badly taught at first? Instead of keeping him in the close air of his nursery, he should be taken out every day into the open fields. There he might run and play about; and if he tumbles a hundred times a day, so much the better; he will the sooner learn, when down, to get up again. The pleasure of being at liberty will be a sufficient recompense for his falls.

Sect. VIII. *Of Obedience, and the ill Effects of Restraint.*

There is another step in the progress of children, which renders complaints less needful; and this depends on the developement of their *corporeal powers*. When they are capable of doing more themselves, they have less need of recurring frequently to others. With the increase of their strength, increases also their knowledge in the means of exerting it. It is at this period the life of the individual may be properly said to commence; it is at this time he begins to be conscious of himself. His memory extends the sense of his identity to every moment of his existence; he becomes always one and the same person, and of course already susceptible of happiness or misery. From this time, therefore, he must be considered as a mortal being.

Although the longest term of human life is determinate, and it be easy to calculate the probability of our reaching that term at any intermediate age, yet nothing is more uncertain than the duration of life in the persons of individuals; very few of whom arrive at its longest period. Life is the most precarious at its commencement; the less time we have existed, the less hope we have of future existence. Of all the children that are born, the half only, at most, arrive at the age of fourteen, and it is very probable yours may not reach the age of manhood.

What can we think, then, of that barbarous method of education, by which the present is sacrificed to an uncertain future; by which a child is laid under every kind of restraint, and is made miserable, by way of preparing him for we know not what pretended happiness, which there is reason to believe he may never live to enjoy? Supposing it not unreasonable in its design, how can we see without indignation, the unhappy innocents subjected to a yoke of insupportable rigour, and condemned like galley-slaves to continual labour, without being assured that such mortifications and restrictions will ever be of any service to them? The age of cheerfulness and gaiety is spent in the midst of tears, punishments, threats, and slavery. We torment the poor creatures, for their *future* good, and perceive not that death is at hand, and ready to seize them amidst all this sorrowful preparation for life. Who can tell how many children have fallen victims to the extravagant sagacity of their parents and guardians? Happy to escape such cruelty, the only advantage the poor sufferers reaped from the evils they endured, being to die without regretting a life of misery.

Man! be humane! It is the first, the chief of moral duties, to exercise humanity to every thing, of what age or condition soever, that is relative to man. What, is wisdom void of humanity? Have a tender regard for children, indulge them in their diversions, their pleasures, and in every thing dictated by their harmless natures.

Who is there among us that has not, at times, looked back with regret on that period of our lives, wherein the countenance was always smiling, and the heart as constantly at ease? Why will you deprive the little innocents of the enjoyment of a season so short and transient? of a blessing so precious, which they cannot abuse? Why will you clog, with bitterness and sorrow, those rapid moments which will return no more for them than you? Ye fathers! Do you know when the stroke of death shall fall on your offspring? Lay not up in store, then, for your own sorrow, by depriving them of the enjoyment of the few moments nature has allotted them; as soon as they become sensible of the pleasures of existence, let them enjoy it, so that, whenever it may please God to call them home, they may not die without having tasted of life.

What exclamations are here raised! How loud the clamours of that mistaken wisdom, which leads us perpetually out of ourselves; which regards the present always as *nothing*, and incessantly pursuing a future that *recedes as we advance*, by taking us from the spot we are in, transports us where we shall never be! This is the time, you will perhaps reply, to correct the propensities of human nature. It is in infancy, you will say, when our pains are least violent, that they should be multiplied, in order to diminish their number when we arrive at years of discretion. But who hath told you, that such will be the consequence, or that such an arrangement of cause and effect is in your power? Or that all the fine discipline, in which you train the weak mind of an infant, will not be one day more pernicious than useful? Who hath assured you that you shall save him any pain or trouble hereafter, by what you inflict on him now? And how will you prove to us, that those evil propensities which you pretend to eradicate, are not owing to your own mistaken behaviour, much more than to nature? At all events, that cannot but be an unlucky foresight which makes us for the *present* miserable, under the notion, whether well or ill founded, of rendering us *one day or other happy*. Hence let those who usually confound liberty

and licentioufnefs, and make no difference between a child that is *fpoiled* and one that is made *happy*, learn to make a diftinction.

To prevent our running into chimeras, let us never lofe fight of what is befitting our fituation. Humanity has its place in the order and conftitution of things: the ftate of infancy in thofe of human life; men fhould be confidered as men, and children as children. To affign both their feparate places, and regulate the human paffions, agreeable to the conftitution of man, are all that can be done for his happinefs. The reft depends on circumftances which are not in our power.

He only performs the actions of his own will, who ftands in no need of the affiftance of others, to put his defigns in execution: and hence it follows, that the greateft of all bleffings is not authority, but liberty. A man, truly free, wills only what he is able to perform, and performs what he pleafes. This fhould be a fundamental maxim. It need only be applied to a ftate of infancy, and all the rules of education will naturally flow from it.

Society has enervated man, not only by depriving him of the privilege of exerting his natural faculties, but particularly in rendering them infufficient for his purpofes. Hence it is that his defires are increafed with his weaknefs; and hence alfo we may fee what is the weaknefs of a child compared with that of a man. If man is a powerful, and a child a feeble being, it is not becaufe the former has more abfolute ftrength than the latter, but becaufe he is naturally capable of fupplying his own wants, and the other is not. Men, therefore, fhould be more refolute, and children more capricious; by which we mean, the latter fhould have a greater number of defires that do not arife from real wants, and cannot be gratified without the affiftance of others.

We have given a reafon for the weaknefs of a ftate of infancy. Nature hath provided for it, in the attachment of parents to their offspring. This attachment, howevever, may be carried to excefs, and is fubject to great abufe. Parents who live themfelves in a civilized ftate, introduce their children into the world too young. By increafing the number of their wants, inftead of relieving, they augment the natural weaknefs of infancy. They augment it farther, in requiring more of a child than is required by nature; in fubjecting to the will of the parent, the little ftrength a child has to execute its own; and in converting into fervility, on both fides, the reciprocal dependence adapted to the weaknefs of the one and the attachment of the other.

A wife man knows and will keep his place; but a child is ignorant of *his*, and therefore cannot confine himfelf to it. There are a thoufand avenues through which he will be apt to efcape: it belongs to thofe who have the care of his education, therefore, to prevent him; a tafk, by the way, which is not very eafy. He fhould be neither treated as an irrational animal, nor as a man; but fimply as a *child*: he fhould be made fenfible of his weaknefs, but not abandoned to fuffer by it; he fhould be taught dependence, and not merely obedience; he fhould be inftructed to *afk*, and not to *command*. He is in a ftate of fubmiffion to others, only becaufe of his wants, and becaufe they know better than himfelf what is good or hurtful for him. No one hath a right, not even the *father* of a child, to *command it to do any thing that is ufelefs*.

Before prejudice and cuftom have altered our natural difpofitions, the happinefs of children, as well as of men, confifts in the exercife of their liberty; but this liberty in the firft is limited by their weaknefs. Whofoever does what he will is happy, provided he is capable of doing it himfelf. This is the cafe with man in a ftate of nature. But though a man act as he pleafes, yet if his defires furpafs his perfonal abilities, he is not happy. This is the cafe with children in the fame ftate. They enjoy, even in that of nature, but an imperfect liberty, refembling that which men enjoy in a ftate of civil fociety. As we all ftand in need of each other, we become by that means weak and miferable. Nature intended us to be men; the laws and cuftoms of fociety have reduced us to the condition of children. The rich, the great, the powerful, are all mere infants, who, feeing every one folicitous to relieve their mifery, deduce from thence the moft puerile vanity, and are proud of that fervice and attendance which would not be paid them if they were completely *men*.

Thefe confiderations are of great importance, and may ferve to account for all the contradictions we meet with in the focial fyftem. Man is fubjected by two kinds of dependence; the firft on circumftances and things, which is that of nature; and the fecond on men, which is the effect of fociety. The former being merely phyfical, is in no degree deftructive of liberty, nor productive of guilt: the latter, being unnatural and diforderly, is productive of all manner of vice, and it is by means of this the mafter and the flave mutually corrupt each other. If there be any way to remedy this evil in fociety, it is by fubftituting laws in the place of perfons, and to inveft the general will with a real power, fuperior to that of individuals.

If the laws of nations, like thofe of nature, were fo fixed and invariable, as that no human force or art could alter them, our dependence on men would then become the fame as that on circumftances; we might unite, in a republican government, all the advantages of a ftate of nature with thofe of fociety; to that liberty which preferves man from falling into vice, we might add that morality which raifes him up to virtue. But this is not the cafe. Subject your child, therefore, only to a dependence on *circumftances*; you will then follow the order of nature in the progrefs of his education. Oppofe to his indifcreet defires only *phyfical* obftacles, or *the inconveniences naturally arifing from the actions themfelves*; thefe he will remember on a future occafion: without forbidding him to do ill, it is fufficient to prevent him. Experience and impotence only fhould lay on him their pofitive commands. Give him nothing becaufe he *defires it*, but becaufe it is *needful for him*. Let him not know, that in doing your will he is obedient to you, nor that in doing his you are fubfervient to him. Inftil no ideas of command or obedience, but let him conceive both your actions and his own to be equally independent. Affift him when he ftands in need of it, juft fo much as is neceffary to make him free, but not imperious; thus, in receiving that affiftance with a kind of humiliation, he will afpire after that moment when he fhall be able to do without it, and have the honour to ferve himfelf.

In order to ftrengthen, and forward the body in its growth, nature employs various means, which fhould never be thwarted. We fhould never, for inftance, oblige a child to ftand ftill, when it is defirous of running about; nor to walk about when it is propenfe to ftand ftill. If the difpofition of children is not fpoiled by our own fault, they will never require any thing that is ufelefs. Let them leap, run about, and make what noife they pleafe. This is all the natural effect of the activity of their conftitution, exerting itfelf to gather ftrength; but we ought to diftruft every defire which they are incapable of themfelves to gratify, and for which they are obliged to requeft our affiftance. We fhould be very careful here to diftinguifh between the true, the phyfical want, and that of caprice, which now begins to fhew itfelf, or that which arifes only from the fuperfluity before mentioned.

SECT. IX. *Of Artifice and Cunning in Children.*

HAVING already advifed what is to be done when a child

cries for this thing or the other, to this we will only add, that, when it is capable of expreſſing itſelf in words, if it endeavours to enforce its demands by crying, in order to obtain its wants more ſpeedily, or to overcome a refuſal, it ought to be abſolutely and *irrevocably denied*. When it deſires what is neceſſary, you ought to know and immediately comply with its requeſt: but to be induced to do any thing by its *tears*, is to encourage it to *cry*; it is to teach it to doubt your good-will, and to think you are influenced more by importunity than benevolence. Beware of this: for if your child once comes to imagine you are not of a good diſpoſition, he will ſoon be of a bad one; if he once thinks you compliant, he will ſoon grow obſtinate. You ſhould comply with his requeſt immediately, if you do not intend to refuſe it. Mortify him not with *frequent denials*, but *never revoke a refuſal once made*.

But, above all things, beware of teaching your child the ceremonious jargon of politeneſs, a ſet of phraſes which he employs, like magic ſyllables, to ſubject to his pleaſure every one that comes near him, and to obtain upon demand whatever he deſires. In the mode of education adopted by the rich, their children never fail of being rendered *politely imperious*, by being inſtructed to make uſe of ſuch expreſſions as nobody chooſes to reſiſt. Neither in voice nor manner have they any thing *ſuppliant* about them: on the contrary, they are as arrogant, if not more ſo, in their requeſts, than in their commands, inaſmuch as they are always more certain of being obeyed. One ſees immediately, that their *If you pleaſe*, means, *It is I pleaſe*; and that their *pray* ſtands for *do*. Admirable politeneſs this, which teaches them only to pervert the meaning of words, and not to be able to ſpeak otherwiſe than with the air of command! Surely it is a leſs evil that a child ſhould prove clowniſh than inſolent, and we had much rather hear him ſay in a ſuppliant tone, *Do* ſo or ſo, than make uſe of a dictatorial *Pray, if you pleaſe*. It is not the words he makes uſe of that are of ſo much conſequence, but the acceptance he annexes to them.

Exceſſive ſeverity, as well as exceſſive indulgence, ſhould be equally avoided. If you leave children to ſuffer, you expoſe their health, endanger their lives, and make them actually miſerable: on the other hand, if you are too anxious to prevent their being ſenſible of any kind of pain and inconvenience, you only pave their way to feel much greater; you enervate their conſtitutions, make them tender and effeminate; in a word, you remove them out of their ſituation as men, into which they muſt hereafter return in ſpite of all your ſolicitude. In order not to expoſe them to the few evils nature would inflict on them, you provide for them many which they would otherwiſe never have ſuffered.

It may here perhaps be objected, that we fall into the ſame error, for which we have reproached thoſe miſtaken parents, who ſacrifice the preſent happineſs of their children to the conſideration of an uncertain or imaginary futurity. Not ſo; for our pupils will be ſufficiently indemnified for the ſlight inconveniences they ſuffer, by the liberty in which they are indulged. The neglected little rogues will be ſeen ſometimes playing amidſt the ſnow, with their hands black and blue, and ſo benumbed as hardly to be able to move their fingers. They may go, if they will, to the fire and warm themſelves; yet this they refuſe to do; and, if you ſhould compel them to it, they would ſuffer an hundred times more from your ſeverity than from that of the cold. Of what then do you complain? Do we make the child unhappy by expoſing him only to thoſe inconveniences *he chooſes* to ſuffer? No. We make him happy for the preſent, by leaving him to enjoy his liberty; and prepare him for being ſo hereafter, by arming him againſt thoſe evils he muſt neceſſarily encounter. If it depended on his choice to be our pupil or yours, do you think he would heſitate a moment which to prefer?

Do you conceive any being can be truly happy in circumſtances inconſiſtent with its conſtitution? And is it not inconſiſtent with the conſtitution of man, to endeavour to exempt him from all the evils incident to his ſpecies? It is a fact, that we are capacitated to experience great pleaſure, only by being inured to ſlight pain; for ſuch is the nature of man. If his phyſical conſtitution be too vigorous, his moral conſtitution tends to depravity. The man who ſhould be ignorant of pain, would be a ſtranger alſo to the ſenſations of humanity, and the tender feelings of compaſſion for his ſpecies; his heart would be unſuſceptible of ſympathy; he would be unſocial; he would be a monſter among his fellow-creatures.

Would you know the moſt infallible way to make your child miſerable? It is to accuſtom him to obtain every thing he deſires: for, thoſe deſires ſtill increaſing from the facility of gratification, your incapacity to ſatisfy them muſt ſooner or later reduce you to the neceſſity of a refuſal; and that refuſal, ſo new and uncommon, will give him more trouble than even the want of that which he deſires. From wanting your cane, he will proceed to your watch; he will next want the bird that flies in the air, the ſtar that glitters in the firmament; in ſhort, every thing he ſees: nothing leſs than omnipotence would enable you to ſatisfy it.

It is natural to man to regard every thing as his own, which he has in his power. Could we increaſe with our deſire the means of gratifying them, every one would conceive himſelf the lord over all. The child, therefore, who needs only deſire a thing to obtain it, is led naturally to imagine himſelf the proprietor of the univerſe: he looks upon all mankind as his ſlaves; and when any thing is, at length, refuſed him, he, who conceives not the impoſſibility of executing any of his commands, eſteems ſuch refuſal as an act of rebellion: all the reaſons that can be given him at an age incapable of reaſoning, appear to him only pretexts. He ſees your ill-will through the whole: the ſenſe of an imaginary injuſtice ſours his diſpoſition; he begins to hate every body; and, without ever thinking himſelf obliged by their complaiſance, is enraged at their contradiction. How is it poſſible that children, thus ſubject to be made the prey of the moſt iraſcible paſſions, can ever be *happy?* Their deſires, irritated by the facility with which they have uſually been gratified, are bent on impoſſibilities, whilſt they meet on every ſide with nothing but contradictions, obſtacles, ſufferings, and ſorrow. Always grumbling, fractious, and paſſionate, they paſs their time amidſt perpetual tears and complaints. How can theſe be ſuppoſed *happy* in their ſituation? Imbecility and authority united, generate only folly and miſery. But if theſe notions of tyranny and command make men miſerable in their infancy, how much more will they do ſo as they grow up, when the relations they ſtand in to others become more numerous and extenſive! Accuſtomed to ſee every thing give way to their deſires, how will they be ſurpriſed, in entering on the world, to ſee every thing reſiſt their will, and to find themſelves oppreſſed by the weight of that univerſe, which they imagined they could move about at pleaſure!

If we conſider the ſtate of childhood in itſelf, is there in the world a more feeble and helpleſs being, more expoſed to the mercy of every thing about it, that hath more need of pity, aſſiſtance, and protection, than an infant? Do not even its innocent looks and engaging figure ſeem peculiarly calculated to intereſt in its favour all that approach it, and to induce them to ſuccour its weakneſs? What then is more diſguſting, and contrary to the nature of things, than to ſee a child imperious and refractory, commanding every one that comes near it,

and impudently ufurping the tone of a mafter over thofe who have only to leave it, and it muft perifh?

On the other hand, who muft not fee that a child lies under fo many reftrictions on account of its natural weaknefs, as to acknowledge it barbarous to add to this reftraint that of *our caprizes*, in depriving it of fo confined a liberty, which it can fo little abufe, and is of fo little ufe to itfelf, or to us, who take it away? If there be no object fo deferving contempt as an infolent child, there is none fo deferving our compaffion as a timid and bafhful one. Since we enter, at the age of difcretion, into public flavery, why fhould we be previoufly fubjected to private fervitude? Let us permit one moment at leaft of human life to be exempted from that yoke which nature has not impofed; let us permit our children the free exercife of that natural liberty which keeps at a diftance, for fome time at leaft, thofe vices which are contracted in the bondage of fociety. Let the advocates for feverity, then, on the one hand, and thofe fond parents who are flaves to their children, on the other, offer what frivolous objections they pleafe; it is proper for them before they boaft the excellence of their own methods, to ftudy that of *nature*.

Sect. X. *Of Obedience and the Effects of reafoning with Children.*

We have already faid, that a child fhould obtain nothing merely becaufe he *afks for it*, but becaufe he *ftands in need* of it*; that he fhould be made to do nothing out of obedience, but only out of neceffity. Thus the words, *command* and *obey*, fhould have no place in his dictionary, much lefs thofe of *duty* and *obligation*; but thofe of power, neceffity, impotence, and reftraint, ought to ftand forth in capitals. Before children arrive at years of difcretion, they can form no ideas of moral beings or focial relations. It is proper, therefore, to avoid, as much as poffible, the ufe of thofe terms which exprefs them; left, if made ufe of in their hearing, children fhould at firft annex ideas to them, which afterwards it may be difficult to feparate. The firft wrong idea that he forms, becomes the feed of error and of vice. It is to this firft ftep we fhould give particular attention. Order it fo, therefore, that while he continues to be affected only by fenfible objects, all his ideas be confined to *his fenfations*: let him perceive nothing but the material world about him: otherwife you may be affured, that either he muft hear you fay nothing of the moral world at all, or he will form fuch fantaftic notions of it, as you will not be able to efface all the days of his life.

Mr. Locke's maxim was to educate children by *reafoning with them*; and it is that which has been much in vogue. The fuccefs of it, however, doth not appear to recommend it; for, in fact, we meet with no children fo filly and ridiculous as thofe with whom much *argument* hath been held. Of all the faculties of man, that of reafon, which, indeed, is only a compound of all the reft, unfolds itfelf the lateft, and with the greateft difficulty; and yet this is what we would make ufe of to develop the firft and eafieft of them. The great end of a good education is to form a reafonable man; and we pretend to educate a child by the means of reafon! This is beginning where we fhould leave off, and making an implement of the work we are about.

If children were capable of reafoning, they would ftand in no need of education; but, in talking to them fo early a language they do not underftand, we ufe them to content themfelves with words, to cavil at every thing that is faid to them, to think themfelves as wife as their mafters, and to become petulant and captious: at the fame time, whatever we imagine to obtain of them by reafonable motives, is effected only by thofe of covetoufnefs, fear, or vanity, always annexed. We may reduce almoft all the leffons of morality that have, or can be, formed for the ufe of children, to the following formula:

Mafter. You muft not do fo.
Child. And why muft I not do fo?
Mafter. Becaufe it is naughty.
Child. Naughty! what is that being naughty?
Mafter. Doing what you are forbid.
Child. And what harm is there in doing what one's forbid?
Mafter. The harm is, you will be whipped for difobedience.
Child. Then I will do it fo that nobody fhall know any thing of the matter.
Mafter. O, but you will be watched.
Child. Ah! but then I will hide myfelf.
Mafter. Then you will be examined.
Child. Then I will tell a fib.
Mafter. But you muft not tell fibs.
Child. Why muft not I?
Mafter. Becaufe it is naughty, &c.

Thus we go round the circle; and yet, if we go out of it, the child underftands us no longer. Are not thefe very ufeful inftructions? And yet we know not what could be fubftituted in the place of this fine dialogue. Locke himfelf would certainly have been embarraffed had he been afked fo puzzling a queftion. To diftinguifh between good and evil, to perceive the reafons on which our moral obligations are founded, is not the bufinefs, as it is not within the capacity of a child.

Nature requires children to be children before they are men. By endeavouring to pervert this order, we produce forward fruits, that have neither maturity nor tafte, and will not fail foon to wither or corrupt. Hence it is we have fo many young profeffors and old children. Childhood hath its manner of feeing, perceiving, and thinking, peculiar to itfelf; nor is there any thing more abfurd than our being anxious to fubftitute our own in its ftead. It would be not lefs abfurd to require an infant to be five feet high, than to expect a boy to have judgement at ten years of age. In fact, of what ufe would reafon be to him at that age? Reafon is given us as a check upon our *power*; a child has no need of fuch reftraint.

In ftriving to perfuade your pupils to look upon obedience as their duty, you always add, to this pretended perfuafion, the force of compulfion, or menace; or, what is ftill worfe, enforce it by flattery and promifes. And thus it is that, allured by intereft or conftrained by violence, they affect to be convinced by reafon. They fee very well that to be obedient is advantageous, and to be refractory hurtful, as foon as you yourfelf perceive either the one or the other. But, as you require nothing of them but what is difagreeable, and, as it is always difagreeable to do the will of others, they conceal themfelves in order to be at liberty to do their own; perfuaded that, fo long as their difobedience is undifcovered, they are doing right; but very ready to confefs themfelves wrong when detected, for fear of feverer chaftifement. The rational princi-

* It ought to be obferved, that as pain is often a neceffity, fo pleafure is fometimes a natural want. Children have, therefore, but one defire only which fhould not be gratified, and this is the defire of *exacting obedience*. Hence it follows, that in every thing they demand, it is the motive which excites them to make fuch demand, which ought to engage our attention. Indulge them, as much as poffible, in every thing which may give them real pleafure; but conftantly refufe them what they require from motives of caprice, or merely to exercife their authority.

ples of moral obligation are beyond their comprehension: there is not a man in the world capable of making them truly sensible of them; though the fear of punishment, the hope of pardon, importunity, and the perplexity of knowing what to say, draw from them the confession required, and we imagine them convinced when they are only harassed and intimidated.

The consequence of all this is, that, in the first place, by imposing on them an obligation they are insensible of, you set them against your authority and alienate from you their affections; you teach them to *dissemble*, *lie*, and *deceive*, in order to extort rewards, or avoid punishment. And lastly, by using them to conceal their real motives under apparent ones, you yourself furnish them with the means of perpetually abusing you, of preventing your knowledge of their true characters, and of amusing you and every body else, occasionally, with empty words. The laws, you will say, though obligatory, in point of conscience, use the same means of restraint with grown persons. It is true: but what are these persons but children spoiled in their education? This is the very thing we should endeavour to prevent. *Use force with children, and argument with men:* such is the order of nature: the philosopher stands in no need of legal restrictions.

Treat your pupil according to his years. Put him at first into his place, and keep him there so strictly, that he may never afterwards be tempted to go from it. Thus, before he may have learned what prudence is, he will have practised the most important of all its lessons. *Never command him to do any thing in the world:* let him not even imagine you pretend to have any authority over him. Let him only be made sensible that he is weak, and you are strong; that, from your situation and his, he lies necessarily at your mercy; let him know, let him learn to perceive this circumstance; let him early feel on his aspiring crest the hard yoke nature hath imposed on man, the heavy yoke of *necessity*, under which every finite being must bow; let him *see that necessity* in the *nature and constitution of things*, and not in the *caprices* * *of mankind*. The bridle of his restraint should be force, and not authority. As to doing those things from which he ought to abstain, forbid him not, but prevent him, without explanation or argument: whatever you indulge him in, grant it to his first request without solicitation or entreaty, particularly without making any *conditions*. Grant with pleasure, and refuse with reluctance: but, *let all your denials be irrevocable*; let no importunity overcome your resolution; let the *no!* once pronounced be as a brazen wall, against which when a child hath some few times exhausted his strength, without making any impression, he will never attempt to overthrow it again.

By this method you will render his disposition patient, equal, resigned, and peaceable, even when he is not indulged in the pursuit of his own inclinations: for *it is in the nature of man to endure patiently* the absolute *necessity of his circumstances*, but not the capricious and evil disposition of his fellow-creatures. *It is all gone*, is an answer against which a child never objects, at least if he believes it true. After all, it must be observed there is no mean to be preserved in our conduct in this particular; we must either exact nothing of children at all, or subject them, at once, to the most perfect obedience. The worst education in the world is that which keeps a child *wavering* between the will of the tutor and its own; and eternally disputing which of the two shall *be master*. It is very strange, that, in the education of children, tutors should never have thought of any other instruments to effect their purpose than those of emulation, jealousy, envy, pride, covetousness, and servile fear; all passions the most dangerous, the most apt to ferment, and most proper to corrupt the soul, even before the body is formed. The fact is, almost every method has been tried but one, and that the *only one* which can succeed, *natural liberty duly regulated*. No one ought to undertake the education of a child who cannot conduct him at pleasure, merely by the maxims of possibility and impossibility. Give your pupil no kind of verbal instructions; he should receive none but from experience: inflict on him no kind of punishment, for he knows not what it is to be in fault. Require him never to ask pardon, for he cannot offend you. As he is insensible of all moral obligation, he cannot do any thing morally evil, or that is deserving of punishment or reprimand.

Parents, you are already frightened, in judging such a child by your own; in this, however, you are mistaken. The constant restraint, in which you keep your pupils, irritates their vivacity; the more they are restrained under your eye, the more turbulent they are when they escape from it; they must indemnify themselves, when they can, for that severe confinement you impose on them. Two scholars, broke loose from a school in town, will do more mischief in a country-village than all the boys in the parish. Shut up one of these young gentlemen with the son of a peasant of the same age; and the first will have broken or turned topsy-turvy all the moveables in the room, before the latter shall have stirred from his seat. What can be the reason of this, if the one be not in a hurry to abuse his momentary liberty, while the other, accustomed to freedom, is not in any haste to make use of it? And yet the children of peasants, being frequently humoured and thwarted, are very far from being in that order that could be wished.

Let us lay it down as an incontestable maxim, That the first emotions of nature are always right. There is no original perversity in the human heart. There is not perhaps a single vice to be found there, that one could not say how and which way it entered. The only passion natural to man is the love of himself, or *self love taken in an extensive sense*. This passion considered in itself, or as relative to us, is good and useful; and, as it has no necessary relation to any one else, it is in that respect naturally indifferent: it becomes good or evil, therefore, from our application of it, and the several relations we give it. Till the guide of self-love, then, which is reason, appears, a child should do nothing merely because he is seen or heard, nothing from causes merely relative to others, but only those things which nature requires and instigates; and then he will never do wrong.

It is not to be expected, that he will never do any mischief; that he will never hurt himself, or perhaps break in pieces a valuable utensil that may happen to be unluckily placed within his reach. He may do a great deal of *harm* without doing *ill*; because the evil of the action depends on his *intention* to do an injury, and he will be always free from such intention. Should he not, and should he once acquire an evil intention, he is already spoiled; he is vicious almost beyond remedy. An action may be evil in the eyes of *avarice*, that is not so in those of *reason*. In leaving children at liberty to play about as they please, it is proper to remove every thing out of their way that may render their agility or wantonness expensive; thus nothing that is brittle and costly should be left within their reach. Let the furniture of their apartment be coarse and solid. Let them have no looking-glass, no china, nor other objects of luxury. Children educated in the country should have nothing

* We may be very certain that a child will think every injunction *capricious* that is contrary to its own inclinations, and for which *it sees not a reason*. Now, a child sees no manner of reason in any thing that contradicts its own humour.

in their chamber whereby it may be diftinguifhed from that of the meaneft peafant. To what purpofe fhould it be carefully ornamented, when they are to ftay in it fo fhort a time?

But if, notwithftanding all precautions, your child fhould commit fome diforder, or break fome piece of furniture, do not go to punifh or rate him for your own negligence; do not let him hear from you a fingle word of reproach; let him not even perceive you are difpleafed, but act exactly in the fame manner as if it had been broken by accident. In a word, you may think you have effected a great point, if you can prevail on yourfelf to fay nothing about the matter.

Sect. XI. *Of Inftruction.*

The moft critical interval of human life is that between the hour of our birth and twelve years of age. This is the time wherein vice and error take root, without our being poffeffed of any inftrument to deftroy them. And when the implement is found, they are fo deeply grounded, that they are no longer to be eradicated. If children took a leap from their mother's breaft, and at once arrived at the age of reafon, the methods of education now ufually taken with them would be very proper; but, according to the progrefs of nature, they require thofe which are very different. We fhould not tamper with the mind, till it has acquired all its faculties. For it is impoffible it fhould perceive the light we hold out to it while it is blind; or that it fhould purfue, over an immenfe plain of ideas, that route which reafon hath fo flightly traced, as to be perceptible only to the fharpeft fight. *The firft part of education, therefore, ought to be purely negative.* It confifts, neither in teaching virtue nor truth; but in guarding the heart from vice, and the mind from error. If you could be content to do nothing yourfelf, and could prevent any thing being done by others, if you could bring up your pupil *healthy and robuft* to the age of twelve years, without his being able to diftinguifh his right hand from his left, the eyes of his underftanding would be open to reafon at your firft leffon; void both of habit and prejudice, his paffions would not operate againft your endeavours, and he would become, under proper inftructions, the wifeft of men. It is thus, by attempting nothing in the beginning, you might produce a prodigy of education.

Take the road directly oppofite to that which is in ufe, and you will almoft always do right. As we think it not enough that children fhould be children, but it is expected they fhould be *mafters of arts*, fo fathers and preceptors think they can never have too many checks, corrections, reprimands, menaces, promifes, inftructions, fair fpeeches, and fine arguments. You will act wifer than all this, by being reafonable yourfelf, and never arguing with your child, particularly in ftriving to reconcile him to what he diflikes. For to ufe him to reafon only upon difagreeable fubjects, is the way to difguft him, and bring argument early into difcredit with a mind incapable of underftanding it. *Exercife his corporeal organs, fenfes, and faculties, as much as you pleafe, but keep his intellectual ones inactive as long as poffible.* Be cautious of all the fentiments he acquires previous to the judgment, which fhould enable him to fcrutinize them. Prevent or reftrain all foreign impreffions; and, in order to hinder the rife of evil, be not in too great a hurry to inftil good; for it is only fuch when the mind is enlightened by reafon. Look upon every delay as an advantage; it is gaining a great deal to advance without lofing any thing. Let the infancy of children therefore have time to ripen. In fhort, whatever inftruction is neceffary for them, take care not to give it them to-day, if it may be deferred without danger till tomorrow.

Another confideration, which confirms the utility of this method, is the particular genius of the child; which ought to be known before it can be judged what moral regimen is beft adapted to it. Every mind hath its peculiar turn, according to which it ought to be educated; and it is of very material confequence to our endeavours, that it be educated according to that turn, and not any other. The prudent governor will watch a long time the workings of nature, will obferve his pupil well before he fpeaks the firft word to him. Leave then his natural character at liberty to unfold itfelf; *lay it under no reftraint whatever*, that it may the better be laid open to view. Do you think the time loft in which a child is thus left at liberty? Quite the contrary; it will be fo beft employed: For is it not thus you yourfelf learn to hufband time ftill more precious? If you fet about any thing, before you know in what manner to act, you proceed at random. Liable to miftake, you are frequently obliged to undo what is done; and find yourfelves farther from the end defigned, than if you had been lefs precipitate to begin the work. Act not like the mifer, who lofes much becaufe he is unwilling to lofe a little; but facrifice in infancy that time which you will regain with ufury in a more advanced age.

But where, will it be faid, muft we place an infant thus to be educated as an infenfible being, as a mere automaton? Shall we take him to the world in the moon, or to fome defert ifland? Shall we feparate him from the reft of his fpecies? Will he not, if in the world, have before him continually the profpect and example of the paffions of others? Will he never meet in company with children of his own age? Will he not fee his parents, his neighbours, his nurfe, his governefs, his fervant, and at laft his governor himfelf, who, after all, will be no angel? This objection is reafonable and folid. But who has told you the *natural education* of a child was an *eafy* undertaking? It is your fault, ye men of fociety! that you have made every thing which is right, fo difficult to be put in execution. The difficulties muft be acknowledged; and perhaps they are infurmountable. It is, however, certain, that, by *endeavouring to obviate* them, we may fucceed *to a certain degree*. It is requifite to point out the end we fhould aim at. It is not perhaps poffible to *reach it*; but he who approaches *the neareft* this end, will have fucceeded the beft.

Sect. XII. *Of the Effects of the Paffions.*

Violent paffions produce a great effect on a child who is witnefs of them, becaufe their marks are ftriking, and command attention. Anger in particular is fo boifterous in its expreffions, that it is impoffible not to perceive it when near at hand. You will afk, perhaps, if this does not afford a fine opportunity for a pedagogue to make an excellent difcourfe? No. No excellent difcourfe at all; not a word fhould be faid on the occafion. Let the child only be a witnefs to the fcene; he will be too much furprifed at the fight not to afk you the meaning of it. Your anfwer is very fimple, and naturally arifes from the very objects that ftrike his fenfes. He fees an inflamed countenance, fparkling eyes, menacing geftures; he hears violent exclamations; all figns that the body is out of order. Tell him, therefore, ferioufly, and without appearance of affectation, the poor man is taken fuddenly ill; that he is feized with a fit of an ague. You may hence take occafion to give him, in a few words, a general notion of difeafes and their effects: for thefe depend immediately on nature, and form one of thofe chains by which he fhould perceive himfelf bound to the immoveable weight of neceffity.

Is it not probable, that from this notion, which is far from being a falfe one, he may contract an early repugnance to all excefs of paffion, which he would regard as a diftemper? Do not you think, at leaft, that fuch a notion, properly inculcated, might produce as falutary an effect as a tedious moral fermon? The future advantages attached to this notion alfo are not in-

considerable; as you are thereby authorised, if there should be occasion for it, to treat a fractious child as if he were sick; to confine him to his chamber, or even to his bed, if needful, and to prescribe him a strict regimen; by which means he will become afraid of these growing vices, and will look upon them as odious and formidable; without ever regarding the severity you are obliged to make use of, in order to cure him of them, in the light of a punishment. Should it so happen, also, that you yourself, in some unguarded moment, should depart from that temperance and moderation which it should be your constant study to maintain, you need not seek to disguise your error; but apologize, for such sally of your passion, by frankly telling him, with a tender reproach, that he hath made you very ill.

It is further to be observed, as a matter of great consequence, that none of those simple and ingenuous expressions, which may give a child an idea of the ignorance in which he is educated, should be taken notice of and repeated in his hearing. An indiscreet fit of laughter in a bystander might disconcert all that you had been doing for six months, and do him an irreparable injury perhaps all his life-time. We cannot be too often reminded, that to be master of a child, it is necessary to be master of one's self. If your pupil happen to be present at a scolding-bout between two female neighbours, and, going up to the most violent, he says to her, in a tone of compassion: *Good woman, you are extremely ill: I am very sorry for it*; this instance of simplicity would undoubtedly have its effect on the spectators, if not on the actresses themselves. Without either smiling, chiding or commending him, however, it would be requisite to take him instantly away, before he perceives that effect, at least before he can have time to reflect on it; and, by diverting his mind to other objects, soon drive it entirely out of his thoughts.

Sect. XIII. *Of Property.*

Our design is not to be circumstantial on every occasion; but only to lay down general maxims, and illustrate what is difficult by examples. It is impossible to bring up a child in the midst of society, to the age of twelve years, without giving him some idea of the relations between man and man, and of the morality of human actions. It is sufficient, therefore, to defer instructing him in these necessary notions as long as possible; and that, when it becomes absolutely requisite, such instruction be confined to objects of present utility; being calculated only to prevent his thinking himself at liberty to do what he pleases. There are children of dispositions so mild and conformable, that they may be conducted very far without danger, in their primitive innocence: but there are others so stubborn and violent, that it is necessary to make men of them as soon as possible, that we may not be obliged to chain them up, as too unruly for children.

The first obligations we lie under, respect ourselves: our primary sentiments centre in our own existence; all our natural emotions, at first, relating to self-preservation. Hence, our first sense of justice arises *not from what we owe to others*, but from what is *due from them to us*; a circumstance which manifests another blunder in the common methods of education; wherein, by talking to children of their duties instead of their *claims*, we begin by telling them the reverse of what we ought to do, by endeavouring to inculcate what they cannot understand, and of course that in which they cannot be interested. Had we, therefore, the direction of one of those children just spoken of, we should say to ourselves, A child strives not so much to gain the mastery over *persons** as over *things*; and he will soon learn from experience to respect those of the former who are superior to him in strength and years, whereas the latter cannot stand up in defence of themselves. The first notion to be given such a child, is less that of liberty than of property; and in order to give him that idea, it is necessary he should become the *proprietor of something*. To tell him of his clothes, his furniture, and his playthings, is saying nothing; because although such things are at his disposal, yet he knows not how, or why, he is possessed of them. To tell him they are his, because they are given to him, is to just as little purpose; for, in order to give them to him, somebody must have a prior right to them; and it is *the principle of property* itself which we want to explain to him. Add to this, that a gift betokens a convention or agreement between the parties, and a child cannot be made to comprehend the nature of a convention †.

It is our business to recur to the *origin and foundation of property*; for thence our first ideas thereof should arise. My pupil, says M. Rousseau, living in the country, has of course acquired some little notion of husbandry; to this end he wanted only observation and leisure, both which he possessed. It is natural to people of all ages, and more particularly to children, to wish to show signs of their power and activity, and to exert themselves in the imitation, creation, and *production* of things. Emilius has not twice seen the gardener sow, and raise beans and pease, and he has already conceived a strong desire to become a gardener.

Agreeable to the principles already established, I oppose not his inclination; on the contrary, I encourage him in it, second his design, and work along with him, not merely to please *him*, but myself; at least I make him *think so*. Thus am I become a gardener's labourer, and, as my pupil wants strength to handle the spade, am contented to turn up the soil for him. He takes possession of it by planting *a bean*; a possession certainly as sacred and respectable as Nunes Balbao took of South America, in the name of the king of Spain, by planting his standard on the coast of the South sea. We come every day to water our beans, and see them with great pleasure come out of the ground. At the same time, I increase this satisfaction of my pupil by informing him that this little spot *belongs* to him; explaining the nature of his property therein, by representing to him that he hath spent his time, his trouble, and in short employed his whole person in the cultivation; that he has as much right to reclaim the produce thereof from any person whatever, as to wrest his arm out of the hands of any one who would retain it against his consent.

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* We should never permit a child to play with grown persons in the same manner as with his inferiors, nor even as with his equals. If he should ever strike any one in earnest, though it were a foot-boy, or the meanest servant, let them always return his blows with interest, and in such a manner as to make him take heed how he strikes them again. Many an imprudent governess has encouraged the anger of children; exciting them to strike others, and even herself, while she laughed at their feeble attempts; not thinking that such attempts were *intentional murders* in the little creatures, whose blows would have been fatal had their strength been equal to their fury.

† This is the reason that children want to have those things again which they give away, and cry when they are not returned to them. This, however, is not the case when they come to know the nature of a gift: they are then only more circumspect and cautious of what they give away.

Having thus made him fenfible of his right to the produce of his labour, he comes on a fine day, as ufual, to water his rifing plants; when, behold his beans are all torn up by the roots, the ground turned up, and the place hardly to be known. What a fight! what caufe of affliction is here! His bofom fwells with grief and indignation. Alas! he cries, what is become of my labour and pains, the fruit of all my toil and induftry? Who hath deprived me of my property? Who hath taken away my beans? Thus, venting his exclamations at *this firft fenfe of injuftice*, he fheds a flood of tears, and fills the air with his cries and complaints. In the mean time, I take part in his diftrefs, and endeavour to find out the author of the mifchief. This is found to be the gardener, who is immediately fent for. Here again is poor Emilius deceived in his expectations; the gardener, underftanding our complaint, begins to complain louder than we. So! Gentlemen, it is you I find that have deftroyed my fine melons with your pretended gardening. Did you not know that I had fown fome choice Maltefe melon-feed on that very fpot, which you dug up in order to plant your worthlefs beans? Yes—the feeds were given me as a curiofity, and I was in hopes to regale you daintily with the fruit when it became ripe. But you have deftroyed the plants juft peeping out of the ground, and have not only done me an irreparable injury, but have deprived yourfelves of the pleafure of tafting the moft exquifite melons in the world.

Rouffeau. Forgive us, honeft Robert; we did not know that you had beftowed your toil and pains on that fpot. I fee that we have been to blame, in fpoiling your work: but we will fend for fome other feed, to fupply the place of that we have dug up; and will take care, when we go to digging again, that nobody hath been there before us.

Robert. Then you may throw afide your tools, Gentlemen; for there is no ground lies here uncultivated. For my part, I labour on the foil my father improved before me; and my neighbours do the fame; fo that all the land you fee, has been occupied long ago.

Emilius. Then, there muft be a good deal of melon-feed deftroyed, Mr. Robert.

Rob. Excufe me there, young Gentleman; we do not often meet with fuch wild little gardeners as you. With us, nobody meddles with another's garden; but has a regard to the fruits of his labour, in order to fecure thofe of his own.

Emil. Well, but what muft I do? I have no garden.

Rob. That is nothing to me. I affure you, if you fpoil mine, you fhall walk in it no more; for, take notice, I will not throw my time and labour away.

Rouff. No, that would be unreafonable; but cannot we fomehow accommodate this matter? What if our friend Robert was to allot us a corner of his garden to ourfelves, on condition of fharing with us in the produce of it?

Rob. That I will do, without conditions; but remember that I fhall dig up your beans, if you meddle with my melons.

In this fpecimen of the manner of *implanting the firft notion of moral principles* in the minds of children, it is obfervable how naturally the idea of property refers to the right of the *firft* occupier. This method is plain and fimple, and agreeable to the capacity of a child. It is to be obferved here, however, that the inftructions on this head, which in theory are laid down in two or three pages, may take up a whole year to put in practice; for in the purfuit of moral ideas we cannot advance too flow nor tread too fecurely. Think of this example, ye young preceptors! and remember that your lectures fhould always confift rather of *action* than difcourfe: for children eafily forget what they *fay*, as well as what is faid; but not what they *do*, or what is done to them. Inftructions of this kind fhould be given, as we before obferved, either fooner or later, according as the mild or turbulent difpofition of the child may render them neceffary. Their utility is obvious to the moft fuperficial obferver. To omit nothing, however, of importance on a difficult fubject, we fhall here give another example.

Your child, we will fuppofe, is fo rude and boifterous as to fpoil every thing he lays his hands on. Be not angry with him; but remove what you are fearful of his fpoiling, out of his reach. If he break the utenfils which he ftand in daily need of, be not in hafte to give him others; but let him *experience the want* of them. If he break the windows of his apartment, let the wind blow day and night in upon him, without troubling yourfelf about his catching cold; for it is better he fhould catch cold, than be indulged in fuch frantic airs: never complain of the inconveniencies to which he may put yourfelf; but contrive fo that he may be the firft to feel their effects. After fome time, indeed, you may have your windows mended; but without faying any thing to him: and fhould he break them again, change your method. In that cafe fay to him, very coldly, and without putting yourfelf into a paffion, Thefe windows are mine; I took care to have them placed there, and will prevent their being broke, by fhutting you up in a dark room where there are no windows to break. At the novelty of this proceeding, he will begin to cry and ftorm; nobody, however, muft feem to hear him. On this, he will foon change his tone, to the milder notes of fighs and complaint. At this time, let one of the fervants pafs by accidentally, of whom he will doubtlefs beg his deliverance. Without any other pretence, however, the fervant fhould be directed to fay, *I have alfo windows to preferve*, and then walk away. In fhort, after the child fhould have remained there fome hours, long enough to tire him heartily, and make him remember it, fomebody fhould fuggeft to him the making you a propofal to fet him at liberty, on condition of his breaking no more windows. He would defire no better terms, and accordingly would fend for you to come to him. You fhould go, and hear his propofal, which being made, you fhould inftantly accept of it; obferving that it was a prudent thought, and that it was a pity he did not hit on it fooner, as you would both have been gainers by it. You fhould then, without requiring any proteftation or verbal confirmation of his promife, falute him in the moft friendly manner, and lead him immediately to your apartment; regarding the agreement made between you as facred and inviolable as if attefted on oath. What an idea do you think he will deduce from this procedure, of the faith and utility of engagements? It is a queftion if there be fcarcely a child in the world, not already quite fpoiled, who could withftand fuch a proceeding, or would wilfully break a window ever afterwards.

SECT. XIV. *Of Lying and Deception.*

WE enter now on the moral world. Behold the opening to vice. With our fenfe of mutual conventions and reciprocal duties arife falfehood and deceit. No fooner do we find ourfelves capable of doing what we ought not to do, than we are prompted to conceal our having done what we ought not to have done. When intereft induces us to promife, intereft in a greater degree tempts us to violate that promife; all that is required is to do it with impunity. The refource is natural; we endeavour to hide our actions, and to deceive by our words. Not being able to prevent vice, we are already in the circumftances of punifhing it: hence arife the miferies of human life which take root in our errors.

Enough has been already faid to give the reader to underftand, that punifhment ought never to be inflicted on children *as a punifhment*, but that it fhould be made to *follow as a natural con-*

ſequence of their miſdeeds. Hence you ſhould never declaim againſt lying, nor puniſh them directly for telling untruths; but you ſhould ſo manage it, that they ſhould feel the ill effects of lying, by not being believed when they ſpeak truth, and by being ſtill accuſed of facts they are innocent of, notwithſtanding all their aſſeverations.

An helpleſs being, ſenſible of its ſtanding in need of the aſſiſtance of others, and conſtantly experiencing their benevolence, can have no intereſt in deceiving them; on the contrary, it is very evidently his intereſt that they ſhould ſee things as they really are, leſt, if they are deceived, it ſhould turn out to his prejudice. Hence it is clear, that it is not natural for children to deceive in matters of fact: but it is *the law of obedience*, to which they are ſubjected, that produces the *neceſſity* for lying; becauſe obedience being in itſelf painful, children diſpenſe with it in private as much as poſſible; and their preſent intereſt, in avoiding puniſhment or reproach, is more powerful than the future one, ariſing from telling truth. When a child is educated, therefore, agreeable to the natural principles of liberty, why ſhould he deceive you in his words, or hide from you his actions? As you never reprehend nor puniſh him, never require any thing of him, why ſhould he not make you privy to his actions, as well as any of his little companions? Whence ſhould he apprehend more danger on one ſide than on the other?

It is ſtill leſs natural for children to deceive in matters of right; as all promiſes to do any thing, or abſtain from it, are deeds of convention, which are not included in a ſtate of nature, but derogate from its freedom. Add to this, that all engagements entered into by children are null and void of themſelves; in as much as, not being able to extend their limited views beyond the preſent, they know not what they are about in making ſuch engagements. Nay, a child can hardly be ſaid to deceive, at the very time of entering therein; for, thinking about nothing but diſengaging himſelf from ſomething elſe for the preſent, whatever he undertakes to do hereafter is in fact nothing. If, for inſtance, he ſhould be able to eſcape a whipping-bout, or obtain a box of ſugar-plums, by promiſing to throw himſelf out of the window the next day, he would very readily promiſe to do it. Hence it is that the law very prudently pays no regard to engagements entered into by children; and when fathers, or maſters, more ſevere, inſiſt on their fulfilling them, it is only in caſes where a child ought to have ſo done, had he made no ſuch promiſe.

A child, not knowing what he is about in making engagements, cannot be ſaid therefore to tell a lie, or deceive, in ſo doing. It is not the ſame, however, in his refuſing to fulfil them; for he may remember very well the promiſe he hath made, but he does not ſee the importance of keeping it. Having little or no ability to judge of the future, he cannot foreſee the conſequences of things; and though he ſhould break his engagements, he does nothing inconſiſtent with the underſtanding of his years. It follows hence, that deceit and lying in children muſt all be attributed to their *maſters*, and that, in endeavouring to teach them the truth, they only inſtruct them to lie. In our great haſte to regulate, to govern and inſtruct them, we find not ſufficient means to compaſs our end: we endeavour, therefore, to lay ſtronger hold on their minds by maxims without foundation, and precepts without reaſon; while we had rather they ſhould learn our leſſons, and be deceitful, than remain ignorant and be ſincere. Give your pupil only practical leſſons, and deſire rather to ſee him *good* than learned. Never exact any promiſe of him, for fear he ſhould be tempted to break it. If any miſchief be done in your abſence, and you know not the author of it, take care never to tax your pupil with it, or to aſk him, if it was *he* that did it *? For in ſo doing you will only teach him to deny it. And if at any time his intractable diſpoſition oblige you to enter into any engagement with him, be ſure to take your meaſures ſo well, that the propoſal ſhall always come from *him*, not from you; that, when he is once engaged, he ſhall always perceive a preſent and actual intereſt in *fulfilling* his engagement; and that, if he ever fails ſo to do, the ill conſequences of ſuch failure ſhall appear to riſe naturally from the order and conſtitution of things, and not from your reſentment. It is very plain, that the more independent you render his welfare, either of the will or judgment of others, the more you deprive him of any intereſt in practiſing falſehood.

When we are not in haſte to inſtruct, we are not in haſte to exact any thing of children; and we take our time, in order not to require it out of ſeaſon. Thus an infant is properly formed without being ſpoiled; but, when a blundering preceptor, ignorant of his duty, is every moment requiring him to promiſe this or that, without diſtinction, choice, or reaſon, the child, wearied out and overburdened with ſuch a heap of engagements, neglects, forgets, or deſpiſes them; regarding them all as ſo many mere formalities, he diverts himſelf with making and breaking them. Would you have him, therefore, be always faithful to his word, you muſt be diſcreet in exacting it of him.

SECT. XV. *Of the Moral Obligations impoſed on Children.*

THE examples here given concerning falſehood, are applicable in many reſpects to all thoſe other obligations which we impoſe on children, by rendering them not only diſagreeable, but impracticable. By appearing to preach up virtue, we make them in love with vice; and encourage them to practiſe by forbidding it. In order to render them pious, we tire out their patience at church; and by making them mutter their prayers perpetually, we compel them to ſigh for the liberty of *praying no longer*. To teach them charity, we make them give alms, as if we were above doing it ourſelves. It is the maſter, however, that ſhould give alms, and not the ſcholar: indeed, how fond ſoever the former may be of his pupil, he ought to diſpute with him that honour: he ought to make him believe that a child of his age is as yet *unworthy* ſo great a privilege. To give alms is the action of a man, who may be ſuppoſed to know *the value* of what he beſtows, and the *want* his fellow-creature has of it. A child, who knows nothing of either, can have no merit in giving alms: give what he will, it is *without charity* or beneficence; indeed he will be almoſt aſhamed to give, when, judging from your example, he muſt think it is the buſineſs of children, and that he ſhall do ſo no more when he grows up. It is to be obſerved alſo, that we generally uſe children to give thoſe things only of which they know not the value. What are to them the round pieces of metal they carry in their pockets, and which ſerve no other purpoſe but to give away? A child would ſooner give a beggar an hundred guineas than a cake: but require the little prodigal to give away his playthings, his ſweet-meats, and other trifles he is fond of, and we

* Nothing can be more indiſcreet than ſuch a queſtion, particularly when the child is culpable; for, if he thinks you know that he is ſo, he will ſee you are laying a trap for him; a circumſtance that will influence him greatly in your diſfavour: and if he thinks you know it not, he will very naturally ſay to himſelf, Why ſhould I diſcover my own guilt? And thus your imprudent queſtion will be a temptation to his telling a lie.

ſhall preſently ſee whether or not you have made him truly liberal.

An expedient, however, is readily found in this caſe, which is, by *returning* to children immediately *whatever they give*; ſo that they are ready enough to give what they know will be ſpeedily returned to them again. I have never ſeen any generoſity in children but what was of one of theſe two kinds; that is, they either gave away that which was of no uſe to them, or what they were certain of having again. Mr. Locke adviſes us to manage this matter ſo, as to convince children by experience, that the moſt liberal is always the beſt provided for. This, however, is to render a child only liberal *in appearance*, and covetous in fact. He adds, that children would thus acquire an habit of liberality; yes, the liberality of an uſurer, who would give a penny for a pound. But when they come to the point of giving things away in good earneſt, adieu to habit! When they found things did not come back again, they would ſoon ceaſe to give them away. We ſhould regard the habit of the *mind*, and not that of the hand. All the other virtues which are taught children, reſemble this of their liberality; and it is by preaching them up to no purpoſe, that we load their early years with vexation and ſorrow. Is not ſuch a very wiſe ſcheme of education?

Throw aſide, then, ye miſtaken tutors! your grimace and affectation; be virtuous and good yourſelves, that your examples may be engraven in the memory of your pupils, till they have weight enough to ſink into their hearts. Inſtead of being in haſte to require him to perform acts of charity, perform them yourſelves in his preſence, and deprive him of the means of imitating you; as being an honour too great for his years; for it is of conſequence that he ſhould not look upon the obligations of men merely as thoſe of children.

It cannot be denied that the imitative virtues are but the virtues of an ape, and that no action is morally good which is not performed as ſuch, and not merely becauſe it is done by others. But at ſo early an age, while the heart is as yet inſenſible, children ought to be inſtructed to imitate thoſe actions of which we want them to acquire an habit, and which they may afterwards perform from principle and a love of virtue. Man is an imitative being; mere animals are ſo too; this turn for imitation is well adapted to a ſtate of nature, but degenerates into vice in a ſtate of ſociety. The monkey imitates man, whom he fears, but imitates not the animals he deſpiſes; he approves the actions of a being ſuperior to himſelf. Among us, on the contrary, we ſee our harlequins both of the theatre and the world, imitate the beautiful only, to debaſe and render it ridiculous: they endeavour to make out of their own meanneſs, ſomething equal to thoſe who are better than themſelves; or, if they attempt really to imitate what they admire, they diſcover in the choice of their objects the falſe taſte of imitators: they are more deſirous of impoſing on others, or of diſplaying their talents, than of making themſelves better or wiſer. The ſource of imitation among us, ariſes from a deſire of tranſporting ourſelves out of our own characters. If we ſucceed in our enterpriſe, our pupil will certainly have no ſuch deſire. We muſt therefore relinquiſh the apparent good of which it might be productive.

Examine the rules of the common method of education, and you will find them all wrong, particularly thoſe which relate to virtue and manners. The only leſſon of morality proper for children, and the moſt important to perſons of all ages, is *never to do an injury* to any one. Even the poſitive precept of doing good, if not made ſubordinate to this, is dangerous, falſe, and contradictory. Who is there that doth not do good? All the world, even the vicious man, does good to one party or the other: he will often make one perſon happy at the expence of making an hundred miſerable; hence ariſe all our calamities. The moſt ſublime virtues are negative; they are alſo the moſt difficult to put in practice, becauſe they are attended with no oſtentation, and are even above that pleaſure ſo flattering to the heart of man, that of ſending away others ſatisfied with our benevolence. O, how much good muſt that man neceſſarily do his fellow-creatures, if ſuch a man there be, who never did any of them harm! What intrepidity of ſoul, what conſtancy of mind are neceſſary here! It is not, however, by reaſoning on this maxim, but by endeavouring to put it in practice, that all its difficulty is to be diſcovered.

Thus have we endeavoured to give the reader ſome imperfect ideas of the precautions to be taken, in giving children thoſe inſtructions which cannot be ſometimes neglected without expoſing them to the danger of injuring themſelves and others, or of contracting ill habits of which they cannot afterwards be corrected: but you may be aſſured, the neceſſity of doing this will ſeldom happen, where children are properly educated; becauſe it is impoſſible they ſhould become intractable, miſchievous, lying, and ſelfiſh, unleſs we ſow in their hearts the ſeeds of thoſe vices which make them ſo. What has been ſaid on this head, therefore, may ſerve rather as exceptions than rules; theſe exceptions, however, are the more numerous and frequent in proportion as children depart from their natural ſtate of innocence, and contract the vices of men. It will be neceſſary, in the public education of children, to make uſe of inſtructions more premature, than in a private education of an individual in the country. In the latter, it is always beſt to take thoſe methods which give childhood time to grow up at leiſure to maturity.

Sect. XVI. *Of the Intellects of Children.*

There are other exceptions of a different kind, adapted to ſuch whoſe natural genius raiſes them above their years. As there are men who remain children all their lives, ſo there are others who may be ſaid to have been men almoſt from their birth. The misfortune is, that the number of the latter are but few; that it is very difficult to diſtinguiſh them in infancy; and that every mother, fondly conceiving her own child to be a prodigy, generally concludes he is one. The moſt brilliant thoughts may happen to enter into the heads of children; or rather the moſt ſtriking expreſſions may drop from their lips, as diamonds of the firſt water from their hands, without either the thoughts or the diamonds belonging properly to them: there is in fact no property of any kind annexed to childhood. Whatever expreſſions children may make uſe of, they convey not the ſame meaning to them as to us. Their ideas, ſuch as they have, are looſe and unconnected: there is nothing fixed and determinate in any of their reflections.

Forward, prating children uſually make but ordinary men: there is no obſervation more certain and general than this. There is nothing more difficult than to diſtinguiſh, in children, between real ſtupidity and that apparent dulneſs which is the uſual indication of ſtrong intellects. The apparent facility with which children ſeem to learn, operates greatly to their prejudice, and, though we do not obſerve it, is a plain proof they learn nothing. The delicate texture of their brain reflects, like a mirror, every object preſented to them; but nothing penetrates the ſubſtance or remains behind. A child retains the words, but the ideas accompanying them are reflected back again; thoſe who hear him repeat, may underſtand what he means; but he himſelf knows nothing of the matter.

Although the memory and judgement are two faculties eſſentially different, yet the one cannot unfold itſelf without the other. Before a child arrives at years of underſtanding, he entertains not the ideas, but ſimply the images, of things; the difference between which conſiſts in that ſuch images are

only the direct paintings of perceptible objects, and ideas are the notions of fuch objects determined by their refpective relations to each other. A fingle image may fubfift in the mind that is fenfible of it; but every idea neceffarily fuppofes the concomitance of others. To fimple imagination, or the mere formation of images, nothing more is neceffary than to have feen objects; but to conceive any thing about their exiftence, or to form ideas of them, it is required that we fhould be able to compare them. Our fenfations are merely paffive, whereas our perceptions, or the ideas formed in confequence of thofe fenfations, rife from an active principle capable of judging of them.

Children, therefore, being incapable of forming a judgment of things, have no real memory. They retain, it is true, founds, figures, and fenfations, but feldom ideas, and ftill more feldom the connections between them. We are far, however, from thinking that children are capable of no kind of reafoning. On the contrary, they reafon very well as to things they are *acquainted with*, and which regard their prefent and *obvious intereft*. But it is in the *depth* of their knowledge we deceive ourfelves; in attributing to them what they have not, and fetting them to reafon about things they cannot comprehend. We are ftill farther deceived, in wanting to render them attentive to fuch confiderations as cannot in any degree affect them, fuch as their *future intereft*, their happinefs when they *come to be men*, the *efteem* in which they will be held *when grown up*, and fo forth; all which pleas, when made ufe of to beings *void of all forefight*, abfolutely fignify nothing, nor can ferve for any good purpofe. Now, all the ftudies impofed on thefe poor unfortunates, tend to fuch objects as are entirely foreign to their minds. Judge then of the attention they are like to beftow on them.

The pedagogues, who make fo circumftantial a parade with the inftructions they pretend to give their fcholars, are paid to talk in a different ftrain: one may fee plainly, however, by their conduct, that they are exactly of our opinion; for, after all their mighty profeffions, what is it they teach them? *Words*; ftill words, and nothing *but* words. In any ftudy whatever, unlefs we poffefs the ideas of the things reprefented, the figns reprefenting them are of no ufe or confequence. A child is, neverthelefs, always confined to thefe figns, without our being capable of making him comprehend any of thofe things reprefented by them. Thus, while we imagine we are teaching him the defcription of the earth, we are only teaching him to underftand the map: we teach him the names of countries, towns, and rivers, of whofe exiftence he has no other idea, than as they are marked on the paper before him. It reminds us of a tract of geography which began as follows: *What is the world?—It is a globe of pafteboard.* This is exactly the geography of children: for we may lay it down as certain, that there is not a child of ten years of age, though he may have fpent two years in the ftudy of cofmography and the ufe of the globes, that can tell, by the rules he has been taught, how to find his way from London to Barnet. Nay, there is not one, perhaps, who, by means of a plan of his father's garden, would be able to go through the feveral walks and windings without lofing himfelf. Yet fuch are thefe learned geographers, who can tell to a minute the longitude and latitude of Pekin, Ifpahan, Mexico, and all other countries in the known world.

It has been faid, that children fhould be engaged in ftudies that require nothing more than that they fhould be able to *fee*: this maxim may poffibly be right, if there be any fuch ftudies; but that is, at beft, very doubtful.

From a miftaken notion, ftill more ridiculous, they are directed to the ftudy of hiftory: it is imagined, that hiftory is not above the capacity of children, becaufe it is only a collection of facts: but may we not afk what is underftood by the word *facts?* Is it conceived that the relations which determine hiftorical facts are fo eafily taken in, that the ideas of them are formed without any trouble in the minds of children? Is it fuppofed that the knowledge of events is fo eafily feparable from that of their caufes, or that hiftorical knowledge depends fo little on moral, as that one can be obtained without the other? If, in the conduct of men, you fee nothing more than merely external and phyfical actions, what is it you can learn from hiftory? Abfolutely nothing: but, divefted of all that renders it interefting, this ftudy would afford as little pleafure as inftruction. On the other hand, if you would regard their actions as connected by moral relations, and endeavour to give your pupils an idea of thofe relations, you would foon fee whether or not the ftudy of hiftory were above the capacity of children.

It is eafy for us to teach them to repeat the words *kings*, *emperors*, *wars*, *conquefts*, *revolutions*, *laws*; but when we come to annex precife ideas to thefe terms, we fhall ftand in need of fuch a converfation as we held with Robert the gardener, in order to make ourfelves underftood. As no fcience confifts in the knowledge of words, fo there is no ftudy proper for children. As they have no certain ideas, fo they have no real memory; for we do not call that fo which is retentive only of mere fenfations. What fignifies imprinting on their minds a catalogue of figns which to them reprefent nothing? Is it to be feared, that, in acquiring the knowledge of things, they will not acquire alfo that of figns? Why then fhall we put them to the unneceffary trouble of learning them twice? And yet what dangerous prejudices do we not begin to inftil, by impofing on them, as a fcience, a heap of words, which to them are without meaning! In the very firft unintelligible fentence with which a child fits down fatisfied, in the very firft thing he takes *upon truft*, or learns from others, without being himfelf convinced of its *utility*, he lofes part of his underftanding; and he may figure long in the eyes of fools before he will be able to repair fo confiderable a lofs.

No; if nature has given to the texture of the brain in children that pliability, which renders it proper to receive all impreffions, it is not with a view that we fhould imprint thereon the names of kings, dates, technical terms, or any of thofe words or phrafes with which we burthen their infant memories, though unintelligible to them, and ufelefs to every one elfe; but rather that we may give them all fuch ideas as are adapted to their capacity, and may be ufeful; all fuch as relate to their prefent happinefs, and tend to enlighten their underftandings concerning their future welfare: thefe fhould be made to fink deep into their minds, being early traced in indelible characters, as ferving to influence their conduct in life in a manner agreeable to their being and faculties.

That kind of memory which is poffeffed by children, may, without fetting them to ftudy books, be fully employed. Every thing they fee, or hear, appears ftriking, and they commit it to memory. A child keeps in his mind a regifter of the actions and converfation of thofe who are about him; every fcene he is engaged in, is a book, from which he infenfibly enriches his memory, treafuring up his ftore till time fhall ripen his judgement, and turn it to profit. It is in the choice of thefe fcenes and objects, in the care of prefenting thofe conftantly to his view, which he ought to be familiar with, and in hiding from him fuch as are improper, that confifts the true art of cultivating this primary faculty of a child. By fuch means alfo it is, that we fhould endeavour to form that magazine of knowledge which would ferve for his education in youth, and to regulate his conduct afterwards. This method, it is true, is not productive of little prodigies of learning, nor doth it tend to enhance the characters of the

governefs or preceptor; but it is the way to form robuft and judicious men, perfons found in body and mind, who, without being admired while children, know how to make themfelves refpected when grown up.

Our pupil fhall never be fet to learn any thing by heart, not even fables, not even the fables of Fontaine, fimple and beautiful as they are; for the words of a fable are no more the fable itfelf, than thofe of a hiftory are the hiftory. How is it poffible men can be fo blind as to call fables the moral lectures for children, without reflecting that the apologue, in amufing, only deceives them; and that, feduced by the charms of falfehood, the truth couched underneath it efcapes their notice? Yet, fo it is; and the means which are thus taken to render inftruction agreeable prevent their profiting by it. Fables may inftruct grown perfons, but the *naked truth* fhould ever be prefented to children: for, if we once fpread over it a veil, they will not take the trouble to draw it afide in order to look at it.

Children univerfally read the fables of Fontaine, and yet there is not one who underftands them. It would be ftill worfe, however, if they did underftand them; for the moral is fo complicated and *difproportionate to their capacities*, that it would rather induce them to vice than virtue. You will fay this is a paradox; be it fo; let us fee whether what is affirmed be not true.

A child certainly does not comprehend the fables which he gets by rote; becaufe, whatever pains we take to render them fimple, the inftruction we would deduce from them is attended with other ideas above his capacity; and becaufe that even the poetic turn given them, in order to make them the more eafily remembered, makes them, at the fame time, the lefs eafily comprehended; fo that they are rendered entertaining at the expence of perfpicuity. Not to mention many of thefe fables, that are totally unintelligible and ufelefs to children, and which neverthelefs are indifcreetly taught them, becaufe they are found mixed with the reft, we fhall confine ourfelves to thofe which the author appears to have written exprefsly for children.

"In the whole collection of Fontaine's fables," fays M. Rouffeau, "there are but five or fix that are eminently diftinguifhed for puerile fimplicity." Of thefe, by way of an example, we will take the firft; the moral of which is the moft adapted to children, being that which they underftand beft, and learn with the greateft pleafure; it is that alfo which the author has, for this reafon, placed at the beginning of this book. On the fuppofition that the object of this fable be intelligible to children, and capable of affording them inftruction and amufement, it is doubtlefs his mafter-piece; we will take the freedom therefore to give it a fhort examination. Its title is, *Le Corbeau et le Renard;* the Raven and the Fox.

Maitre Corbeau, fur un arbre perché,
Mafter Raven, on a tree perched,

Maitre! What is the fignification of the word *Mafter*, in itfelf? What is the cafe of it before a proper name? and what is the particular meaning of it on this occafion? We muft next tell the child what is a raven. But what is *fur un arbre perché?* We do not fay, *on a tree perched*, but *perched on a tree.* We muft therefore talk to him of the tranfpofition of words by poetical licence, and inftruct him in the difference between verfe and profe.

Tenoit dans fon bec un fromage.
Held in his beak a cheefe.

What kind of a cheefe? Was it a Swifs, or a Dutch cheefe? If a child has never feen ravens, what can you get by talking to him about them? and if he has feen them, how will he conceive they could hold whole cheefes in their beaks? Let our defcriptions be ever agreeable to nature.

Maitre Renard, par l'odeur alléché,
Mafter Fox, by the fmell allured,

Mafter again! but this may be thought a good title for a fox, who may be fuppofed to have taken up his degrees in the arts of his profeffion. We muft, however, defcribe the nature of the fox, and diftinguifh between his natural character and that which is given him in fable. *Alléché* is an obfolete word, and ufed only in verfe: a child, being informed of this, will naturally afk, why we talk otherwife in verfe than in profe? What anfwer will you make to fuch a queftion? Again, *Allured by the fmell of a cheefe!* This cheefe held by a raven perched on a tree, muft furely have a ftrong fmell to be fcented by a fox lurking in a thicket, or earthed in a burrow. Is this the method you would take to exercife the genius of your pupil; to teach him to fuffer himfelf not to be impofed on, and to difcern truth from falfehood in the relations of others?

Lui tint à-peu près ce langage:
Held with him nearly this difcourfe:

Ce langage! Do foxes talk then? and do they fpeak the fame language as ravens? Take care, fagacious preceptor! confider well before you reply to thefe queftions of your pupil. It is of more confequence, perhaps, than you imagine.

Eh! bon jour, Monfieur le Corbeau!
Ha! good morrow, Mr. Raven!

Monfieur! So, *Mr.* is a title which the child hears turned into ridicule before he knows it is a mark of refpect. Again, thofe who may read this paffage, *Monfieur du Corbeau*, will have enough to do, before they explain to a child the meaning of the particle *du.*

Que vous êtes charmant! que vous me femblez beau!
How charming you are! how beautiful you feem to me!

Wretchedly expletive and redundant! A child, hearing the fame thing repeated in different words, will hence learn a loofe and inaccurate method of fpeaking. If you fay this redundancy is a piece of art in the writer, and agreeable to the defign of the fox, who would feem to multiply his praifes by making ufe of different terms, this excufe is fufficient with me, but it is a very bad one to be given to my pupil.

Sans mentir, fi votre ramage
Without lying, if your finging

Without lying! So, then it is ufual to lie fometimes: but what would your pupil think, if you were to tell him the fox fays this only becaufe he is actually telling the raven a lie?

Repondoit à votre plumage,
Be anfwerable to your feathers,

Repondoit! What can the word mean? Endeavour to teach a child to compare two qualities fo different as the plumage and the finging of a bird; and fee how well he will underftand you.

Vous feriez le phenix des hôtes de ces bois.
You are a phœnix among the lords of thefe woods.

A phœnix! what is a phœnix? Behold us already entering upon the fictions of the ancient mythology. *The lords of the woods!* How figurative! The flatterer raifes his language, and gives it more dignity, in order to render it the more feductive. How is a child to underftand this fineffe? Does he know, is it poffible that he fhould know, the difference between an elevated and a mean ftyle?

A ces mots, le Corbeau ne fe fent pas de joie;
At thefe words, the raven is out of his wits with delight;

A child must have already experienced very lively and strong passions, to be able to comprehend this proverbial mode of expression.

Et, pour montrer sa belle voix,
And, to display his fine singing,

It must not be forgotten, that, in order to understand this verse and the whole fable, a child ought to be previously made acquainted with the fine singing of a raven.

Il ouvre un large bec, laisse tomber sa proie.
He opens his large beak, and lets fall his prey.

Il ouvre, &c. This verse is admirable; the sound and the sense go incomparably well together. We see his wide beak open, and hear the cheese rattle down through the boughs: but this kind of beauty is lost on children.

Le Renard s'en saisit; et dit, Mon bon Monsieur,
The fox snapped it up; and then said, My good Sir,

Good Sir! See already goodness made synonymous to folly. Is it not indeed mere loss of time thus to instruct children?

Apprenez que tout flateur
Learn that every flatterer

A general maxim! Children know nothing of general maxims.

Vit aux dépens de celui qui l'écoute.
Lives at the cost of those who listen to him.

No child of ten years of age can understand the meaning of this line.

Cette leçon vaut bien un fromage, sans doute.
This lesson is worth a cheese, without doubt.

This line is unintelligible, and the thought is good. There are, nevertheless, but few children who are capable of comparing a moral lesson to a cheese; and fewer who would not prefer the cheese to the lesson. They must be taught, therefore, to look upon this as a piece of raillery. What a deal of subtilty is here required of children!

Le Corbeau, honteux et confus,
The raven, ashamed and confused,

Another pleonasm; but this is inexcusable:

Jura, mais un peu tard, qu'on ne l'y prendroit plus.
Swore, though somewhat too late, he would never be so deceived again.

Swore! Where is the preceptor weak enough to explain to a child the nature of an oath? These remarks may to some appear circumstantial: they are much less so, however, than would have been necessary to analyse all the complex ideas of that fable, and to resolve them into the simple and *elementary ones* of which they are composed. Yet who thinks such analysis necessary to make ourselves understood? We are none of us philosophers enough to put ourselves in the place of children. But to proceed to the moral of the fable:

We would first ask, if there are any children of six years of age, whom it would be proper to teach, that mankind flatter and deceive each other through motives of self-interest? One might teach them, indeed, that there are satirists who laugh at little boys, and privately ridicule their childish vanity: but the cheese spoils all: and they learn less to prevent its falling from their own mouths, than how to make it fall from the mouths of others. This is another paradox, and not the least important.

Trace the progress of children in learning fables, and you will find, that, when they are in a capacity to make any application of them, they almost always do it in a manner contrary to the intention of the fabulist; and that, instead of remarking the error or fault you are desirous of guarding them against, they fall in love with the vice of the party exposed. In reading the fable above cited, children laugh at and despise the silly raven; but they are fond of the fox. In the next fable of the same collection, you think also to set them an example of the grashopper: you are mistaken: they prefer that of the ant. None are fond of humiliation; all choose to act the shining part: it is the choice of self-love, it is in every respect natural. But what a shocking lesson is this fable for children! A covetous child would be the most detestable of all monsters, when sensible of what was asked of it, and what it refused. The ant in the fable does more than this; he not only refuses to assist the suppliant in distress, but aggravates that refusal with raillery and reproach.

In all fables where a lion is introduced, as it is generally the most shining character, a child never fails to take upon himself the part of the lion; and when he presides at any distribution, he generally profits by his model, and sweeps all to his own share. But when the gnat stings the lion to the quick, it is another affair: the child is then no longer the lion, but the gnat; and learns thence in what manner he may some time or other kill those with the prick of a pin, whom he durst not attack openly. In the fable also of the lean wolf and the fat dog, instead of deducing from it the lesson of moderation designed, he is encouraged to licentiousness.

Thus the moral of the first fable, is to a child a lesson of the most servile flattery; that of the second, a lesson of inhumanity; that of the third, of injustice; that of the fourth, of satire; and that of the fifth, of independence. This last lesson is superfluous to our pupil, and not more expedient for yours: for when the precepts you instil are contradictory to each other, what good can you expect from them? But, perhaps, this defect in the moral of fables, which makes us object to them, may furnish a reason for your preserving their use. In the world, there is one kind of morality in discourse, and another in actions; both which never agree together. The first is to be found in the catechism, where we shall leave it; the other we meet with in Fontaine: in his fables, as to what regards children; and in his tales, as to what relates to their *mammas*. The same author suffices for both.

But let us compromise this matter with La Fontaine. We ourselves may read, and admire his fables, because we are not afraid of being mistaken in their design. But, as for our pupil, we cannot suffer him to read a line in the book, till we become convinced that it is proper for him to get words *by rote*, of which he does not understand one-fourth part; that the meaning which he may annex to some, cannot be false; and that, instead of profiting by the example of the dupe, he may not form himself on that of the knave.

Sect. XVII. *Of Reading*.

In thus relieving children from the various obligations injudiciously imposed on them, we free them from their greatest source of uneasiness, that of poring over their books. *Reading* is a vexation to children, and yet it is the only occupation they are usually employed in. Our pupil will hardly know what a book is at twelve years of age. But you will say, he ought surely to *learn to read*, at least. Yes, he shall learn to read when reading will be of any *use* to him: till then, it is good for nothing but to disgust and fatigue him.

If nothing is to be required of children merely out of obedience, it follows that they will learn nothing, whether of use or amusement, unless they perceive *some present advantage* in it;

for what other motive ſhould induce them? The art of ſpeaking to perſons who are abſent, of underſtanding them in turn, of communicating to thoſe who are at a great diſtance, our ſentiments, our inclinations, and deſires—this is an art, whoſe utility may be made known to the ſimpleſt underſtanding. Whence comes it, then, that an art ſo uſeful and agreeable ſhould prove ſo tormenting to children? The reaſon is plain: the conſtraint they lie under of cultivating it *againſt their inclinations*, and the miſapplication of it *to uſes they cannot comprehend*. It cannot be expected a child ſhould be very curious to perfect thoſe means by which he is tormented. Find out the way of making them uſeful to his pleaſures, and he will then apply to them of his own accord.

It has been made a matter of great importance, to find out the beſt method of teaching children to read; and to this end cards and other implements have been invented, ſo various and numerous, that they make the nurſery reſemble the workſhop of a printer. Mr. Locke would have a child taught to read by means of letters carved on dice. Is not this an excellent invention? A more certain method than any of theſe, and that which is nevertheleſs always neglected, is *to excite in children a deſire to learn*. Give a child this deſire, and do as you will with your cards and dice. Any method will then be ſufficient.

The grand motive, indeed the only one that is certain and effectual, is *preſent intereſt*. By way of example we will ſuppoſe our pupil ſometimes receives written invitations from his father, mother, and other friends, to dinner, to go on a party of pleaſure, or to ſee ſome public entertainment. Theſe invitations are ſhort, plain, preciſe, and well written. When received, it is neceſſary for him to find ſomebody to read them to him: ſuch a perſon is not always at hand, or complaiſant enough to comply with his requeſt. Thus the opportunity is loſt: the billet, indeed, is read to him *afterwards*, but then it is *too late* to obey the ſummons. How ardently muſt he *wiſh* on ſuch an occaſion to be able to read *himſelf!* He receives others, equally ſhort and intereſting. He ſets immediately about deciphering them; ſometimes receiving aſſiſtance, and at others denied it. By dint of ſtudy, he at length hammers out that he is invited to go to-morrow to eat cakes; but where, or with whom, he cannot diſcover. How many efforts will he not make to find out the reſt! No doubt he will learn to read and even to write by ſuch means as theſe, without ſtanding in need of horn-books, cards, or dice. It is an important maxim, that children in general acquire ſpeedily and certainly, what they are *not importuned to learn*.

If, proceeding on the plan we have begun to delineate, you follow rules directly contrary to thoſe which are generally received; if, inſtead of exciting the attention of your pupil to diſtant objects, and perpetually bewildering him with different places, climates, and ages; if, inſtead of perplexing his mind in excurſions to the extremities of the earth, and the diſtant regions of the ſkies, you keep him conſtantly attentive to what paſſes *in and about himſelf*; you will then find him capable of perception, memory, and reaſon. *This is the order of nature.* In proportion as the ſenſitive becomes an active being, he acquires a diſcernment proportional to his corporeal abilities. When he poſſeſſes more of the latter, alſo, than are neceſſary for his preſervation, it is with that redundancy, and not before, that he diſplays thoſe ſpeculative faculties which are adapted to the employment of ſuch abilities to other purpoſes. Are you deſirous, therefore, to cultivate the underſtanding of your pupil? Cultivate thoſe abilities on which it depends. Keep him in conſtant exerciſe of body; *bring him up robuſt and healthy*, in order to make him *reaſonable and wiſe*. Let him work, let him run about, let him make a noiſe; in a word, let him be always active and in motion. Make him once a man in point of health and vigour, and he will ſoon become a man in underſtanding. It is to be obſerved, however, that you will check and diſguſt him, even with this method, if you proceed by way of *directing him in every thing he is to do*; by telling him when he is to come and go, to run about, or ſtand ſtill, to do this thing or the other. If your head be always to direct his hands, his own will of courſe become uſeleſs.

Sect. XVIII. *Of the Effects of Exerciſe on the Mind.*

It is a wretched miſtake to think the exerciſe of the body prejudicial to the operations of the mind; as if the action of both were incompatible, or that the one could not always direct the other. There are two kinds of men who live in a continual exerciſe of body, and think juſt as little of the cultivation of their minds. Theſe are peaſants and ſavages. The former nevertheleſs are clowniſh, brutal, and dull, while the latter are as remarkable for their ſtrong ſenſe as for their ſubtlety. Generally ſpeaking, nothing is ſo ſtupid as a clown, nor ſo cunning as a ſavage. Whence comes this difference? Doubtleſs it ariſes hence; the former being accuſtomed to do what he is bid, or what his father uſed to do before him, plods on in the ſame beaten track; and being little better than a mere machine, conſtantly employed in the ſame manner, habit and obedience ſtand with him in the place of reaſon. As to the ſavage, the caſe is widely different; being attached to no one place, having no ſettled taſk, obedient to none, and reſtrained by no other law than his own will, he is obliged to reaſon upon every action of his life; he makes not a motion, nor takes a ſtep, without having previouſly conſidered the conſequences. Thus the more his body is exerciſed, the more is his mind enlightened; his mental and corporeal faculties advance together and reciprocally improve each other.

Which would moſt reſemble the ſavage, and which the peaſant, Emilius, or the more poliſhed pupil of a faſhionable preceptor? The latter, ſubjected in every thing to dictatorial authority, does nothing but what he is commanded. He dares not eat when he is hungry, ſmile when he is pleaſed, or weep when he is ſad; he dares not preſent one hand inſtead of the other, nor take a ſtep otherwiſe than he is directed; in a little time he will ſcarce venture to breathe, except agreeably to ſome ſtated rules. To what purpoſe do you require him to think, when you always take the trouble to think for him? Being always aſſured of your forecaſt, what buſineſs hath he for any of his own? Seeing that you charge yourſelf with the care of his preſervation and welfare, he finds himſelf freed from that ſolicitude: his judgment repoſes ſafely on yours; all that you do not expreſsly forbid him to do, he does without reflection, well knowing that he runs no riſk. What buſineſs hath he to learn to foretel rain? He knows that *you* are careful to preſerve him from the ſhower. Why ſhould he take care to regulate the length of his excurſions? He is not afraid that *you* will let him loſe his dinner. If *you* forbid not his eating, he eats; when *you* bid him give over, he hath done. He obeys not his own appetite, but *yours*. You may enervate his body by inaction, and make it as delicate as you pleaſe, but you will not render his underſtanding the more acute and refined. On the contrary, you will only proceed to diſcredit the uſe of reaſon, by making him uſe the little he has on ſubjects which appear frivolous and uſeleſs. By never ſeeing what it is good for, he begins at length to conclude it is good for nothing. The worſt that can happen to him, from his miſtaken reaſoning, is to be ſet right; and this happens ſo often, that he ſoon learns to think lightly of it.

Take a contrary method with your pupil; let him always be his own maſter *in appearance*, and do *you* take care to be ſo *in reality*. There is no ſubjection ſo complete as that which preſerves the *appearance of liberty*; it is by theſe means even the will itſelf is led captive. The poor child, who knows nothing,

who is capable of nothing, is ſurely ſufficiently at your mercy. Do not you diſpoſe, with regard to him, of every thing about him? Aſſuredly, he ought not to be *compelled* to do any thing *contrary to his inclinations*; but then he ought not *to be inclined* to do any thing contrary to *yours*.

When you have once brought him under ſuch regulations, you may indulge him freely in all thoſe corporeal exerciſes which his age requires, without running the hazard of blunting his intellects. You will then ſee that inſtead of employing all his ſubtile arts to ſhake off a burthenſome and diſagreeable tyranny, he will be buſied only in making the beſt uſe of every thing about him. It is in this caſe, you will have reaſon to be ſurpriſed at the ſubtility of his invention, and the ingenuity with which he makes every thing that is in his power contribute to his gratification, without being obliged to prepoſſeſſion or opinion.

In thus leaving him at liberty to follow *his own will*, you will not augment *his caprice*. By being accuſtomed only to do that which is *proper for his ſtate and condition*, he will ſoon do nothing but what he *ought*; and, though he ſhould be in continual motion of body, yet, while he is employed only in the purſuit of his preſent and apparent intereſt, you will find his reaſoning faculties diſplay themſelves better, and in a manner more peculiar to himſelf, than if he was engaged in ſtudies of pure ſpeculation. Hence, ſeeing you never intent on croſſing him, having no reaſon to be ſuſpicious or hide any thing from you, he would never deceive you; but would ſhow himſelf ſuch as he is without fear or reſtraint. Thus you might ſtudy his character and diſpoſition at leiſure, and diſpoſe him to receive ſuch leſſons as you might intend to give him, without his being ſenſible of his receiving any at your hands.

All thoſe who have made their reflections on the manner of living among the ancients, attribute to their gymnaſtic exerciſes that ſtrength of body and mind which ſo eminently diſtinguiſh them from the moderns. The manner in which Montagne hath dwelt upon this ſentiment, ſerves to ſhow how extremely ſenſible he was of its truth. In ſpeaking of the education of a child, he ſays, in order to increaſe the vigour of the mind, we ought to increaſe the ſtrength of the muſcles; by uſing a child to labour, we inure him to pain; we muſt prepare him by exerciſe to bear the accidents of diſlocation, the colic, and other evils attendant on the human frame. The ſagacious Locke, the good Rollin, the learned Fleury, and the pedantic de Crouſaz, however they differ from each other in every thing elſe, all agree in recommending bodily exerciſe to children. This is the moſt judicious of all their precepts, and yet is that which is, and always will be, the moſt neglected. We have already ſpoken ſufficiently of its importance; and as it is impoſſible to give better reaſons, or lay down better rules for the practice, than are to be found in Locke, the reader may conſult his writings on that ſubject.

Sect. XIX. *Of Dreſs.*

The limbs of a growing child ſhould have room enough in its clothes; he ſhould have nothing to reſtrain his motions or growth, nothing too tight, no ligatures about him. The dreſs of the Engliſh, too cloſe and confined even for men, is particularly prejudicial to children. The beſt way is to let them go as long as poſſible in looſe veſts; and, afterwards, to let their clothes be made large enough; and not to ſtand upon their diſplaying a fine ſhape, by means which will only ſerve to deſtroy it. Their defects, both of body and mind, ariſe almoſt all from the ſame cauſe: we are deſirous of making men of them before their time. With reſpect to the colour of their clothes, children are generally fond of the gay and lively: they ſuit them better alſo, and there is no reaſon why we ſhould not in ſuch caſes conſult their natural inclinations; but, as ſoon as ever they begin to prefer one ſtuff to another becauſe it is rich and coſtly, their hearts are infected by *luxury* and *the caprices of opinion*. This kind of taſte, aſſuredly, they have not acquired of themſelves. It is not eaſy to ſay what an influence the choice of clothes, and the motives for that choice, have on education. We not only ſee fond mothers ridiculouſly promiſing their children fine clothes, as a recompenſe for their good behaviour; but often hear fooliſh preceptors threatening their pupils with coarſer and plainer clothes, as a puniſhment for their faults. "If you do not mind your book better, if you do not keep "your clothes cleaner, you ſhall go dreſſed like a ploughboy." Is not this as much as to tell them, *that the merit and importance of a man lie in his garb*, and that theirs conſiſt entirely in their dreſs? Is it to be wondered at, that youth profit by ſuch wiſe leſſons; that they hold nothing in eſteem but dreſs, and judge of merit by external appearances?

Should it be neceſſary to correct a child that has been ſpoiled in this manner, take care that his *richeſt* clothes prove the *moſt inconvenient*; that he ſhould be hardly able to ſtir his arms and move about in them: take care that his *liberty and gaiety* be in every ſhape ſacrificed to *his magnificence*. If he at any time join in the play of other children more plainly dreſſed, they ſhould give over and diſappear immediately. In a word, you ſhould ſo tire him out with his finery, and render him ſo great a ſlave to his laced clothes, that he ſhould ſoon think them the plague of his life, and do any thing rather than put them on. If a child be not ſubjected to our own idle notions and prejudices, his chief deſire is to be eaſy and at liberty. The moſt ſimple, the moſt convenient dreſs, is always the moſt prized.

There is an habit of body proper for perſons who take much exerciſe, and another more ſuitable to the ſedentary and inactive. The latter, preſerving an equal and uniform circulation of the fluids, ſhould be defended againſt the alterations of the air and the weather; the former, paſſing from labour to reſt, and from heat to cold, ought, on the contrary, to inure themſelves to ſuch alterations. Hence it follows, that ſtudious and indolent people ought always to go warmly clothed, in order to preſerve the body in the ſame temperature, as near as poſſible, at all times and ſeaſons. Thoſe, on the other hand, who come and go in the wind, the ſun, and the rain, who take a good deal of exerciſe, and paſs moſt of their time in the open air, ought to be clothed lightly, in order to habituate themſelves to all the viciſſitudes in the temperature of the air, without injury. Children, in general, are too warmly clothed; particularly in their earlieſt infancy. It is much better to inure them to bear cold than heat. The former will never hurt them, if they are expoſed to it early; but the latter ſubjects them to an inevitable waſte of ſtrength and ſpirits. On a compariſon between the northern people and the inhabitants of the ſouthern climates, mankind grow more robuſt by ſupporting exceſſive cold than they do by bearing exceſſive heat. As your child grows up, however, and his fibres gather ſtrength, you ſhould inure him by degrees to bear the rays of the ſun; which you may thus eaſily effect, till he ſhould run no riſk even from the ſcorching heat of the torrid zone.

Sect. XX. *Of Sleep.*

Children require a good deal of ſleep, becauſe they uſe much exerciſe. The one ſerves to counterbalance the other; ſo that hence we ſee they have need of both. The proper time for reſt is pointed out by nature, and is in the night. It is a certain obſervation, that our ſleep is more tranquil and agreeable when the ſun is below the horizon; the air, heated by its direct rays, never involving our ſenſes in ſo profound a calm. Hence the moſt ſalutary habit is certainly to riſe and lie down with the ſun; and hence it follows, that, in theſe climates,

men, as well as all other animals, require in general more sleep in winter than in summer. But the state of civil life is not sufficiently simple and exempted from accident, for us to think of using a child to such an uniformity, so far as to render it necessary. He ought, without doubt, to be subject to some regulations in this respect; but our chief rule should be to enable him to depart from them when occasion requires, without endangering his health. Do not enervate your pupil, therefore, by indulging him in soft and uninterrupted slumbers. Let him enjoy his rest at first without restraint, as the law of nature dictates; but forget not, that in society it is frequently necessary to be above that law. He should be used, therefore, as he grows up, to sit up late, and rise early; to be waked unexpectedly even out of his sleep, and to sit up occasionally all night, without inconvenience.

It is of great consequence to accustom ourselves betimes to indifferent lodgings: it is the way to prevent our ever meeting with bad beds; and in general an hardy way of living, when we are once used to it, increases the number of agreeable sensations; whereas a soft and luxurious life prepares us for an infinity of displeasing ones. Persons tenderly brought up cannot go to sleep but on a couch of down; those who are accustomed to lie on the floor, can sleep any where. The man who falls asleep as soon as he lies down, feels not the hardness of his bed.

The best bed is that which procures the best sleep. We know by experience, that, when a child is in health, we may make it go to sleep or keep it awake, almost as we please. When children are put to bed, and the nurse is tired with their prattle, nothing is more common than for the latter to bid them go to sleep. But this is much the same thing as if she should bid them be *well*, when they are sick. The right way to make children go to sleep, is to weary them, and not ourselves. Keep talking to them, therefore, incessantly; so that they must be forced to keep silence themselves, and they will soon fall asleep. Long discourses, thus, you see, are good for something; and preaching a sermon is as good as rocking the cradle. But though you make use of this narcotic in the night, you should be careful how you employ it in the day-time.

Awaken your pupil sometimes, less for fear he should get a habit of sleeping too long, than to accustom him to every thing, even to the circumstance of being awakened suddenly. We ought also to make him wake of himself, and rise, in a manner, at our pleasure, without saying a single word to him about the matter. If, for instance, he does not usually sleep *enough*, let him foresee that he will have but a disagreeable morning; in consequence of which he will think all the time clear gain that he spends of it in sleep. On the contrary, does he sleep *too much*, provide for him some amusement that he is fond of against he awake. Are we desirous of teaching him to wake at a *certain hour?* Let his preceptor say to him, "To-"morrow morning at six o'clock I propose the diversion of "angling, or I shall take a walk to such a place; will you be "of the party?" He consents, and desires to be called; this is either promised or not, as occasion may require. If he wakes too late, he finds the party gone. Hence he sees his misfortune, if he does not soon learn to wake another time without being called.

When it so happens, which however is very rare, that an indolent child gives itself up to sloth and inactivity, it should not be indulged in such a vicious propensity, but stimulated by some powerful motive to action. It will be readily conceived, that it is not meant we should proceed to use absolute force, but only to employ the stimulus of *some appetite* that may answer that end: by which means also, if we follow the direction of nature, we shall effect two purposes at once.

There is hardly any thing in the world, for which we might not, with a little address, excite an inclination, or even an ardent desire, in children, without either vanity, jealousy, or emulation. Their vivacity and turn for imitation may suffice, and particularly their native cheerfulness, by which we may always have a sure hold of them, although no preceptor has ever known how to make use of it. In their sports and diversions, while they think they are only at play, they will suffer without complaint, and even sometimes laugh at injuries they would not otherwise have borne without shedding tears. Fastings, stripes, burnings, and fatigues of every kind, are the ordinary amusements of the young savages, which is a proof that even pain itself will admit of a seasoning to give a relish to its bitterness. Every master, however, has not the art of making this dish palatable, nor every disciple the appetite to taste it without grimace.

Sect. XXI. *Of the Art of Swimming.*

In a particular or exclusive method of education, calculated only to distinguish persons so educated from the vulgar, those instructions are always preferred which are the most costly; while the more common, which by the way are the most useful, are neglected. Thus young gentlemen politely educated go through the exercises of the riding-school, because this course is expensive; but hardly any of them learn to swim, because it costs nothing, and a common peasant may know how to swim as well as the first lord in the land. And yet we see the traveller, without having learned to ride the great horse, mounts his nag, and manages him very well; but whoever falls into the water and cannot swim, must be drowned: and nobody can swim without having learned it. Besides, we know not that any one is obliged on pain of death to ride on horseback; whereas no one is certain of avoiding the danger, to which we are so often exposed, from the water. Our pupil shall learn to move in the water, as well as on land. Why should he not be taught to live in all elements? Could he be taught to fly in the air, he should be an eagle; and, if to bear the fire, a salamander.

We are generally afraid children should drown themselves in learning to swim; but whether they drown themselves in learning, or are drowned when they have grown up for having *never* learned, it is the fault of those who have the care of them, when young. It is vanity only that inspires temerity; we are never fool-hardy, or run ourselves in danger, when alone; nor would a well-educated child be so, though the eyes of the whole universe were upon him. As exercise does not depend on running into danger, he might learn, in the canal of his father's park, to cross the Hellespont; but it is necessary to familiarise him in some degree to danger itself, that he may not be over-solicitous about it. This is a necessary part of that apprenticeship we shall describe hereafter.

Sect. XXII. *Of the Powers of Discrimination in Children.*

A child hath neither the strength nor the judgment of a man; but he is capable of seeing and hearing as well, or at least nearly so. His palate also is as sensible, though less delicate; and he distinguishes odours as well, though not with the same nicety. Of all our faculties, the senses are perfected the first: these therefore are the first we should cultivate: they are, nevertheless, the only ones that are usually forgotten, or the most neglected.

To exercise the senses is not merely to make use of them; it is to learn rightly to judge by them; to learn, if the expression be admissible, to *perceive*; for, it is most certain, we know how to touch, to see, to hear, only as we have learned. Some exercises are purely natural and mechanical, and serve to make the body strong and robust, without taking the least hold on the judgment: such are those of swimming, running, leaping,

whipping a top, throwing ſtones, &c. All theſe are very well: but have we only arms and legs? Have we not alſo eyes and ears; and are not theſe organs neceſſary to the expert uſe of the former? Do not only exerciſe your ſtrength, therefore, but all the ſenſes that direct it: make the beſt poſſible uſe of each, and let the impreſſions of one confirm thoſe of another. Meaſure, reckon, weigh, and compare. Exert not your force till you have eſtimated the reſiſtance you are going to encounter; always ſo contriving it, that an eſtimation of the effect may precede the uſe of the means. Let your pupil ſee his intereſt in never making ſuperfluous or inſufficient efforts. By thus uſing him to foreſee the effect of all his motions, and to correct his errors by experience, is it not clear that the more extenſive and various his exerciſe, the more judicious he will grow?

Let us ſuppoſe him going to move an heavy body by means of a lever; if he takes one too long, he will find it unmanageable with his ſhort arms; if too ſhort, he will not have ſufficient force: experience will teach him to chooſe one of the proper length. This kind of knowledge is not above his age. Does the matter in queſtion regard the lifting a burthen? If he would take up one as heavy as he could carry, and not make a fruitleſs endeavour to raiſe one he could not lift, is he not under a neceſſity of eſtimating the weight by his eye? When he knows how to make a compariſon between maſſes of the ſame matter, but of different bulk, let him learn to do the ſame between maſſes of the ſame bulk, but of different matter; he will then experience the difference of their ſpecific gravity.

We are not all equally expert in the uſe of our ſenſes. There is one, to wit, the touch, whoſe action is never ſuſpended while we are awake, and which is extended over the whole ſurface of the body, as a continual guard to give us notice of every thing that may be offenſive. It is by means of the continual and involuntary exerciſe of this ſenſe, that we acquire our earlieſt experience, which makes it the leſs needful for us to give it any particular cultivation. We find, however, that blind people have a much ſtronger and more delicate ſenſe of feeling than we; becauſe, having no information from the ſight, they are obliged to deduce the ſame concluſions from the former ſenſe only, which we are furniſhed with by the latter. Why then ſhould we not learn to walk, like them, in the dark, to know bodies by the touch, to judge of the objects that ſurround us; to do, in ſhort, by night without candles, all they do by day without eyes? While the ſun is above the horizon, we have the advantage of them, and lead them about; but in the dark they are our guides, and take the lead in turn. We are blind as they during one half of our lives, with this difference, that thoſe who are really blind can at all times find their way about, whereas we that have eyes hardly dare to ſtir a foot in the night. Will it be ſaid, We may call for candles and torches? We may ſo: but this it is to be always recurring to machines; and who can aſſure us they will always be at hand?

Should you be ſhut up in a houſe in the middle of the night, clap your hands, and you may perceive by the echo, whether the room you are in be large or ſmall; whether you are in the middle or in one corner. Within ſix inches of the wall, the very air will give a different ſenſation to your face to what it does in the middle of the room. Turn yourſelf round ſucceſſively, facing every part of the room, and if there be a door open, you will perceive it by a gentle draught of air. Are you in a veſſel upon the water, you may know by the manner in which the air ſtrikes againſt your face, not only which way you are going, but whether you go faſt or ſlow. Theſe obſervations, and a thouſand others of a ſimilar kind, can be made only in the night; for, whatever attention we beſtow on them in the day-time, we are always ſo far either aſſiſted or prevented by the ſight, that the experiment eſcapes us. We here make uſe neither of hands nor ſticks; indeed, we might acquire a conſiderable ſhare of ocular information by the touch, even without touching any of the objects in queſtion.

We ſhould provide a variety of diverſions for the night. This piece of advice is of much greater importance than it may at firſt appear. The night naturally ſtrikes a terror into men as well as brute animals. Reaſon or knowledge, wiſdom or courage, deliver few perſons from paying this tribute to darkneſs. Caſuiſts, freethinkers, philoſophers, and even ſoldiers, whom nothing could daunt by day, have been known to tremble by night, like women, at the ruſtling of the leaves of a tree. This timidity is uſually attributed to the idle tales told us when young, by our nurſes. This, however, is a miſtake; it is founded in nature; the cauſe of it being the ſame as that which makes deaf people miſtruſtful, and the vulgar ſuperſtitious; that is, *our ignorance of the things that ſurround us*, and of what is paſſing about us. Being accuſtomed to perceive objects at a diſtance, and to anticipate their impreſſions, how can we help ſuppoſing, when we no longer ſee any thing of ſuch objects, that there may be a thouſand hurtful things in motion around us, from which we cannot guard ourſelves? It is to no purpoſe that we are convinced of our ſecurity in the place where we are; we can never be ſo fully perſuaded, as if we had ocular proof of it: we have, therefore, always a motive for fear in the night, which we ſhould not have in the day-time.

The cauſe of the evil being found, it ſufficiently indicates the remedy. Habit, in every thing, deſtroys the effects of imagination: theſe are excited only by the novelty of the object. The imagination is never employed in thoſe which are familiar to us; theſe affect only the memory; and hence we ſee the reaſon of the axiom, *Ab aſſuetis non fit paſſio*; for the paſſions are lighted up only at the fire of the imagination. Never argue, therefore, with thoſe whom you are deſirous to cure of the fear of being in the dark; but entice them often into it; and be aſſured that all the philoſophical arguments in the world will be of leſs avail than that practice. A bricklayer, or a tyler, is never made giddy by looking down from the roofs of houſes; nor do we ſee thoſe who are accuſtomed to go about in the obſcurity of the night, under any terrors on that ſcore.

Here, then, is another advantage ariſing from our nocturnal entertainments, to be added to the former: but, in order that ſuch diverſions ſhould anſwer the end propoſed, we cannot too much recommend cheerfulneſs and gaiety. Nothing is more diſmal than to be in darkneſs: never ſhut up a child, therefore, to remain in a dungeon. On the contrary, let him go laughing into the dark, and come laughing out again: take care that the notion of the amuſement he hath juſt left, and is going again to partake of, may defend him from thoſe fantaſtic ideas which might otherwiſe intrude on his imagination.

In a large ſaloon or dark antichamber, make a kind of labyrinth, with ſtools, tables, ſcreens, &c. In the moſt inacceſſible part of theſe, place ſome little boxes, all of a ſort and ſize, one of which only ſhould be filled with ſweetmeats: deſcribe in ſhort and plain terms the place where this box lies; and after making the little candidates caſt lots for precedency, each ſhould go in his turn, till the prize be found. The directions given ſhould appear plain enough to perſons in any degree more attentive and leſs blundering than children; and ſhould increaſe the difficulty of finding the box in proportion to their dexterity. Figure to yourſelf a little Hercules coming in with a box in his hand, elated with the ſuppoſed ſucceſs of his expedition. It is laid down on the table, and opened with a deal of ceremony. How violent are the peals of laughter and hiſſes of the joyous little company, when, inſtead of the

expected fweetmeats, nothing is found in it but a fnail-fhell, a coal, an acorn, a little turnip, or fome fuch trifle, carefully wrapt up in mofs or cotton!

What advantages would not a man, educated in this manner, have, in the night, over others! His feet accuftomed to tread firm and fecure, his hands exercifed in the touch of furrounding objects, are capable of conducting him with eafe through the thickeft darknefs. His imagination, full of the nocturnal amufements of his youth, is eafily diverted from terrifying objects. If he hears the fits of unexpected laughter, inftead of conceiting them to be the effects of ludicrous fpirits, they recall to mind thofe of his former companions: if his imagination raifes up a nocturnal affembly, it is not a meeting of witches, but that he formerly attended in the apartment of his preceptor. The night, recalling to his mind nothing but cheerful ideas, will never appear hideous: on the contrary, having nothing to fear, he will delight in it. Is he required to go on a military expedition? He will be ready at any hour, either with his company or alone. He will be able to go into the camp of Saul, to explore every part of it, without bewildering himfelf, to march forward even to the king's tent, without awakening the guard, and to return unperceived by any one. Are you to carry off the white horfes of Rhefus? Apply boldly to him. Among perfons differently educated, you will not eafily find an Ulyffes. Some people endeavour to cure children of being fearful in the night, by ufing them to frequent furprifes. This method, however, is a very bad one, and productive of a contrary effect to that for which it is calculated: rendering them in fact only the more timid. Neither reafon nor habit can poffibly make us perfectly eafy concerning an object of prefent danger, of which we know neither the kind nor the degree; much lefs can they deprive us of the fear arifing from thofe furprifes we may often have experienced.

Sect. XXIII. *Of the Exercife of the Senfes.*

The fenfe, perhaps, we more conftantly exercife than any other, is that of touch; neverthelefs, the judgment immediately formed from it is, as has been before obferved, more grofs and imperfect than that which is formed on any other; becaufe perfons who enjoy their eye-fight, are continually making ufe of that fenfe inftead of it; and as the eye reconnoitres a body much more eafily and fpeedily than the hand, we almoft always judge of bodies without employing the latter. On the other hand, however, the judgment of the touch is more certain; and that purely becaufe it is more confined: for this fenfe, not extending itfelf to bodies beyond the reach of our hands, it ferves to rectify the miftakes of the others, which, launching forth to a great diftance, are exerted on objects barely perceptible; whereas, whatever is perceived by the touch is fully and completely fo. Add to this, that, joining, when we pleafe, the force of the mufcles to the action of the nerves, we unite in one fimultaneous fenfation, the temperature, magnitude, figure, weight, and folidity of the object perceived. Thus the touch being, of all our fenfes, that which informs us beft of the impreffion which other bodies make on ours, it is that for which we have the moft frequent ufe, and which more immediately fupplies us with the knowledge neceffary to our prefervation.

As our fenfe of feeling, when properly exercifed, becomes a fupplement to fight, why may it not alfo fupply that of hearing to a certain degree; efpecially as founds are known to excite, in fonorous bodies, vibrations fenfible to the touch? Lay your hand upon the body of the violoncello, and you will be able, without the affiftance of either eyes or ears, to diftinguifh, by the manner in which it vibrates, whether the found it gives be grave or acute; whether it arife from the treble ftring or the bafe. Were the fenfes exercifed, with attention, in this manner, there is no doubt but, in time, we might acquire fuch a degree of fenfibility as to be able to diftinguifh a whole air by means of the fingers. On this fuppofition, it is plain, we might eafily talk to deaf perfons by mufic: for notes and time being no lefs fufceptible of regular combinations than articulate words, they may be made ufe of in the fame manner as the elements of fpeech.

There are fome exercifes, however, that impair the fenfe of feeling, and make it dull; others again render it more fine and delicate. But we fhall treat of our pupil's manual fports and labour prefently; in the mean time, he fhould learn all thofe fteps which favour the various turnings and windings of the body, and to affume an eafy and firm pofition in all its various attitudes. He fhould learn to leap well, both as to diftance and height, as well as to climb up a tree; and to fpring over a wall; he fhould acquire the knack of being always mafter of his equilibrium in thefe exercifes, all his motions and geftures being regulated by the laws of gravity, long before we fhould trouble him with an explanation of the principles of ftatics. By the manner in which his foot refts on the ground, and his body on his leg, he fhould feel whether it were well or ill placed. A fteady pofture is always graceful, and the firmeft attitudes are ever the moft elegant. Rather make him emulous of a roebuck, than of a dancer at the opera.

As the operations of the fenfe of feeling are confined within the reach of our hands, fo thofe of the fight are extended beyond it. It is this circumftance which renders the latter fo delufive; at one view, the fight comprehends the various objects contained in half the horizon. How is it poffible it fhould not be fometimes deceived, amidft that multitude of fimultaneous fenfations, and the judgement they excite? The fight is, indeed, the moft defective of all our fenfes; and that precifely becaufe it is the moft comprehenfive, and that, leaving the reft at fo great a diftance behind it, its operations are too extenfive and inftantaneous to be corrected by them. We may add further, that the very illufions of perfpective are neceffary to enable us to form a right notion of extenfion, and compare its feveral parts and relations. Were there no deception in the appearances of things, nothing would feem to exift at a diftance: without the gradations of magnitude and fhade we could not perceive any diftance; or rather with regard to us, there would in fact be none at all. If of two trees of equal height, the one at a hundred paces diftance fhould appear as tall and as diftinct as the other which ftood but ten paces off, we fhould naturally place one clofe by the fide of the other. If we were to perceive the dimenfions of all objects, fuch as they really are, we fhould perceive no fpace, but every thing would appear immediately in the eye.

The fenfe of feeing has but one ftandard whereby to judge of the magnitude and diftance of objects; and this is the angle they make in the eye; and, as this angle is the fimple effect of a compound caufe, the judgement immediately excited thereby, leaves every particular caufe indeterminate, or neceffarily defective. For how is it poffible for us to tell, on mere infpection, whether the angle, under which I fee one object lefs than another, is fo, becaufe the firft object is really lefs, or becaufe it only exifts at a greater diftance?

We muft, in this cafe, inftead of reducing the fenfation to its fimpleft form, double it, or confirm it by another; fubjecting the vifual to the tactile organ, and repreffing, if we may ufe the expreffion, the impetuofity of the former fenfe, by the more precife and regular operations of the latter. For want of being accuftomed to this practice, we eftimate heights, diftances, and magnitudes very inaccurately. A proof, alfo, that this is not the defect of the fenfe, but of the ufe of it, is, that engineers, furveyors, architects, mafons, and painters, have generally more dexterity this way than any other people,

and eſtimate dimenſions and diſtances much more exactly. Their profeſſion affording them that experience which we neglect to acquire, they correct the ambiguity of the angle, by thoſe more determinate appearances which accompany it.

It is eaſy to prevail on children to engage in any thing that requires them to move freely about. There are a thouſand ways, therefore, to intereſt them in meaſuring and eſtimating diſtances. Let us ſuppoſe we have a very high cherry-tree; what muſt we do to gather ſome cherries from the top? Is the ladder in the barn long enough? Here is a rivulet too wide for us to jump over: how ſhall we get acroſs? Will one of the planks that lie in the court-yard, reach from ſide to ſide? We have a mind to fiſh, out of our chamber-window, in the moat that ſurrounds the houſe: how many fathoms muſt be our line? We would make a ſwing to reach from tree to tree; how many yards of rope are neceſſary? They tell us that our room in the other houſe is to be five-and-twenty feet ſquare. Do you think it will be big enough for us? Is it bigger than this? Theſe, and a thouſand other occaſions of the like kind, might be laid hold of, to effect this purpoſe.

As the judgement is more inſeparably attached to the ſight than to any other of the ſenſes, it requires a great deal of time to learn to ſee: a long time is requiſite for us, to compare the ſenſations of the ſight with thoſe of the touch, in order to habituate the former of thoſe ſenſes to make a faithful report of figures and diſtances. The moſt penetrating ſight in the world can give us no idea of extenſion without the touch, or a ſenſe of progreſſive motion. The whole univerſe muſt appear to an oyſter but as a ſingle point; nor would it ſeem otherwiſe were that oyſter animated by a human ſoul. It is only by means of walking about, touching, counting, and taking the dimenſions of objects, that we learn to judge of them: but if we accuſtom ourſelves always to meaſure them, the ſenſe confiding on the inſtrument, acquires no accuracy to eſtimate without it. Neither is it proper for a child to paſs immediately from the menſuration of objects to eſtimate them; he ſhould begin to eſtimate by parts what he cannot comprehend altogether; comparing ſuch imaginary diviſions to aliquot parts of admeaſurement: theſe again he ſhould learn to apply to the ſight only, and not by the hand. He ought, however, to confirm his operations, by afterwards taking the real admeaſurement, in order to correct his errors, and that, if any falſe appearance remained in the ſenſe, he might be able to rectify it by his judgement. There are natural meaſures, which are nearly the ſame in all places; ſuch are the ſtep of a man, the extent of his arms, his height, &c. When a child can eſtimate the height of a ſtory, his preceptor may make him employ it as the meaſure of a fathom; ſo that, when he would eſtimate the height of a ſteeple, he may meaſure it by the ſtories of a houſe. If he would know how many leagues he has travelled, let him reckon the time he has been in going; which will ſerve him very well, particularly if you give him no aſſiſtance in any of theſe things, but let him diſcover them all himſelf.

Sect. XXIV. *Of Drawing.*

It is impoſſible to judge accurately of the dimenſions of bodies, unleſs we learn alſo to know *their figures*, and even to *imitate* thoſe figures; for this imitation is founded on nothing elſe but the rules of perſpective, and we cannot eſtimate the extenſion of bodies by their appearance, unleſs we have ſome knowledge of thoſe rules. Children, being great imitators, all attempt to deſign. Our pupil muſt cultivate that art; not for the ſake of the art itſelf, but only to give him a good eye, and a ſupple hand. It is to be obſerved, indeed, in general, that it is of little conſequence whether he be expert at any one of the exerciſes he partakes of, provided he acquires that perſpicacity and agility which they are calculated to teach him. Particular care, therefore, muſt be taken, that he have *no drawing-maſter*, who will only teach him to imitate imitations, and deſign after deſigns. He ſhould have no other maſter than *nature*; no other model than the *objects themſelves*. He ſhould have before his eyes the original itſelf, and not the paper repreſenting it: thus he ſhould deſign an houſe from an houſe, a tree from a tree, a man from a man, that he might be accuſtomed to obſerve minutely and accurately the appearances of bodies, and not take falſe and artificial imitations for true and genuine. He ſhould even be diſcouraged from endeavouring to trace any thing from memory, till, by frequent and repeated obſervations, its figure ſhould be ſtrongly imprinted on his imagination; leſt he ſhould otherwiſe, by ſubſtituting ſome fantaſtic image inſtead of the real one, loſe the knowledge of proportion, and a taſte for the genuine beauties of nature.

Doubtleſs, by going to work in this manner, he will continue to blot and ſcratch a long time, without producing any likeneſs: it will be long before he acquires by theſe means an elegance in ſketching the outlines, and the light touches of the maſter; nay, it is poſſible he may never attain any diſcernment in the fine effect of painting, or a good taſte for deſign. By way of recompenſe, however, he will certainly contract a juſter ſight, and a more ſteady hand; he will acquire the knowledge of the true relations of ſize and figure between animals, plants, and other natural bodies, and a more perfect experience in the effects of perſpective. This is the very point we aim at; our intention being, not ſo much that he ſhould know how to *imitate* objects, as *to become fully acquainted with them.*

In this exerciſe, as well as in all the reſt, our pupil ſhould not amuſe himſelf alone: it ſhould be rendered ſtill more agreeable, by our conſtantly partaking with him an employment, which would thus become intereſting without exciting jealouſy. Follow his example, in taking up the crayon, and in drawing at firſt as bad as himſelf. Though you were an Apelles, you ſhould appear to him as a mere dauber. Begin by ſketching out the figure of a man, as boys do againſt the wall; an horizontal ſtroke for each arm, and a vertical one for each leg, and the fingers as big as the wriſts. After ſome time, both would obſerve the diſproportion of this wretched ſketch; obſerving that a man's leg is not equally thick all the way, that the length of the arms bears a certain proportion to the height of the body, &c. In his progreſs in this art, take care to keep pace with him cloſely; or, if you advance a little, let it be ſo much only as to give him room eaſily to overtake you, and ſometimes to go before you in his turn. Being properly provided with pencils and colours, we endeavour to imitate the appearance and colouring of objects as well as their figure and outlines. The artiſt will readily perceive, that this method of proceeding muſt make ſtrange work. In theſe rude ſketches, however, and amidſt the worſt daubings, there will be ſome reſemblance of nature, as the eye is conſtantly kept on the works of our great maſter.

The firſt and groſſeſt daubings you ſhould take care to have ſet in fine gilt frames, which will ſerve as a foil to their deformity; and, in proportion as the deſign itſelf is improved, and the imitation becomes more exact, diminiſh the luſtre of the frames; giving as a reaſon, that when the painting is good, it requires no ornament to ſet it off, and that it would be a pity the frame ſhould engage the attention that ſhould be beſtowed on the picture. Hence your pupil will aſpire to the honour of having his pieces ſet in plain frames.

Sect. XXV. *Of Geometry.*

It has been ſaid, that geometry is above the capacity of children; but that it is ſo, is our own fault. We do not

perceive that their method is not ours; and that what is the art of reafoning in us, is nothing more than the art of perceiving in them. Inftead of teaching them, therefore, our method, we ought to ftudy theirs. For our way of learning geometry is as much an affair of the imagination, as of reafoning. When once the propofition is laid down, we fet about conceiving the demonftration of it; that is, we endeavour to find from what propofition already known, the other is a neceffary confequence; and from all the confequences which may be drawn from fuch propofition, to fix on that which is precifely fought.

By this method, however, the moft exact reafoner in the world, unlefs he is alfo poffeffed of invention, muft foon be obliged to ftop fhort. And what is the confequence? Inftead of being inftructed to trace out demonftrations, we only receive thofe which are dictated to us; inftead of being taught to reafon, the mafter reafons for us, and exercifes only our memories.

If you cut out and form exact geometrical figures, combine them, place them one upon another, and examine their relations, you will foon make yourfelf mafter of the elements of geometry; without ever troubling yourfelf about definitions, problems, or any other theoretical modes of demonftration. We will not therefore pretend to teach our pupil geometry; but fo contrive matters that he fhall teach it us. Search for the proper relations, but let him find them; which he will the more eafily do, as you look for them merely with that view. Inftead of taking a pair of compaffes, for example, to defcribe a circle, you would do it with a piece of thread, turning on a point. By which means, when you come afterwards to compare the length of the different radii of fuch a circle, your pupil will naturally laugh at your fimplicity, and give you to underftand, that the fame thread being conftantly extended from the centre, in tracing the periphery, it is impoffible that all the parts of the latter fhould not be at equal diftances from the former.

If you are defirous of meafuring an angle of fixty degrees, defcribe not only a fegment, but a whole circle; for with children nothing fhould be left to fuppofition. By doing thus, you find that the fegment bounded by the two fides of the angle is juft a fixth part of the whole circle. After this, keeping the point of the compaffes in the fame centre, defcribe a fecond circle; of which you will find the fegment to be alfo a fixth part of the whole, as before: then defcribe a third, and fo go on with defcribing concentric circles, and meafuring the angle on each, till your pupil, ftruck with your ftupidity, fhall inform you, that, whether the arch be greater or lefs, the fame angle will be always the fixth part of a circle. By this example alone your pupil would become perfectly acquainted with the ufe of a protractor.

To prove that the three angles of a triangle are equal to two right angles, they are ufually defcribed in a circle. On the contrary, you fhould fo contrive it that your pupil fhould firft obferve this in the circle itfelf; when you would obferve to him that, if the circle were rubbed out, and the right lines only remained, the angles would remain ftill the fame.

It is common to neglect the nicety of geometrical figures, as they are fuppofed perfect in the demonftration. But, as we fhall never trouble ourfelves about demonftrations, our moft important concern will be to draw our figures exactly; to make a fquare as perfectly fquare, and a circle as completely round, as poffible. To prove the accuracy of the figure, we fhould examine it by all its perceptible properties, and this would give us every day an opportunity of difcovering new ones. We fhould compare the two halves of a circle, by folding it together in the line of its diameter; and of thofe of a fquare, by doubling it in that of its diagonal. We fhould difpute whether the equality obfervable in the circle and fquare thus folded, obtained alfo in the parallelogram, the trapezium, and other figures. Sometimes, alfo, we fhould attempt to forefee the fuccefs of the experiment, before we made it; to endeavour to affign the reafons, &c.

Thus geometry would be, to our pupil, only the art of ufing the fcale and compafs; nor fhould he ever be fuffered to confound it with the art of defign, in profecuting which he fhould ufe neither of thofe inftruments. Thefe indeed fhould be always kept under lock and key; left by their frequent ufe he acquire a flovenly way of fketching his defigns: we fhould, however, frequently take out our drawings in our excurfions and difcourfe on what we had done, or might defign to do, at our return.

Sect. XXVI. *Of the Exercife of the Voice.*

We have an organ which anfwers to that of hearing, *viz.* that of the voice; but we have none that anfwers in the like manner to that of the fight, nor can we imitate colours as we do founds. Hence we have one method more of cultivating the former fenfe than the latter. This is by exercifing the active and paffive organs reciprocally on each other. Man hath three kinds of voice; the fpeaking or articulate voice, the finging or melodious voice, and the pathetic or accented voice, which is the language of the paffions, and animates both our finging and our fpeech. A child hath thefe three kinds of voice, as well as a grown perfon, but without knowing how to conjoin them in the fame manner He difplays, like us, laughter, cries, complaints, exclamations, &c. but he is incapable of modifying thefe with the various inflections of the other two modes of voice. In the moft perfect union of thefe three voices, confifts the moft complete mufic. Children are incapable, therefore, of this mufic, and thus have no expreffion in their finging. It is the fame with their verbal difcourfe, in which they have no emphafis; they cry out, it is true, but they lay no accent on their words; and, as there is little energy in what they fay, there is nothing emphatic in their voice and language. Our pupil will be ftill more plain and fimple in his fpeech and difcourfe, becaufe his paffions, not being as yet excited, will not mix their language with his. Never fet him, therefore, to recite fpeeches out of plays, nor teach him the arts of declamation. He will have too much good fenfe to know how to give an affected tone to the word he does not underftand, or expreffion to fentiments he has never felt.

Teach him to fpeak plainly, articulately, and to pronounce his words clearly, and without affectation; to know and practife the grammatical accent, to fpeak always loud enough to be heard; but never to raife his voice higher than the occafion requires, which is a common fault in the fchools. In every thing avoid what is fuperfluous. In the fame manner, in finging, you fhould endeavour to render his voice clear, equal, eafy, and fonorous; and his ear fufceptible of meafure and harmony, but nothing more. Imitative and theatrical mufic is above his capacity: he fhould not even make ufe of words in finging; or if it were required, we fhould endeavour to compofe fongs on purpofe for him, which fhould be adapted to his years, interefting, and equally fimple with his ideas.

Sect. XXVII. *Of Food.*

We are already well acquainted with the ftate of external bodies, with relation to our own, of their weight, figure, colour, folidity, magnitude, diftance, temperature, motion, and reft. We are informed concerning thofe which fhould be fuffered to approach us, or fhould be kept at a diftance; of the methods we are to take to overcome their refiftance, or to make ufe of other bodies in our own prefervation. All this, however, is not enough: Our own bodies are conftantly wafting, and

ſtand in need of being perpetually recruited. Although we are capable of converting ſome other bodies into the ſubſtance of ours, we are not indifferent as to the choice of them. Every thing that offers itſelf doth not yield aliment for the human body; and all thoſe ſubſtances that do, are more or leſs proper to this end, as they are adapted to the conſtitution of our ſpecies, the climate we inhabit, our own particular temperament, and manner of living.

We ſhould be poiſoned, or might periſh with hunger, if, in order to make choice of proper aliment, we were obliged to wait till experience had inſtructed us. But that Supreme Goodneſs which hath made the pleaſures of ſenſible creatures the inſtruments of their preſervation, for the moſt part, informs us, by that which is pleaſing to the palate, what will agree with the ſtomach. There is naturally no phyſician ſo infallible as the appetite; and it is doubtful whether, in our primitive ſtate, thoſe aliments which were the moſt agreeable to our taſte, were not alſo the moſt wholeſome.

Add to this, that our Creator has not only provided for the neceſſities he hath laid us under, but alſo for the wants we bring on ourſelves; and that it is with a view of making our deſires go hand in hand with our neceſſities, that our taſte and inclinations change and alter with our manner of living. The farther we depart from a ſtate of nature, the more we loſe of our natural taſte and inclinations; or rather, this conſtitutes a ſecond nature, which we ſo ſubſtitute in the place of the former, that none of us can diſcover the difference.

It follows hence, that the moſt natural taſtes are the moſt ſimple; for theſe are the moſt eaſily transformed. Whereas, by whetting and irritating them by our caprices, they become inflexible and unchangeable. The man who is as yet of no country, will eaſily fall into the cuſtoms of any country whatever; but one countryman cannot become another.

This appears true in all ſenſes, but more particularly in that of taſte, properly ſo called. Our firſt aliment is milk; we are even diſguſted at firſt with ſtrong ſavours, and accuſtom ourſelves to them by degrees. Fruits, pulſe, herbs, and at length broiled meat, without ſalt or ſeaſoning, were the aliments of primitive mortals. The firſt time a ſavage taſtes wine, he is diſguſted with it, and ſpits it out; and even among us we find, that thoſe who attain their twentieth year without taſting fermented liquors, can never bring themſelves to reliſh them afterwards. We ſhould have been all abſtemious if wine had not been given us in our younger years. In a word, the more ſimple our taſte, the more univerſal; the moſt common diſguſts are entertained againſt compounds. Did we ever know a perſon entertain a diſtaſte againſt bread or water? Hence we ſee the path indicated by nature; this therefore is what we ſhall follow. Let us endeavour, as much as poſſible, to preſerve the taſte of children in its primitive and unvitiated ſtate; let their nutriment be ordinary and ſimple, nor familiariſe their palates to any thing that is high flavoured.

It is not neceſſary to enquire here whether ſuch a manner of living be healthful or not, as this is not to our preſent purpoſe. It is ſufficient for us to give it the preference, to know that it is *moſt conformable to nature*, and that it is the moſt eaſily convertible into any other. Thoſe who ſay we ought to accuſtom children to thoſe aliments which they are to make uſe of when grown up, reaſon, it is evident, very improperly. Why ſhould their nutriment be the ſame, when their manner of living is ſo very different? A man, whoſe ſpirits are waſted with care, labour, and fatigue, ſtands in need of ſucculent aliments that may furniſh him with new ſpirits; whereas a child that is growing, and always ſporting about, requires an abundant nouriſhment, productive of good chyle. Beſides this, a grown perſon hath already ſome ſettled rank, employment, and reſidence; but who can be certain what may happen to be the future circumſtances of a child? Take care, in every caſe, not to give him too determinate a form, leſt it ſhould coſt him too dear to change it when occaſion requires. Let us not ſo educate him that he muſt periſh with hunger in a foreign country, unleſs he travel with a French cook, nor that he may be induced to ſay hereafter, that people know how to eat only in his own country.

Of all our various ſenſations, thoſe we receive by means of the taſte affect us moſt; for we are more intereſted to judge of thoſe ſubſtances which are to become part of our own, than of thoſe which barely exiſt around us. A thouſand things are indifferent to the touch, the hearing, and the ſight; but there is hardly any thing indifferent to the taſte. Add to this, that the activity of this ſenſe is altogether phyſical; it is the only one which has nothing to ſay to the imagination; at leaſt, it is that into which the imagination enters leſs than into any other; whereas imitation and fancy often unite a moral impreſſion to the phyſical in all others. Thus, generally ſpeaking, voluptuous and ſuſceptible characters, eaſily affected by the other ſenſes, are cold and indifferent to this. For this reaſon alone, which ſeems to place the taſte below them, and to render our deſire of gratifying the palate contemptible, we ought to conclude, on the contrary, that the beſt method to govern children, is to *lead them* by the *mouth*. The motive of gluttony is at worſt preferable to that of vanity, in that the firſt is a natural appetite, depending immediately on the gratification of the ſenſe, whereas the ſecond ariſes only from opinion, is ſubject to the caprices of mankind, and to all manner of abuſe. Gluttony is the paſſion of children, nor takes place of any other, but diſappears preſently when others make their appearance. There is no doubt, a child will ceaſe but too ſoon to think of what he is to *eat*: when his *heart* is fully engaged, his *palate* will have but little to do. As he grows up, a thouſand impetuous ſentiments will divert his attention from eating to excite his vanity: for this latter paſſion is that which profits by the others, and at length engroſſes them all. If we attentively make our obſervations on thoſe perſons who hold good eating to be of ſo much importance; who begin to think as ſoon as they wake in the morning, what they ſhall have to eat during the day, and deſcribe a feaſt with more exactneſs than Polybius deſcribes a battle, we ſhall always find, that ſuch pretenders to manhood are only *great boys*, thirty or forty years of age, without vigour and without conſiſtence; *fruges conſumere nati*. Gluttony in grown perſons is the vice of thoſe who have *no hearts*. The ſoul of a glutton lies always in his palate; he is formed for nothing but to eat. Incapable of every other enjoyment, he is nothing but when at table, and is incapable to judge of any thing in the world but made diſhes. There let us leave him, without regret, to his brutal employment; it is fitter for him than any other, as well for his ſake as our own.

To be fearful leſt gluttony ſhould take root, and grow up in a child of any capacity, is the effect of a narrow way of thinking. In *childhood* only we think on what we are to eat; in youth we think little on this ſubject; every thing goes down, when we have other affairs to mind. An indiſcreet uſe, however, ſhould not be made of ſo mean a motive, nor that we ſhould render the honour of doing a noble action dependant on ſweetmeats and biſcuits. But there is no reaſon, as childhood is, or ought to be employed in mere amuſements, why exerciſes purely corporeal ſhould not be attended with a perceptible and material prize. When the little Majorcans were uſed to fetch down a baſket from the top of a tree, by flinging ſtones at it, was it not very juſt that a good breakfaſt ſhould repair the ſtrength they had exhauſted in the enterprize?

This doth not contradict the maxims advanced concerning the wholeſome ſimplicity of viands; for to flatter the appetite

of children, it is not neceſſary to make them nice, but only to ſatisfy them; and this may be done by the moſt ſimple and common things in the world, if we do not endeavour to refine their taſte. That conſtant appetite which is excited in them by their tendency to growth, is a certain ſauce which ſupplies the place of many others. Fruits, milk-meats, cakes ſomewhat better than common bread, and particularly the art of diſpenſing theſe things moderately, are ſufficient to lead a whole army of children round the world, without giving them any taſte for high-flavoured meats, or running the riſk of ſpoiling their palates.

One proof that the taſte of meat is not natural to the human palate, is the indifference which children have for that kind of food, and the preference they give to vegetable aliments, ſuch as milk-meats, paſtry, fruit, &c. It is of ſome little conſequence not to vitiate this primitive taſte in children, to make them carnivorous. Were even their health not concerned, it would be expedient, on account of their diſpoſition and character; for it is ſufficiently clear from experience, that thoſe people who are great eaters of meat, are in general more ferocious in their diſpoſitions than other men.

As to what relates farther to the regimen of children, provided you accuſtom them only to ſimple and common aliments, you may let them eat, run about, and play as much as they will, without any danger of their eating too much, or of being incommoded by indigeſtion. But if you let them go famiſhed one half of their time, and they can poſſibly eſcape your vigilance, they will doubtleſs indemnify themſelves, and eat till they are almoſt ready to burſt. Our appetites are irregular only becauſe we would impoſe rules on them that are not dictated by nature. Being for ever buſied in regulating, preſcribing, adding or retrenching, we do nothing without a pair of ſcales in our hands; but theſe ſcales ſerve only to weigh our own caprices, and are not the balance of our appetite. Among the peaſants, the cup-board and orchard are always open, and we do not find that either the old or young among them know any thing of indigeſtion.

If it ſhould ever happen, however, that a child is given to eat too much, which is ſcarcely poſſible in our way of education, it is very eaſy ſo far to divert his attention, by ſuch amuſements as he is fond of, that he may become almoſt famiſhed without even thinking of his victuals. Is it not ſtrange that ſuch ſimple and eaſy means ſhould have eſcaped all thoſe who have treated this ſubject of education? Herodotus relates, that the Lydians, being oppreſſed by a great famine, invented and inſtituted certain games and other amuſements, in order to divert their attention from the cravings of appetite, and enable them to paſs away whole days without thinking of any thing to eat *.

Sect. XXVIII. *Of Common Senſe.*

It remains for us to treat, in the ſucceeding parts of this work, of the cultivation of a kind of ſixth ſenſe; called *common ſenſe*; not ſo much becauſe it is common to all men, as becauſe it reſults from the well-regulated uſe of the other ſenſes, and inſtructs us in the nature of things, from their concurrent appearances. This ſixth ſenſe has, of courſe, no particular organ; but reſides in the brain; its ſenſations, which are purely internal, being called *perceptions* or *ideas*. It is the number of theſe ideas that limits the extent of our knowledge; it is their perſpicuity that determines the clearneſs of the underſtanding; and it is the art of comparing them with each other, that is called human reaſon. Thus, what we call ſenſitive or puerile reaſon, conſiſts in forming ſimple ideas from the concurrence of various ſenſations; and what we call intellectual or human reaſon, conſiſts in forming complex ideas from the concurrence of many ſimple ideas.

On the ſuppoſition, then, that the method we have pointed out is natural, and that we are not deceived in the application, we have conducted our pupil through the region of ſenſation to the confines of puerile reaſoning: the firſt ſtep we take beyond theſe limits, ought to be that of a man. But before we enter on this new career, let us caſt our eye, for a moment, over that through which we have paſſed. Every age, every ſtate of life has its particular degrees of perfection, a kind of maturity peculiar to itſelf. We have often heard talk of a full-grown man; let us conſider a little what is a full-grown child: this object will be more new to us, and perhaps not leſs agreeable.

The exiſtence of finite beings is ſo poor and limited, that when we ſee them only as they are, we are little affected. The real object is aggrandized by chimeras, and if the imagination added no charm to thoſe which actually ſtrike our ſenſes, the barren pleaſure we ſhould take therein would be confined to the organ, and would leave the heart unaffected. The fields and vineyards, adorned with all the treaſures of autumn, preſent a ſcene which the eye naturally admires; but this admiration is cold and unaffecting; if it pleaſes, it is more from reflection than ſentiment. In the ſpring the country appears bleak and naked; the woods afford no ſhade, and the verdure is hardly perceptible on the plain; and yet the heart is immediately affected with the proſpect. At the ſight of re-animated nature, it feels itſelf re-animated; the images of delight are excited all around. The companions of its pleaſures, thoſe tears of joy which are ever ready to accompany delightful ſentiments, ſtand already in our eyes; but the proſpect of harveſt, however animated, lively, and agreeable, we always behold with different ſenſations.

Whence is this difference? It is, that, to the proſpect of the ſpring, the imagination joins that of the ſucceeding ſeaſons; to the tender buds which the eye juſt beholds, it adds the flowers, the fruits, the ſpreading ſhades, and ſometimes the myſterious pleaſures they ſpread themſelves to conceal. The imagination preſents, in one point of view, various ſucceſſive ſcenes, and takes a proſpect of objects, not as they really are, but as it could wiſh them to be. In autumn, on the contrary, nothing more is to be ſeen in idea than exiſts in fact. If we would anticipate the ſpring, cold winter intervenes, and the imagination is chilled amidſt froſt and ſnows.

Such is the ſource of thoſe charms which are preſented us by promiſing infancy, in preference to the perfection of maturer age. When do we conceive any real pleaſure in taking a view of the ſituation of a man? It is then only, when the remembrance of his actions enables us to take a retroſpect of his life, and to repreſent him in the time of his youth. If we are reduced to the neceſſity of conſidering him ſuch as he is, or to ſuppoſe him ſuch as he will be in old age, the idea of declining nature effaces all our pleaſures. We can take no delight in ſeeing a man advance with haſty ſtrides to the tomb; the image of death involves every thing in deformity.

But when we view a child, ten or twelve years of age, robuſt,

* The ancient hiſtorians preſent many uſeful things to our view, were even the facts on which they are founded confeſſedly falſe. But we know not how to make any good uſe of hiſtory. Critical erudition engroſſes every thing, as if it was of more conſequence to know the truth of a fact, than to draw from it any uſeful inſtruction. Senſible men ought to look upon hiſtory as a collection of fables, whoſe morals may be uſeful to mankind.

and well formed, every idea that his ſituation excites is agreeable, whether relative to the preſent or the future. We ſee him animated, lively, active, ſporting about without care, and undiſturbed by the thoughts of futurity; capable of enjoying all his faculties, and ſo full of life as to ſeem deſirous to infuſe it into every object around him. We foreſee him in a more advanced age, exerting that ſenſe and genius, which his faculties are daily diſplaying. If we contemplate the object before us as a child, he gives us great delight; as a future man, he delights us ſtill more; his youthful blood ſeems to give freſh motion to ours. We catch from him a new portion of life, and grow young again in his vivacity.

But the clock ſtrikes: the ſchool hour is come. What an alteration! In a moment his eyes loſe their fire, his cheerfulneſs is at an end. Farewell to joy and play. A ſevere and crabbed preceptor takes him by the hand, and ſaying gravely, *Come, Sir*, forces him away. The chamber he is led into, is furniſhed with books. Books! Dull furniture indeed for a child of his age; but the poor infant ſuffers himſelf to be dragged thither, caſting in ſilence an eye of regret on every object around him, his eyes ſwimming in tears he dares not ſhed, and his heart ſwelling with ſighs he dares not vent.

O thou! who haſt nothing of this kind to fear: thou! who art always a ſtranger to trouble and reſtraint: thou! who paſſeſt the day without diſquietude, the night without impatience, and reckoneſt the hours only by thy pleaſures, come, thou happy, thou amiable child! and comfort us, by thy preſence, for the departure of this little unfortunate! He comes.---We feel at his approach a ſenſation of joy, of which he ſeems to partake. It is his friend, his comrade, the companion of his ſports, who called him; he is certain, that, whenever he ſees his preceptor, he ſhall not be long without ſome agreeable amuſement; we never are dependent on each other, yet always agree, and are never ſo happy with any other perſon as when we are together.

His figure, attitude, and countenance, ſpeak aſſurance and contentment; his face is the picture of health; his firm ſtep gives him an air of ſtrength and vigour; his complexion, delicate without being pale and wan, has nothing in it of effeminate ſoftneſs; the ſun and the wind having already given to his ſkin the honourable tint of his ſex. His features, though ſtill plump, begin to ſhow ſome diſtinguiſhing marks of phyſiognomy; his eyes, as yet unanimated by the glow of ſentiment, have all their natural ſerenity; they are not grown dull and heavy, from care or ſorrow, nor have inceſſant tears made furrows in his cheeks. On the contrary, you may ſee, in his alert but ſteady motions, the vivacity of his age, the firmneſs of his independence, and the experience he hath gained from the many and various exerciſes to which he has been accuſtomed. He has an open and liberal mien, without the leaſt air of inſolence or vanity; as he has not been kept poring over his books, his looks are not directed downwards, nor is there any occaſion to bid him hold up his head. Neither fear nor ſhame ever made him hang it down.

He is arrived at the maturity of infancy; he hath lived the life of a child, and has not purchaſed the perfection he hath attained at the expence of his happineſs; on the contrary, both have concurred in his education. Even in acquiring the knowledge and underſtanding of his age, he hath been as free and happy as his conſtitution would permit him. So that if Providence ſhould deprive us of him in the bloſſom of our hopes, we ſhall not have at once to lament both his life and his death; our ſorrows will not be aggravated by the remembrance of thoſe which we have occaſioned him. We ſhall have it to ſay, at leaſt, that he enjoyed life in his infancy, and that we did not deprive him of any of thoſe good things nature beſtowed on him.

Although, till the age of puberty, the whole courſe of life be one continued ſeries of imbecility, there is a certain period in this firſt age of life, in which the progreſs of his paſſions exceeding that of his neceſſities, the growing animal, though abſolutely weak, becomes relatively ſtrong. His wants not being wholly diſplayed, his actual abilities are more than ſufficient to provide for thoſe which he really feels. Conſidered as a man, he is very weak; but as a child, he is abundantly ſtrong. Whence proceeds the weakneſs of man? From the diſproportion he finds between his faculties and his deſires. It is our paſſions that render us feeble; becauſe, to gratify them, requires greater powers than nature has furniſhed us with. Diminiſh, then, the number, check the extravagance of your deſires, and you encreaſe your powers of gratification. He who can compaſs more than he requires, hath ability to ſpare; and is certainly a powerful being. Here begins the third ſtage of infancy, of which we are now about to treat; it being that ſtate of childhood which approaches nearly to puberty without being quite arrived at that term.

At twelve or thirteen years of age, the faculties of a child diſplay themſelves more rapidly than his wants. The moſt impetuous, the moſt coercive of all phyſical neceſſities he hath not yet experienced. The very organs that provide for its gratification are as yet imperfect, and ſeem to wait the exertion of the will to capacitate them for action. Unaffected by the inclemency of the weather, or the change of ſeaſons, his natural heat ſupplies the artificial warmth of apparel, and his keenneſs of appetite the provocatives of ſauce. At his age whatever is but nouriſhing is good; if he be drowſy, he ſtretches himſelf on the ground, and falls aſleep. Whatever he hath occaſion for, is within his reach: he craves not after imaginary dainties; he feels no diſguſt from prepoſſeſſion. His deſires confined within the ſphere of his abilities, he is not only capable of providing for himſelf, but poſſeſſes ſuperfluous faculties for which he has no uſe. This, however, is the only time, during life, in which he will be in ſuch a ſituation.

This interval, in which the individual is able to effect more than he requires, though it be not the period of his greateſt abſolute ſtrength, is, as we before obſerved, that of his greateſt relative ability. This interval contains the moſt precious moments of his life; moments never to return, few, and tranſitory; hence the more precious, as to employ them well becomes of the greater importance. To what uſe, then, is it proper a child ſhould put that redundancy of abilities, of which he is at preſent poſſeſſed, and hereafter will ſtand in need of? He ſhould employ it on thoſe things which may be of utility in time to come. He ſhould throw the ſuperfluity of his preſent being into his future exiſtence. The robuſt child ſhould provide for the ſubſiſtence of the feeble man; not in laying up his treaſure in coffers, nor by entruſting it in the hands of others, but by keeping it in his own. To appropriate his acquiſitions to himſelf, he will ſecure them in the ſtrength and dexterity of his own arms, and in the capacity of his own head. This, therefore, is the time for employment, for inſtruction, for ſtudy. Obſerve however, that we have not arbitrarily fixed on this period for that purpoſe. Nature itſelf plainly points it out to us.

So circumſcribed is human intelligence, that we are not only denied the power of attaining univerſal knowledge, but it is impoſſible even to know perfectly the little that is attained by others. As the reverſe of every falſe propoſition is true, the ſource of truth muſt be as inexhauſtible as that of error. A proper choice therefore ſhould be made of the ſubjects, as well as of the time for inſtruction. Of the arts and ſciences within our acquiſition, ſome are fallacious, others uſeleſs, and others again ſerve only to flatter the vanity of their reſpective profeſſors. The ſmall number of ſuch as really contribute to our

well-being, are thofe only that merit the attention of a wife man, and of courfe of the child that we are folicitous to make fo. The point in view, therefore, is not what may be true, but what is ufeful.

From this fcanty proportion of ufeful knowledge, we muft yet farther fubtract thofe truths which require an underftanding already formed, fuch as prefuppofe the knowledge of thofe different relations and circumftances, with which a child cannot be acquainted, and which, though true in themfelves, difpofe an inexperienced mind to form a wrong judgment on other occafions.

Thus are we reduced, in our fyftem of education, to a very fmall circle, compared with the fyftem of things. This, however, appears an immenfe fphere to the contracted faculties of a child. So dark are the clouds that obfcure the dawn of the human underftanding! Where is the man who hath temerity enough to attempt their diffipation? What an abyfs hath fruitlefs knowledge dug round the haplefs youth! Tremble, prefumptuous man! thou art about to conduct him through its dangerous paths, and to draw from before his eyes the facred curtain of nature. Be firft well affured of his capacity and your own, left the intellects of one or the other, and perhaps both, be perverted in the attempt. Beware of the fpecious allurements of falfehood, and the intoxicating fumes of pride. Remember, conftantly remember, that *mere ignorance* hath never been hurtful; that *error* alone is deftructive, and that we do not err in things we are profeffedly ignorant of, but in thofe which we conceive we know.

The progrefs which your pupil makes in geometry, will ferve, both as a proof and guide, in the difplay of his capacity. As foon, however, as he is capable of diftinguifhing what is ufeful, it requires great addrefs and circumfpection to introduce fpeculative fubjects. Are you defirous, for inftance, that he fhould know how to find a mean proportional between two given lines? Begin by inducing him practically to find a fquare, equal to a given rectangle. If the queftion be, to find two mean proportionals, it will be requifite to make the problem of doubling the cube peculiarly interefting. Hence you fee, in what manner we might approach by degrees thofe truths on which are founded the moral diftinctions of good and evil. Hitherto we have been governed by no law but that of neceffity; at prefent we begin to confider what is ufeful, and fhall not be long before we come to the confideration of what is good and proper.

Sect. XXIX. *Of Curiofity, and the inquifitive Difpofition of Children.*

The various faculties of men are excited by the fame inftinct. To the activity of the body, making conftant efforts to difplay his abilities, fucceeds that of the mind, as conftantly *feeking after information.* Children, when very young, feem endowed only with a capacity and inclination for motion; they afterwards become inquifitive and curious, and this curiofity, well directed, becomes, at the age they have then attained, their chief fpring of action. Let us be always careful to diftinguifh thofe propenfities which are implanted by nature, from thofe which are ingrafted by the dictates of prejudice and opinion. A thirft after knowledge may proceed merely from the vanity of defiring to be thought learned; it may alfo arife from that curiofity which naturally excites us to inquire after every thing in which we may be either directly or indirectly interefted. Our innate defire of happinefs, and the impoffibility of our fully gratifying that defire, are the caufe of our conftant refearches after new expedients to contribute to that end.

This is the firft principle or motive of curiofity: a principle which is natural to the heart of man, but which difplays itfelf only in obedience to our paffions, and in proportion to our acquirement of knowledge. Let us fuppofe a philofopher caft afhore on a defert ifland, together with his books and inftruments, and that he was under an abfolute certainty of fpending in that folitude the remainder of his days. He would never trouble himfelf farther about the fyftem of the univerfe, the laws of attraction, or the fluxionary calculus. It is probable he would never after look in a book, during his whole life; but he certainly would not fail to explore the ifland, however extenfive, even to its remoteft corners. Let us, therefore, in our early ftudies, reject thofe fciences for which man has not a natural turn, and confine ourfelves to thofe which inftinct directs us to purfue.

The earth is the ifland on which mankind are caft, and the moft ftriking object of their obfervation is the fun. As foon as our ideas begin to extend beyond ourfelves, our attention will therefore naturally be ingroffed between two fuch interefting fubjects. Hence the philofophy of almoft every favage nation is confined folely to the imaginary divifions of the earth, and the divinity of the fun. "What an excurfion!" cries the reader. "We were but juft now employed about objects that immediately furround us, and we are now traverfing the globe, and foaring to the diftant extremities of the univerfe." This excurfion, however, is the fimple effect of the progrefs of our faculties, and the bent of our underftanding. During our infant ftate of weaknefs and incapacity, all our thoughts, influenced by felf-prefervation, are confined within ourfelves. On the contrary, in a more advanced age, as our abilities increafe, the defire of improving our exiftence carries us out of ourfelves, and our ideas extend to their utmoft limits. As the intellectual world, however, is as yet unknown to us, our thoughts cannot extend farther than we fee; but our comprehenfion dilates itfelf with the bounds of fpace.

Let us convert our fenfations into ideas; but let us not fly at once from fenfible to intellectual objects. It is by a due and rational attention to the former we can only attain the latter. In the firft operations of the underftanding, let our fenfes then always be our guide, the world our only book, and facts our fole precepts. Children, when taught to read, learn that only; they never think; they gain no information; all their learning confifts in words.

Direct the attention of your pupil to the phænomena of nature, and you will foon awaken his curiofity; but to keep that curiofity alive, you muft be in no hafte to fatisfy it. Put queftions to him adapted to his capacity, and leave him to refolve them. Let him take nothing on truft from his preceptor, but on his own comprehenfion and conviction: he fhould not *learn*, but *invent* the fciences. If ever you fubftitute authority in the place of argument, he will reafon no longer; he will be ever afterwards bandied like a fhuttle-cock between the opinions of others.

You intend, we will fuppofe, to teach your child geography, and for that purpofe provide for him maps, fpheres, and globes. What an apparatus! wherefore all thefe mere reprefentations of things? why do you not rather begin by fhewing him the object itfelf, that he may, at leaft, know what it is you are talking about?

Walk out with him, fome fine evening, to a convenient fpot, from whence an extenfive horizon may give you a full view of the fetting fun; and then take particular notice of fuch objects as mark the place of its going down. Return the next morning, with a profeffed defign only of taking the frefh air, to the fame place, before the fun rifes. There you will fee the fiery rays it fcatters among the clouds, as harbingers of its approach. The illumination increafes, the eaft feems all in flames, and you expect the glorious orb long before it difcovers itfelf above the horizon; you think you fee it every

moment; it at length appears. Its rays dart like lightning over the face of nature, and darknefs vanifhes at the fight. Man glories in his habitation, and fees it embellifhed with new beauty. A pupil educated agreeable to our maxims, and accuftomed to receive no affiftance *till he has difcovered his own abilities*, will examine every new object with a long and filent attention. He will be thoughtful without afking queftions. Content yourfelf, therefore, with prefenting proper objects opportunely to his notice, and when you fee they have fufficiently excited his curiofity, drop fome leading laconic queftions, which may put him in the way of difcovering the truth.

On the prefent occafion, having for fome time contemplated the rifing fun, and made your pupil obferve the hills and other neighbouring objects on that fide, permitting him the while to talk about them without interruption, ftand filent a few moments, and affect a profound meditation. You may then addrefs him thus: "I am thinking that, when the fun fet laft night, it went down yonder behind us; whereas, this morning, you fee, he is rifen on the oppofite fide of the plain here, before us. What can be the meaning of this?" Say nothing more; and, if he afks you any thing about it, divert his attention, for the prefent, by talking of fomething elfe. Leave him to reflect on it himfelf, and be affured he will think of your obfervation.

To accuftom a child to give attention to objects, and to make fenfible truths appear ftriking to his imagination, it is neceffary to keep him fome time in fufpenfe before they are explained or difcovered to him. If he fhould not fufficiently comprehend the nature of the prefent queftion by the means propofed, it may be rendered ftill more obvious, by diverfifying the terms of it. If he cannot comprehend in what manner the fun proceeds from its fetting to its rifing, he knows at leaft how it proceeds from its rifing to its fetting: he hath ocular information of this. Explain the firft queftion, then, by the fecond; and if your pupil be not extremely dull indeed, the analogy is too obvious to efcape him. Such is our firft lecture in *cofmography*.

As we proceed flowly from one fenfible idea to another, making ourfelves familiarly acquainted with each as we go on, and as our pupil's attention is never required upon compulfion, the diftance will be very confiderable, from the object of this firft leffon to the knowledge of the fun's courfe, and the figure of the earth: but as the apparent motion of all the heavenly bodies depends on the fame principle, and as the firft obfervation naturally leads to all the reft, it requires lefs capacity, though more time, to proceed from the diurnal rotation of the earth to the calculation of an eclipfe, than to acquire clear ideas of the phænomenon of day and night.

As the fun turns round the earth, he defcribes a circle, and every circle hath a centre; this we already know. This centre, alfo, muft needs be invifible, becaufe it is in the middle of our globe; but we can fuppofe two points on the furface fo correfponding with it, that a road paffing through all three, and extended both ways to the heavens, would be at once the axis of the earth and of the fun's apparent diurnal motion. A whirl-bone or globular totum, turning upon one of its points, may ferve to reprefent the heavens turning upon their axis, the two points of this plaything being the two poles; one of which may be pointed out to our pupil, near the tale of the little bear. This would furnifh us with an amufement for the night; by which means we fhould become gradually acquainted with the ftars, and thence in time grow anxious to diftinguifh the planets and conftellations.

You and your pupil have feen the fun rife at *midfummer*: next take a view of his rifing, fome fine morning, in the depth of *winter*. We will fuppofe you have taken care to make the fecond obfervation on the *very fame fpot* where you made the former; fo that, in confequence of a little preparatory difcourfe to introduce the remark, one or other of you will infallibly cry out when the fun firft appears before the horizon, "Ha! this is pleafant enough! the fun does not rife in the place it ufed to do. Here, you fee, are our old marks to the left, and now he rifes yonder, to the right. So it feems there is one eaft for the fummer, and another for the winter." Thefe examples will be fufficient to fhew the inexperienced preceptor the way to bring his pupil acquainted with the fphere, by making ufe of *the earth itfelf* inftead of a globe, and the *apparent revolution of the fun* inftead of any imperfect *reprefentation* of it. It ought, indeed, to be laid down as a general rule, never to fubftitute the fhadow unlefs where it is impoffible to exhibit the fubftance; for the reprefentation ingroffing the attention of the child, generally makes him forget the object reprefented.

Sect. XXX. *Of the Sciences.*

We never know how to fuppofe ourfelves in the place of children; we never enter into their manner of thinking. On the contrary, we attribute to them *our* ideas; and, purfuing *our own* method of argumentation, fill their heads, even while we are difcuffing inconteftable truths, with extravagance and error. It is difputed, whether the fciences are beft taught by the fynthetic or analytic method. It is not always neceffary to abide by either. We may fometimes compound and refolve in the fame difquifition, and inftruct a child, by the former mode of argument, while he thinks himfelf employing the latter. Add to this, that, by making ufe of both methods indifferently, they ferve reciprocally to confirm each other. Setting out at the fame time from two different points, without feeming to take the fame route, he will be furprifed to find himfelf directed two ways to one and the fame object; and that furprife cannot fail of giving him great fatisfaction. In teaching him geography, for example, we fhould begin at its two extremes; and, with the ftudy of the apparent aftronomical revolutions, unite that of the divifions and meafurement of the earth. While he is ftudying the fphere, and thus tranfporting himfelf in imagination to the heavens, we fhould call back his attention to the divifions of the earth, and point out to him their relation to his own place of abode.

The two firft objects of his geographical ftudies fhould be the town where he refides, and his father's feat in the country. After having well-obferved the fituation of thefe, he fhould take the like notice of the neighbouring villages and country-feats on the road, together with the adjacent rivers; obferving the fituation and afpect of each object, in regard to the rifing and fetting of the fun. This is the point of reunion. He fhould make a map from this furvey; beginning fimply with the two firft objects before mentioned, and inferting the others by degrees, as he comes to know, or eftimates their pofition and diftance. You fee, already, the advantages he will have in this refpect, by having accuftomed him to meafure objects and diftances by his eye.

Notwithftanding this advantage, however, it will be neceffary to direct a child in thefe operations a little; but this fhould be very little and imperceptibly. If he falls into a miftake, let him alone. Be in no hafte to fet him right; but wait with patience till he be himfelf in a ftate to difcover and correct his error; or at moft take occafion only, at a favourable opportunity, by fome diftant hint, to make him fenfible of it. If he fhould never miftake, he would make but little improvement. It is not neceffary that he fhould know at prefent the topography of the country, but the means whereby fuch knowledge is obtained; it is of no importance to him to have a number of *maps* in his head, provided he knows *what they*

ferve to reprefent, and has clear ideas of the art by which they are conftructed. Here you fee the difference between our pupil and the pupils of others. Their knowledge lies in maps and charts, that of our pupil in the fcience of geograpky. His progrefs in the art of map-making will hence furnifh very proper ornaments for his apartment. You will remember it fhould be a conftant maxim, not to teach a child *a multiplicity of things*, but to prevent his acquiring any but *clear and precife ideas*. His knowing but little is of no confequence, provided he imbibes no *falfe principles*. You ftore his head with truth, only to prevent the entrance of error. Reafon and judgement advance but flowly, while prejudice attacks with early impetuofity; we muft carefully guard therefore againft the latter. If you regard fcience indeed, for its own fake, and aim at knowledge in general, you enter upon an unfathomable ocean, without a fhore, to founder among the rocks. When a man is enamoured by the charms of univerfal knowledge, and flies from the purfuit of one fcience to another, he refembles a child gathering fhells on the fea-fhore. He firft loads himfelf indifcriminately with as many as he can carry; when, tempted by others of a gayer appearance, he throws the former away, taking and rejecting, till fatigued and bewildered in his choice, he hath thrown all away, and returns home without a fingle fhell.

During the firft term of childhood, we endeavoured only to lofe time, to avoid the ill employment of it. The cafe is now altered; and we have not time fufficient for every thing that might be ufeful. The paffions advance upon us apace, and the moment they give notice of their arrival, your pupil will give no ear to any other monitor. The term of difpaffionate intelligence is fhort and tranfitory, and is, befides, employed on fo many fubjects of prefent utility, that it is a folly to think it fufficiently long for a child to acquire much learning or wifdom. It is not our bufinefs at prefent to make him *an adept* in the fciences, but to give him *a tafte for them*, and point out the method of improving it. This is moft certainly the fundamental principle of a rational education.

The prefent is alfo the proper time to accuftom your pupil by degrees to fix his attention, for fome time, on one and the fame object. This attention, however, muft always be accompanied by pleafure or inclination, and never be the effect of compulfion. We muft be careful, alfo, not to keep it too long upon the ftretch, left wearinefs and difguft fhould enfue. Keep, therefore, a watchful eye over your pupil, and by no means permit him to fatigue himfelf by too intenfe application. He had better learn nothing, than learn upon compulfion. When he afks a queftion, be your anfwer always calculated rather to keep alive than fatisfy his curiofity; efpecially when you obferve he has a mind to trifle rather than be inftructed. You ought to pay lefs regard to the terms of interrogation, than to his motives for inquiry. This conduct becomes of the greateft importance when a child begins to reafon.

The fciences are connected together by a feries of propofitions, all dependent on fome general and common principles, which are gradually difplayed. The philofophers make ufe of thefe; with us they are as yet out of the queftion. There is another chain of reafoning, of a different conftruction, by which every particular object is connected to fome other, and points out that which fucceeds it. This order of fucceffion, which, from our natural curiofity, keeps alive our attention, is generally made ufe of by grown perfons, and is peculiarly adapted to children. Before we begin to delineate our map, we muft trace a meridian. The two points of interfection found by fhadows of equal length in the morning and evening, will give an excellent meridian for an aftronomer of thirteen. To find thefe, however, will require time, and oblige us to work conftantly on the fame fpot. This method might be too troublefome and difgufting; having forefeen this inconvenience, therefore, we have provided againft it.

Sect. XXXI. *Of Vanity, and its Cure.*

"My pupil," fays M Rouffeau, "has long fince obferved, that amber, glafs, wax, and feveral other bodies, on being rubbed, attract bits of ftraw, feathers, &c. and that other bodies in general have not that quality. Among them, however, we have accidentally difcovered one, which is poffeffed of a yet more fingular property: it attracts fteel-filings and bits of iron, not only at a diftance, but without friction. This difcovery engages our attention for fome time, without anfwering any other purpofe than amufement. At length, we perceive it communicates its attractive property to iron and fteel. About this time, I take my pupil to fee the diverfions of a neighbouring fair, where, among other wonderful performances, a juggler produces a duck of wax, fwimming about in a bafon after a piece of bread, which he holds in his hand. We are greatly furprifed at this ftrange phænomenon; but as we are unacquainted with the fables of witchcraft, we charge not the artift with being a wizard or a conjuror. As we are daily accuftomed to various ftriking effects, of whofe caufes we are confeffedly ignorant, we are not very anxious to account for every thing we fee; but reft contented till fome fortunate event affords us information.

"At our return home, however, our converfation very naturally turns on this extraordinary duck, and accordingly a thought fuggefts itfelf of imitating it. We take a large needle, and touching it on a loadftone, cover it with wax, which we mould as well as we can into the fhape of a duck, the needle paffing through its body from the beak to the tail. We then fet it afloat in a bafon of water, and prefenting a key to its beak, we find, to our great joy, the duck follows it, in the fame manner as that of the juggler followed the bread. As to the line of direction in which the body of the duck remains when at reft, we may obferve that fome other time: at prefent we are too much taken up with the firft object of attention to think of any thing elfe. In the evening we repair to the juggler's booth, with a piece of bread, properly prepared, in our pocket; when the boafting artift having performed his trick, my young philofopher, who had with difficulty fo long contained himfelf, tells him, there is nothing in it, and that he himfelf can do as much. He is taken at his word; and inftantly pulls the bread with the concealed iron out of his pocket. His heart flutters as he approaches the table, and his hand trembles as he prefents the bread. The duck, however, follows it; on which he leaps for joy, and triumphs in the applaufe of the fpectators. The juggler, though a little confounded, embraces him, felicitates him on his fuccefs, and begs he will honour him with his prefence the next day, when he promifes to collect a more numerous affembly to witnefs and applaud his abilities. Our young naturalift, in the mean while, fo proud of his fcience, is juft on the point of difcovering the fecret, when I hurry him away from the fcene.

"Full of the applaufe he is to receive to-morrow, he counts the moments, in the mean time, with ridiculous impatience. He invites every one he knows, and would be glad the whole world fhould be witneffes of his triumph. At length the appointed hour is come; we haften to the place of rendezvous, and find the room already crowded with fpectators. His young heart is elated with joy at the fight. Other tricks in their courfe preceding ours, the juggler furpaffes his ufual dexterity, and performs wonders. My pupil, however, pays no attention to what is doing; but keeps fumbling all the while in

his pocket, with his piece of bread in his hand, fetching his breath ſhort, and ſweating with impatience and anxiety. At length it is his turn to exhibit: the artiſt pompouſly introduces the apparatus, and prepares the ſpectators for the trick. Emilius, though ſomewhat abaſhed, approaches the table, and offering his bread to the duck—what a new turn in human affairs! Tame as it was yeſterday, it is become a mere wild-duck to-day: inſtead of preſenting its beak, it turns tail and ſwims away, flying from the bread, and the hand preſenting it, as faſt as it before had followed them. After many fruitleſs trials, for which he is conſtantly laughed at by the company, my pupil complains that he is impoſed on, and that this is not the duck he practiſed on yeſterday; defying the juggler himſelf to draw this about in the ſame manner.

"The artiſt, without making a reply, takes up a piece of bread, and preſenting it to the duck, draws it immediately after his hand. Emilius takes up the ſame piece of bread; but, inſtead of ſucceeding better than with the former, has the mortification to ſee the duck turn regardleſs from him, and make circles round the baſon. On this he retires in confuſion, unable to bear the ſneers of the company any longer.

"The juggler now takes the piece of bread my pupil had brought, and makes uſe of it with as much ſucceſs as he did his own. He takes the iron from within it; and expoſing it to the company, raiſes another laugh at our expence. He even draws the duck about, as before, with the bread thus ſeparated from the iron. He performs the ſame trick, alſo, with another piece, cut from the loaf by a third perſon; he does the ſame thing with his glove, and with the bare end of his finger. He next advances into the middle of the room, and declaring aloud, with that emphatic tone ſo peculiar to theſe gentry, that his duck would obey his call, as well as his motions; he ſpeaks to it, and it immediately obeys the word of command. If he bids it move to the right, to the right it goes; if to return, it returns; if to turn about, about it turns; its motion conſtantly obedient to his order. The repeated ſhouts of applauſe that follow theſe ſpecimens of his art, are ſo many inſults upon us; we therefore privately ſlip out, and making the beſt of our way home, ſhut ourſelves up in our apartment, inſtead of going about, as we had projected, to tell every body of our ſucceſs.

"The next morning ſomebody knocks at the door; who ſhould this be but our friend the juggler? He enters, and modeſtly complains of our conduct; he cannot think what he has done to us, that we ſhould endeavour to diſcredit his tricks, and deprive him of his bread; or that there is any thing ſo very wonderful in the art of drawing about a duck of wax, that we ſhould be ambitious of that honour, at the expence of a poor man's ſubſiſtence. Faith, Gentlemen, continues he, if I could get a living by any other talent, I ſhould never be proud of this. You ſhould reflect, that a man who has ſpent great part of his life in the exerciſe of this pitiful induſtry, muſt of courſe know more of the matter than you, who only throw away a few minutes on it. If I did not exhibit the maſter-pieces of my dexterity at firſt, it was becauſe one ſhould not be in haſte to make an unneceſſary diſplay of one's knowledge. I have always taken care to preſerve my beſt tricks for particular occaſions; and have, beſides what you have ſeen, many others to check young and indiſcreet obſervers. I am come, nevertheleſs, Gentlemen, very readily to acquaint you of the ſecret that ſo much embarraſſed you; at the ſame time hoping you will make no uſe of it to my prejudice; and that you will another time be more reſerved.

"He produces his machine; when, to our very great ſurpriſe, we ſee it conſiſts only of a powerful loadſtone, which a child, hid under the table for that purpoſe, moved about without being perceived. As he is putting his loadſtone up again, we thank him, and, excuſing ourſelves for what is paſſed, offer to make him a preſent, which he refuſes. No, Gentlemen, ſays he, you do not deſerve ſo well of me, that I ſhould accept your favours; you ſhall be obliged to me againſt your will; this is all the revenge I ſhall take. You may hence learn that there are men of ſpirit in all conditions of life. I am paid for the exerciſe of my hands, and not of my tongue. In going out he addreſſes to me, particularly, the following reprimand: I can eaſily excuſe the child, ſays he aloud, as he offended only through ignorance. But you, Sir, who ought to have known his error, why did you permit him? As you both live together, you, as the elder, owe him your advice and direction. Your experience ſhould be the authority for his conduct. In reproaching himſelf, as he grows up, for the faults of his youth, he will doubtleſs reproach you for thoſe of which you did not adviſe him. Having ſaid this, he departs, leaving us both in a good deal of confuſion."

The circumſtantial account of this example is of more conſequence than it may at firſt appear. How many leſſons are contained in this one! How many mortifying conſequences are ſure to follow the firſt emotion of vanity! Watch with care, young preceptor, this firſt emotion in your pupil; and be aſſured, that, if you can thus make it productive of humiliation and diſgrace, you will be long before you ſee any appearance of a ſecond.

Sect. XXXII. *Of the Means of acquiring Philoſophical Knowledge.*

Having learned that a loadſtone acts through the ſubſtance of other bodies, we have nothing to do but to conſtruct a machine like that we have ſeen. To this end, we procure a large flat baſon; placing it on a table, and filling it with water: we make our duck alſo a little neater than the former; and thus our apparatus is ready. From our conſtant attention to what paſſes in the baſon, we at length remark that the body of the duck, when at reſt, preſerves always nearly the ſame direction. We repeat the experiment, and, on examination, find this direction to be from ſouth to north. This is ſufficient; we have aſcertained the operations of magnetiſm, and our compaſs is now as good as made.

The earth has various climates, and thoſe climates different temperatures; the ſeaſons varying more conſiderably in proportion as we approach either pole. All bodies contract with cold, and dilate with heat; this effect is ſtill more conſpicuous in fluids than ſolids, and is commenſurable by ſpirituous liquors; by means of which the thermometer was originally conſtructed. The wind blows againſt our faces; hence we find air is a body, a palpable fluid, although we cannot by any means ſee it. Preſs a drinking-glaſs turned upſide down, into water, the fluid will not occupy the whole ſpace within it, unleſs by leaning it ſide-ways you let the air eſcape: hence we find air is capable of reſiſtance. Preſs the glaſs with a ſtill greater force downwards, and the water will gain upon the air, yet without being able entirely to fill the glaſs: hence we find air is capable of a certain degree of compreſſion. A ball filled with compreſſed air will rebound better than another filled with any other ſubſtance. Air then is an elaſtic body. Lying down at one's full length in a bathing tub, if we endeavour to raiſe our arms in an horizontal poſition out of the water, we ſhall find them loaded with a prodigious weight: air, therefore, is evidently heavy, and may be weighed againſt other fluids; hence the contrivance of the barometer, the ſyphon, the wind-gun, and the air-pump. All the laws of ſtatics and hydroſtatics diſcover themſelves by experiments equally obvious and familiar. Let him not, therefore, enter the cabinet of an experimental philoſopher to learn any of theſe. The apparatus and pomp of machinery are diſguſting; their ſcientific air is deſtructive to ſcience itſelf; thoſe

various engines either frightening a child, or taking up that attention to their figure, which he ought to beftow on their effects. All our machines fhould be of our own conftruction; neither fhould we begin to conftruct the inftrument before we have made the experiment; but, after having made this imperfectly, and as it were by chance, we fhould by degrees invent the inftrument to confirm it. We had rather our machines fhould be lefs accurate and complete, and that we fhould have more juft ideas of what they ought to be, and of their operations. For our firft leffon in ftatics, inftead of providing a balance and fcales, lay a ftick acrofs the back of a chair, and meafure the length of both ends, when it hangs in equilibrio. Next hang different weights on each; placing them nearer or farther off the point of fufpenfion, as occafion requires. By thefe means we find that the equilibrium depends on a reciprocal proportion between the weights and the length of the levers; and thus we inftruct our young mechanic to rectify a balance before he has ever feen one.

We acquire, without doubt, notions more clear and certain of things we thus *learn of ourfelves*, than of thofe we are *taught* by others. Another advantage alfo refulting from this method is, that we do not accuftom ourfelves to a fervile fubmiffion to the authority of others; but, by exercifing our reafon, grow every day more ingenious in the difcovery of the relations of things, in connecting our ideas, and in the contrivance of machines; whereas, by adopting thofe which are put into our hands, our invention grows dull and indifferent, as the man who never dreffes himfelf, but is ferved in every thing by his fervants, and drawn about every where by his horfes, lofes by degrees the activity and ufe of his limbs. Among the many admirable methods taken to abridge the ftudy of the fciences, we are in great want of one to make us learn them without difficulty.

The moft obvious advantage of thefe flow and laborious refearches, is to preferve, in the cultivation of fpeculative ftudies, the activity of the body; to preferve the fupplenefs of the limbs, and to be always bufied in fome manual operation, or employment, of ufe to mankind. The diverfity of inftruments, invented to direct us in our experiments, and make up for the deficiency of our organs of fenfe, makes us neglect the exercife of the latter. A theodolite difpenfes with our eftimating the extent of angles; the eye, which is capable of meafuring diftances with great exactnefs, gives up the tafk to the chain; the fteel-yard excufes us from judging of the weight of any thing by poifing it in the hand. Thus the more ingenious and accurate our inftruments, the more unfufceptible and inexpert become our organs: by affembling a heap of machinery about us, we find afterwards none in ourfelves.

But when we fet about the conftruction of thefe machines ourfelves, and employ therein that fagacity and addrefs which are required to do without them, we lofe nothing. On the contrary, we gain every thing; and, by adding the knowledge of art to nature, become more ingenious without being lefs dextrous. If, inftead of keeping a boy poring over books, we employ him in a work-fhop, his hands will be bufied to the improvement of his underftanding; he will become a philofopher while he thinks himfelf only an artifan.

It has already been obferved, that the mere fpeculative part of fcience is by no means adapted to children, even when they approach adolefcency; it is proper, neverthelefs, though you do not enter with them too profoundly into the depth of phyfical theory, to connect their experiments by fome chain of education, that they may arrange them in fome order in their minds, for the fake of remembering them: for it is very difficult to retain feparate and independent facts and conclufions long in the memory, without fome leading clue for occafional recollection.

In your refearches into the laws of nature, begin always with the moft common and obvious phænomena; accuftoming your pupil to look upon them always as mere facts. Take up, for inftance, a ftone; and, pretending to place it in the air, open your hand, and it immediately falls to the ground. Look upon your pupil, who ftands all the while attentive to what you are doing, and afk him, why the ftone falls? Where is there a child who would not have an anfwer ready to that queftion? Every one will fay the ftone falls becaufe it is *heavy*. And what is heavy? The thing that falls. So the ftone falls becaufe it falls. Here our little philofopher is ftopped in good earneft; and thus ends our firft lecture of phyfical theory; whether he profits by it alfo, in this fcience or not, it is a general leffon of good fenfe.

Sect. XXXIII. *Of Purfuits of Utility.*

As a child advances in underftanding, other important confiderations oblige us to be more nice in the objects of his employment. As foon as he acquires fo much knowledge of himfelf, as to conceive in what his happinefs confifts; or becomes fenfible of fuch extenfive relations, as to be able to judge *what is fitting or unfitting to his ftate and condition;* he is then in a fituation to perceive the difference between labour and amufement, and to regard the latter only as a relaxation from the former. Objects of *real utility* may then make part of his ftudy, and engage him to give a more conftant application to it than it might do to mere amufements. The law of neceffity, ever recurring to the mind, teaches us betimes to do that which is difagreeable, in order to prevent confequences ftill more difpleafing. Such is the ufe of *forecaft;* in the regulation of which confifts all the wifdom, and depends all the mifery of mankind.

Every individual would be happy. But, in order to arrive at happinefs, it is firft neceffary to know what it is. The happinefs of man, in a ftate of nature, is as fimple as his manner of living. It confifts in his being free from pain; and is conftituted by health, liberty, and the neceffaries of life. The happinefs of man, in a ftate of fociety, is another thing; but this is at prefent out of the queftion. We cannot too often obferve that objects *purely phyfical* are thofe only which can intereft children, particularly thofe whofe vanity is not yet excited, and who are not already vitiated by the prejudices of opinion.

When they come to forefee their wants, their underftanding is confiderably advanced, and they begin to be fenfible of the value of time. It is of confequence now, to ufe them to employ themfelves on *fubjects of utility*; this utility, however, fhould be applicable to their age, and adapted to their knowledge. Every thing that depends on moral inftitutions and the practice of fociety, fhould not be fo early prefented to their view; becaufe they are not in a capacity to underftand it. It is a folly to require them to apply themfelves to things, merely becaufe they are told in general terms, that fuch things are good for them, while they are ignorant in what that good confifts; we may in vain affure them they will find their intereft therein as they grow up; while they are uninterefted by their prefent ufe, they are incapable of comprehending the future.

Let a child do nothing merely becaufe he is bid; nothing is *good* for him which he cannot *perceive to be fo*. In hurrying him on before his knowledge, you think yourfelves making ufe of forecaft, and you only betray the want of it. In providing him with many implements he may never ufe, you deprive him of the moft univerfal and ufeful of all others, that of *good fenfe*. You ufe him to permit himfelf to be always conducted, and to be only a machine in the hands of others. In requiring him to be docile and tractable when he is little, you prepare him to be a credulous dupe when he is grown up. You are for ever telling him, "All I defire of you, child, is for your own advantage,

"though you are as yet incapable of knowing it to be so. "What is it to me whether you do what I require or not? It "is for your own good only you should do it." With such fine speeches as these, intended to make him wise, you only pave the way for the success of those who may hereafter entrap him by some snare, or make him adopt their own folly.

It is requisite men should be acquainted with many things, of which children cannot in the least comprehend the utility: but is it necessary or even possible, that a child should learn every thing it is requisite a man should know? Endeavour to teach a child *every thing that is useful to him at his age*; and you will find him full employment. Why will you insist on his application to the studies proper for an age to which he may never arrive, in prejudice of those which are proper for him at present? But you will ask, perhaps, whether he will have time to learn what he ought to know, when it is required of him to make use of his knowledge? This no one can tell; but it is impossible to learn it sooner; for our real and only true instructors are *experience* and *sentiment*. Never can man be made truly sensible of what is useful to him but from the circumstances in which he is situated. A child knows he is designed to grow up to manhood; all the ideas he can form of that state will be to him so many opportunities of instruction: but, as for those which are above his capacity to comprehend, it is better he should remain in absolute ignorance of them. This whole treatise is calculated to illustrate this principle of education.

As soon as we are so far advanced as to give our pupil an idea of the word *useful*, we have attained a considerable influence over his future conduct; this term being very striking, provided the sense annexed to it be adapted to his years, and he see clearly its relation to his present welfare. Ordinary children are not affected by this term, because no care has been taken to affix to it an idea conformable to their understandings, and because others taking upon them to provide for them what is useful, they have no need to think of it themselves, and therefore remain ignorant of the meaning of utility.

What is *the use* of that? this should, from this time, be the determinate question between your pupil and you, on all occasions. On your part, you will infallibly make use of it in answer to all his interrogatories, which may serve as a check to that multiplicity of silly, troublesome questions, with which children are incessantly teasing those about them, more for the sake of indulging themselves in a kind of imperiousness, than out of a desire of information. The child who is taught, as the most important lesson, to know nothing but *what is useful to him*, will interrogate with the views of a Socrates: he will not put a question, without having an answer ready to that which he knows will be put to him before his own is resolved.

What a powerful instrument is here put into your hands, for the conduct of your pupil! Knowing a reason for nothing, he is reduced to silence whenever you please; while, on the other hand, you can make use of every advantage your knowledge and experience give you, to demonstrate the utility of what you propose. For you must not mistake the end of this question; it is only to instruct him to *question you* in his turn; and you must expect, in whatever you propose to him afterwards, to have him reply by asking you, of what use is this or that, in the terms of your proposal?

This will lay a snare, perhaps, which a governor will not easily avoid falling into. If on a child's asking this question, you only endeavour to divert this affair, by giving him an answer he cannot well comprehend, he will think that you reason on your own ideas and not on his, and will believe what you call useful to be so to yourself only, and not to him: he will no longer place any confidence in you, and then all is over. But where is the preceptor who will stop short, and own his want of knowledge or mistakes to his pupil? It is the general way with tutors not to confess their real ignorance, whereas they should affect to be more ignorant than they are, when they cannot adapt the required information to his understanding. Hence, always apparently candid in our behaviour, he does not suspect our motives, and we gain more credit with him by affecting ignorance, than other preceptors would by a different conduct.

In the first place, you are to consider how seldom it is proper for you to propose what he is to learn; it is his place to *desire to know*, to seek for, to discover it: it is yours artfully *to excite this desire*, to place the object within his reach, and to furnish him with the *means of attaining it*. It follows hence, that your interrogations should be few, but select; and that, as he will have much more to do with you, than you with him, you will be less exposed than he, and more often in the circumstances of saying to him, *of what use* is it to you to know what you ask? Add to this, that, as it is of little consequence whether he learns many things, or not, provided he has not a clear conception of what he does learn, and its use; whenever you have not a proper explanation of the thing required at hand, you may safely forbear to give him any at all. You may say to him without scruple, "I have no good reason to give you; I am somehow mistaken;" and leave it there. If your instruction was really improper, it is not amiss to give it up entirely; and, if not so, you will soon find occasion to make him sensible of its utility.

Explanatory discourses are by no means adviseable: young people give little attention to them, and never retain them in memory. The *things themselves* are the best explanations. It can never enough be repeated, that *we make words of too much consequence*; with our prating modes of education, we make nothing but praters.

"Let us suppose," says M. Rousseau, "that, while I am studying with my pupil the course of the sun, and the method of its returning to the east, he should stop me short, by asking me to what purpose is all this? What a florid discourse might I not make him, in answer to such a question? What a number of fine things might I not take occasion to expatiate on, by the way, particularly if there were any witnesses to our conversation? I might talk to him of the utility of travelling, the advantages of commerce, the produce peculiar to every climate; of the manners of different nations, of the use of the calendar, of the computations of the returning seasons for agriculture, of the art of navigation, and the manner of conducting a ship at sea. Politics, natural history, astronomy, and even morality itself, with the laws of nations, might all be introduced in the course of my harangue; with a view to give my pupil great ideas of the sciences, and to excite in him a desire to study them. When I had done, however, I should only have been exposing my own pedantry, without my pupil's having comprehended one single thing I had been talking about. He would have still a great mind to ask me, as before, to what end the sun returned to the east, but that he would be fearful of offending. He would therefore find his account in pretending to understand what he was thus compelled to hear. This is the practice carried on in polite education. Our Emilius, however, brought up in greater rusticity, and so difficult of comprehension, will listen to nothing of all this. At the very first word he might not understand, he would turn away and play about the room, leaving me to finish my oration by myself. We must seek, therefore, some more obvious solution: this scientific method of explication being useless to him.

"We were observing the position of the forest to the north of Montmorenci, when he interrupted me with this impertinent question, of 'To what end is all this?' On which, I answer, 'You are in the right; we must think of this matter at

leiſure; and if we find this inquiry is uſeleſs, we will drop it, for we have no need of uſeleſs amuſements.' We then betake ourſelves to ſome other employment, and talk no more of geography during the reſt of the day.

"I propoſe to him next morning a walk before breakfaſt: he likes nothing better; children in general are very ready for running about, and mine is fit for exerciſe. We enter the foreſt, traverſe the country, and rambling about till we are almoſt tired, we loſe ourſelves, and know not which way to return home. Our time is ſpent; the heat of the day increaſes; we begin to grow hungry, and wander about from one place to another, among copſes, woods, and quarries, without meeting with any object we are acquainted with. At length, overheated, famiſhed, fatigued, we find ourſelves only more and more bewildered. We ſit down, therefore, to reſt ourſelves and deliberate on what is to be done. Suppoſing my pupil to have been educated like another child, he does not deliberate about the matter, but ſits down and begins to cry; ignorant that we are juſt by the gate of Montmorenci, which is concealed from us only by the trees of a narrow coppice: theſe trees, however, appear an impenetrable foreſt to him; ſuch a little gentleman as he, loſt in the buſhes. After ſome few minutes paſſed in ſilence, I ſay to him, with an air of diſquietude, What ſhall we do, my dear Emilius, to get out of this foreſt?

Emilius [*all in a ſweat, with the tears running down his cheeks*]. I know not: I am ſo weary, ſo hungry, ſo dry, I know not what to do.

Rouſſeau. Do you think I am in a better ſituation than you; or that I ſhould not cry too if I could breakfaſt upon tears? Our buſineſs is not to weep, but, to look about us. Look at your watch; what is it o'clock?

Emil. It is noon, and I have not yet breakfaſted.

Rouſſ. It is very true; it is noon, and I am faſting too.

Emil. You muſt then, ſurely, be very hungry.

Rouſſ. Yes; but the worſt on it is, my dinner will not come here to find me. Let me ſee—it is noon; that is preciſely the time at which we obſerved yeſterday the ſituation of this foreſt from Montmorenci: if we could but obſerve in like manner the poſition of Montmorenci from this foreſt——

Emil. True, but yeſterday we ſaw the foreſt, and we cannot from hence ſee the town.

Rouſſ. That is our very misfortune.—If we could, by any means, but find its ſituation out without ſeeing it——

Emil. O, my good friend! but how?

Rouſſ. Did not we obſerve that the foreſt lay——

Emil. To the north of Montmorenci.

Rouſſ. Montmorenci therefore ſhould be——

Emil. To the ſouth of the foreſt.

Rouſſ. We have a method to find out the north at noon.

Emil. We have ſo, by the direction of our ſhadow.

Rouſſ. But as for the ſouth.

Emil. How ſhall we find that?

Rouſſ. The ſouth is always oppoſite to the north.

Emil. That is true; we have only to take the direction contrary to our ſhadows: here, this muſt be to the ſouth. Montmorenci muſt lie on this ſide: let us go this way.

Rouſſ. You may poſſibly be in the right; here, let us take this path through the wood.

Emilius [*clapping his hands, and ſhouting for joy*]. Ah! I ſee Montmorenci directly before us. Come along, let us go to breakfaſt, to dinner, let us make haſte: aſtronomy, I ſee is good for ſomething.

"Obſerve that if he does not actually make uſe of this latter expreſſion, he will think ſo; it does not ſignify which, provided I do not teach it him. You may be aſſured, alſo, he never will forget this day's leſſon as long as he lives; whereas, had I only ſuppoſed this adventure in my chamber, all that I could have ſaid on it would have been forgotten the next day. For this reaſon we ought to inculcate all we poſſibly can *by actions*, and to *ſay* only what we *cannot do*."

The reader will not expect we can have ſo indifferent an opinion of his ſagacity, as to give him an example in every kind of ſtudy; but which ſoever may occaſionally relate to the point in queſtion, we cannot too much exhort the preceptor to *adapt* his explication to *the capacity* of his pupil; for certainly the evil lies not in what he is *ignorant* of, but in what he *imagines he underſtands*.

Thoſe relations between cauſe and effect, of which we cannot perceive the connection, that good and evil, of which we have no idea, and the neceſſities we have never felt, have no influence on our underſtandings. We have as vague notions, at fifteen years of age, of the happineſs attendant on wiſdom, as, at thirty, of the celeſtial glories of the New Jeruſalem. If we have no clear conceptions of the one or the other, we ſhall take but little trouble to obtain them; and, though our ideas were ever ſo preciſe on theſe ſubjects, we ſhould take juſt as little, unleſs we felt ſome *attachment to*, or *deſire after* them. It is eaſy to convince a child of the utility of whatever we have a mind to teach him; but it ſignifies little to convince him of this, unleſs you can perſuade him alſo to purſue it. Reaſon in vain may induce us coldly to approve or blame; the paſſions only are the ſprings of action; and how can our paſſions be excited by objects or circumſtances in which we do not perceive ourſelves at all intereſted?

Never point out any thing to a child which is *beyond his views*. While he is a ſtranger to the relations and duties of humanity, as you cannot raiſe his comprehenſion to the ſtate of manhood, you ſhould *bring down the ſtate of manhood to a level with his capacity*. In projecting what may be uſeful to him hereafter, ſpeak to him directly only of what is apparently uſeful to him *at preſent*. Beware alſo, in general, of making compariſons between your pupil and other children; let him have no rival, no competitor, not even in his corporeal exerciſes, as ſoon as he begins to reaſon. It is much better he ſhould not learn at all that which muſt be taught him *by means of vanity*, or *jealouſy*. Content yourſelf, in this reſpect, with remarking his annual progreſs, and comparing his ſituation and exploits in the preſent year with thoſe of the paſt. Say to him, You are grown ſo much ſince ſuch a time; here is the ditch you leaped, the weight you lifted, the diſtance you threw a ſtone, ſo far you ran without fetching breath; let us ſee what you can do more at preſent. Thus you would excite him to emulation, without making him jealous or envious of a rival; he would be deſirous indeed to excel himſelf, and ſo he ought to be; there is no inconvenience in this kind of emulation.

Sect. XXXIV. *Of the Uſe of Books.*

Books are in very general uſe with thoſe who undertake the taſk of educating children. But they are of leſs uſe even to grown perſons than is commonly imagined; for, they only teach people to talk about what they do not underſtand. It is ſaid that Hermes engraved the elements of the ſciences on columns, to ſecure his diſcoveries from being loſt in the time of a general deluge. Had he imprinted them on the minds of men, they had been better preſerved by tradition. The organs of the memory, duly prepared, are the monuments on which human ſcience would be moſt indelibly engraven.

Is there no expedient to be thought of, to collect the various inſtructions, ſcattered up and down in ſo many voluminous tomes? to unite them under one general head, which may be eaſy to comprehend, intereſting to purſue, and which may ſerve as a *ſtimulus*, even to children of this age? If one

could but conceive a ſituation, in which all the natural wants of man would be diſplayed, in a manner *adapted to the underſtanding of a child*, and wherein the means of ſatisfying thoſe wants are gradually diſcovered with the ſame eaſe and ſimplicity, it would be in a juſt and lively deſcription of ſuch a ſtate, that we ſhould firſt exerciſe his imagination.

Happily ſuch a ſituation is already diſcovered; it is already deſcribed, and with great exactneſs and ſimplicity. Since we muſt have books, there is one already, which affords a complete treatiſe on natural education. This book ſhall be the firſt that our pupil ſhall read: in this, indeed, will, for a long time, conſiſt his whole library, and it will always hold a diſtinguiſhed place among others. It will afford us the text, to which all our converſations on the objects of natural ſcience, will ſerve only as a comment. It will ſerve as our guide during our progreſs to a ſtate of reaſon; and will even afterwards give us conſtant pleaſure, unleſs our taſte be totally vitiated. You aſk impatiently, what is the title of this wonderful book? Is it Ariſtotle, Pliny, or Buffon? No. It is Robinſon Cruſoe.

Robinſon Cruſoe, caſt aſhore on a deſolate iſland, deſtitute of human aſſiſtance, and of mechanical implements, providing, nevertheleſs, for his ſubſiſtence, for ſelf-preſervation, and even procuring for himſelf a kind of competency. In theſe circumſtances, there cannot be an object more intereſting to perſons of every age; and there are a thouſand ways to render it agreeable to children. Thus have we realized that deſert iſland, which was at firſt made uſe of only by way of compariſon. Such a ſituation, no doubt, is very different from that of man in a ſtate of ſociety. Very probably this will never be that of our pupil; but it is from ſuch a ſtate he ought to learn to eſtimate others. The moſt certain method for him to raiſe himſelf above vulgar prejudices, and to form his judgement on the actual relations of things, is to take on himſelf the character of ſuch a ſolitary adventurer, and to judge of every thing about him, as a man in ſuch circumſtances would, by its real utility. This romance, beginning with his ſhipwreck on the iſland, and ending with the arrival of the veſſel that brought him away, would, if cleared of its rubbiſh, afford our pupil, during the period we are now treating of, at once both inſtruction and amuſement. He ſhould indeed perſonate the hero of the tale, and be entirely taken up with his caſtle, his goats, and his plantations; he ſhould make himſelf minutely acquainted, not from books, but circumſtances, with every thing requiſite for a man in ſuch a ſituation.

What opportunities of inſtruction would ſuch an amuſement afford an able preceptor, who ſhould project it only with a view to that end? The pupil, eager to furniſh a magazine for his iſland, would be more ready to learn than his tutor to teach him. He would be ſolicitous to know every thing that is uſeful, and nothing elſe: you would in ſuch a caſe have no more occaſion to direct, but only to reſtrain him. Let us haſten, therefore, to eſtabliſh him, in this imaginary iſle, ſince to this he confines his preſent happineſs; for the time will now ſoon come, in which, if he is deſirous of life, it is not to live alone, and in which even a man *Friday*, the want of whom does not now affect him, would not be long ſatisfactory.

The practice of ſimple manual arts, to the exerciſe of which the abilities of the individual are equal, leads to the invention of the arts of induſtry, the exerciſe of which requires the concurrence of many. The former may be practiſed by hermits and ſavages, but the latter can be exerciſed only in a ſtate of ſociety, and render that ſtate neceſſary. While man is ſubject only to the calls of phyſical neceſſity, he is capable of ſatisfying them himſelf; but, by the introduction of ſuperfluous wants, the joint concern and diſtribution of labour become indiſpenſable: for though a man by his own labour, when alone, procures only ſubſiſtence for an individual, yet an hundred men working in concert, will eaſily procure, in the ſame time, ſubſiſtence for double the number. As ſoon, therefore, as one part of mankind take upon themſelves to live idle, it becomes neceſſary that the concurrent labour of numbers ſhould ſupply the place of thoſe who live without work.

Your greateſt care ſhould be to keep from your pupil the notions of thoſe ſocial relations, which he is not in a capacity to comprehend; but when the connection of his ideas obliges you to ſpeak of the mutual dependence of mankind, inſtead of preſenting him at firſt the moral ſide of the queſtion, divert his attention as much as poſſible to induſtry and the mechanic arts, which render men uſeful to one another. In going about with him to the workſhops of various artiſans, never let him ſee any thing performed without lending a hand to the work, nor come out of the ſhop without perfectly underſtanding the reaſon of what he obſerves there. To this end you ſhould work yourſelf, and in every thing ſet him an example. To make him a maſter, be you in every thing the apprentice; and reflect that he will learn more by one hour of manual labour, than he will retain from a whole day's verbal inſtructions.

The different arts are entitled to various proportions of public eſteem, and that in an inverſe ratio to their real uſe. This eſteem is directly as their inutility, and ſo it politically ought to be. The moſt uſeful arts are thoſe which are the worſt paid for, or leaſt rewarded; becauſe the number of workmen is proportioned to the wants of the whole ſociety, and the labour the poor muſt purchaſe muſt neceſſarily be at a low price. On the contrary, thoſe important artiſans, who, by way of diſtinction, are termed artiſts, and are employed only in the ſervice of the rich and idle, ſet an arbitrary price on their workmanſhip; and as the excellence of their baubles is mere matter of opinion, their high price conſtitutes great part of their merit, and they are eſteemed in proportion to what they coſt. The value thus ſet upon them is not on account of any uſe they are of to the rich, but becauſe they are too coſtly to be purchaſed by the poor. *Nolo habere bono niſi quibus populus inviderit.*

What will become of your pupils, if you permit them to adopt this ridiculous prejudice, if you encourage it yourſelf, or ſee them, for example, enter with more reſpect the ſhop of a jeweller than that of a lockſmith? What a judgement will they form of the real merit of the arts, and the intrinſic value of things, when they ſee whim and caprice univerſally oppoſed to real utility, and find the more a thing coſts, the leſs it is worth? If ever ſuch ideas as theſe take root in their minds, you may as well give up at once the remaining part of their education; they will, in ſpite of all you can do, be educated like the reſt of the world, and you will have taken, for fourteen years paſt, all your trouble for nothing.

Your pupil will ſee things in a very different light, while he is employed in furniſhing his iſland. Robinſon Cruſoe would have ſet a greater value on the ſtock in trade of a petty ironmonger, than on that of the moſt magnificent and beſt furniſhed toyſhop in Europe. The firſt had appeared to him a reſpectable perſonage, while the owner of the latter had been deſpiſed as frivolous and contemptible.

It is probable, ſome ſagacious member of ſociety will make the following objection. "My ſon," he will ſay, "is formed to live in the world; not to reſide among a ſet of philoſophers, but to herd with fools: it is proper, therefore, he ſhould be acquainted with thoſe follies that influence their conduct. The knowledge of things, as they are, may be uſeful; but that of men and opinions is much more ſo; for, in ſociety, the knowledge of mankind is the beſt means to make the moſt of them, and he is the wiſeſt man who acquires the moſt, and

makes the beſt uſe of it. To what purpoſe, then, is it to give children the ideas of an imaginary order of things directly contrary to that which cuſtom has eſtabliſhed, and by which they muſt regulate their behaviour? Read them, firſt, lectures to make themſelves wiſe, and then you may take what method you will to inſtruct them in what reſpect others are fools."

Such are the ſpecious maxims, on which is founded the falſe prudence of parents, who endeavour to make their children ſlaves to thoſe prejudices in which they themſelves are educated. How many things are neceſſary to be known, previous to the ſtudy of mankind! This is the laſt and moſt arduous taſk of the philoſopher, and you would have it be the firſt of a child. Before you inſtruct him in the knowledge of your own ſentiments, you ſhould begin, by teaching him to form ſome eſtimate of their truth and propriety. Our opinions are imparted to children as reaſons; is this the way to teach them the folly of them? In order to attain wiſdom, it is neceſſary to be able to diſcern what is not ſo. How ſhall your child know how to ſtudy mankind, if he is incapable to judge of their ſentiments, or to detect their errors? It is a misfortune for him to know their opinions, while he is ignorant whether they be true or falſe. Teach him firſt, therefore, what things are in themſelves; and you may afterwards inſtruct him at leiſure, what are the general ſentiments of mankind. Thus will he be enabled to judge of our opinions by the criterion of truth, and ſoar above the miſtaken notions of the vulgar. To adopt prejudices is not to know them as ſuch, nor are the multitude governed by thoſe who are like themſelves. If you begin by making your pupil acquainted with the opinions of the world, before you have taught him how to judge of them, you may aſſure yourſelf, ſay what you will, they will become his, and you will never after be able to eradicate them. We conclude this ſubject, therefore, by laying down as a maxim, that to render a youth ſenſible and judicious, we ought to form his opinion of things, and not to dictate ours.

Sect. XXXV. *Of Commerce and the Arts.*

Nothing has hitherto been ſaid to our pupil about mankind: his connections with, and relations to, his fellow-creatures are not as yet ſtriking and conſpicuous enough to enable him to judge of others by himſelf. He has no ideas of human nature but what centre in his own perſon, and even his ſelf-knowledge is but very confined. If his ideas, however, are contracted, at leaſt they are juſt. He knows not the relative ſituation of others, but he is ſenſible of his own, and keeps his place. Inſtead of reſtraining him by *ſocial ties*, the force of which he could not comprehend, we have bound him by the obvious chain of *neceſſity*. He is as yet little better than a mere phyſical being; let us continue to treat him as ſuch.

He forms his judgement, and eſtimates the value of the works both of nature and art, by their relation to his own convenience, ſecurity, and preſervation. Hence, he looks upon iron as a more precious metal than gold, and glaſs to be more valuable than diamonds. For the ſame reaſon he hath more reſpect for a ſhoemaker, or a maſon, than for all the celebrated jewellers in Europe. A paſtry-cook is, in *his* opinion, a perſon of ſingular importance, and the whole academy of ſciences of leſs conſequence than the reſpectable perſonage of the meaneſt confectioner. Goldſmiths, engravers, and gilders, are, with him, idle inſignificant people, who amuſe themſelves in employments frivolous and uſeleſs; nay, he does not hold even a watchmaker in very high eſtimation. Happy in the enjoyment of his native liberty, he profits by time without knowing its value. That tranquillity, which, undiſturbed by the violence of paſſion, makes its ſucceſſion equal, ſerves him inſtead of a machine to meaſure the quantity elapſed. In ſuppoſing his pocket to be furniſhed with a watch, as in ſuppoſing him to cry, M. Rouſſeau only made uſe on that occaſion of an Emilius *vulgarly educated*, for the ſake of illuſtration.

There is another order of diſtinction, not leſs natural, and ſtill more judicious, according to which the arts may be ranked agreeable to their order in that neceſſary chain which connects them together; placing the moſt independent in the firſt claſs, and thoſe which depend on the greateſt number of others, in the laſt. This method of arrangement, which may furniſh important conſiderations in the order of ſociety in general, is ſimilar to the former, in that it is equally ſubject to be perverted by the prepoſſeſſions and caprices of mankind. Hence it is, that all manufactured ſubſtances are firſt laboriouſly operated on by workmen below conſideration, and almoſt without pay; that the more hands they paſs through, the more expenſive becomes the labour, and the more creditable the profeſſion of each ſucceſſive artiſan. We ſhall not here enquire whether it be true, that induſtry is more exerted in the elegant arts, than in thoſe which give the firſt form to the maſſive ſubſtance, and fit it for common uſes: but in all caſes, thoſe arts which are the moſt general and indiſpenſable, are inconteſtably thoſe which deſerve to be held in the greateſt eſteem; and ſuch as require the leaſt aſſiſtance from others, deſerve ſtill leſs to be degraded loweſt of all, when they are at the ſame time the moſt free and independent. Theſe rules form the true criterion whereby to judge of the merit, and eſtimate the value, of arts and induſtry. All other are arbitrary and capricious. The firſt and moſt reſpectable of all arts and profeſſions is that of agriculture: next to the huſbandman ranks the ſmith; to the ſmith ſucceeds the carpenter, and ſo on. A child, who ſhould not have acquired a misjudging partiality from *vulgar prejudices*, would rank them preciſely in the ſame order. How many important reflections on this ſubject may not our pupil deduce from Robinſon Cruſoe! What will he think in ſeeing the arts carried to perfection, by being divided and ſubdivided into ſuch a number of branches, and by the invention of ſuch an infinite variety of implements to work with? Will he not call their ingenuity ridiculous, and think they are afraid their arms and fingers are not fit for uſe, that they have contrived ſo many expedients to work without them? To exerciſe one trade, they muſt be furniſhed with tools by a thouſand others. The artiſans of a whole town muſt be employed to ſet any one of them to work: for our parts, we make uſe of tools that we carry about us.

Confine not your obſervation here, reader, to the corporeal exerciſe and manual dexterity of our pupil; but conſider the proper methods we take to gratify his childiſh curioſity; remark the effects of his good ſenſe, his genius for invention, his foreſight, and other intellectual abilities. In whatever he ſees, or is employed in, he wants to know *the reaſon* of every thing: tracing back one inſtrument from another, till he arrive at the firſt and moſt ſimple. He takes nothing upon ſuppoſition or on truſt; but refuſes even to learn any thing that requires a previous knowledge of which he is not poſſeſſed. If he ſees, for inſtance, a file, or a ſpring, he immediately recurs to the method of working up the materials from the ore. If he ſees the ſides of a cheſt fitted together, he muſt know the methods of felling the timber and ſawing it into planks. If he be himſelf at work, he never fails to reflect on every new tool he makes uſe of, and to conſider how he might have conſtructed ſuch an implement, or have made ſhift without it.

There is an error, however, difficult to avoid, in employing your pupil in theſe mechanical operations; and that is, you will always ſuppoſe him to have a taſte for thoſe you are fond of yourſelf: but you muſt beware, that while you are ſeeking

your own amuſement, you do not fatigue and diſguſt your pupil, who perhaps will not let you perceive it. Your little artiſan ſhould find in himſelf every thing needful to direct him in thoſe deſigns. You ſhould obſerve him, and watch his motions continually, without his knowing it; you ſhould anticipate his thoughts, and prevent thoſe which are improper; in ſhort, you ſhould keep him ſo employed, that he ſhould not only be ſenſible of the uſe of his own talents, but that he ſhould take delight in his employment, from a like ſenſe of its utility.

The intercourſe of the arts conſiſts in the reciprocal exchange of induſtry, that of commerce in the exchange of commodities, and that of money in the exchange of bills and caſh: all theſe are intimately connected with each other, and we have already acquired ideas of the principles on which they are founded, from our diſpute with Robert the gardener. At preſent we have nothing more to do than to generalize thoſe ideas, and to extend them to a variety of examples, in order to give our pupil a juſt notion of the nature of commercial connections; which may be exemplified by the natural hiſtory of the produce peculiar to different climates, by enumerating the arts and ſciences which relate to navigation, and repreſenting the various obſtacles that are ſurmounted in tranſporting commodities from one country to another. No ſociety can exiſt without making uſe of the expedients of exchange, nor can any exchange be carried on without ſome common ſtandard: this alſo muſt be formed on ſome principle of equality. Hence every ſociety has, for its firſt law, ſome conventional equality, both of perſons and of property.

The conventional equality between perſons, is very different from the natural, and therefore requires the protection of government and laws. The political knowledge of a child ſhould be very clear and confined: he ought to have no other idea of government in general than what relates to the notion concerning the right of property which he hath already imbibed. The conventional equality between articles of property gave riſe to the invention of money; which ſerves as the means of comparing the value of the different ſpecies of ſuch articles; and in this ſenſe money may be denominated the real bond of ſociety. Every thing, however, may be converted into money. Formerly cattle were made uſe of as ſuch; ſo at preſent, in ſome countries, are ſhells, teeth, &c. The money of Sparta was iron, and that of Sweden has been of leather, as ours is now of gold and ſilver.

Metals, as the moſt eaſily tranſported, are generally made choice of to form this mean term in our uſual courſe of exchange. To facilitate this end, by ſparing the trouble of recurring to weights or meaſures, they are converted into regular coin. For the ſtamp imprinted thereon is no more than an atteſtation, that the piece ſo marked is of ſuch a certain weight; the ſovereign only having a right to coin money, ſo long as he is poſſeſſed of a right to require his atteſtation to paſs unqueſtioned through a whole people, or ſo long as he reſerves to himſelf ſuch excluſive privilege.

The uſe of this invention, thus explained, will be readily perceived by a child of the dulleſt apprehenſion. It is, indeed, difficult to make a direct compariſon between commodities of different kinds; as for example, between cloth and grain: but when a ſtandard common to both, ſuch as *money*, is eſtabliſhed, it is eaſy for the manufacturer and huſbandman to apply the value of their reſpective articles thereto, and to judge what quantity of each is equivalent to the other. For if ſo many yards of broad cloth be worth a certain ſum of money, and ſo many buſhels of wheat be worth the like ſum, the draper, in taking the wheat for his cloth, makes a fair and equitable exchange. Thus it is, that, through the medium of money, the produce and manufactures of different kinds and countries may be eſtimated and compared with each other.

Go no farther than this, nor enter into any diſquiſition concerning the moral effects of this inſtitution. It is of conſequence, in every caſe, to bring your pupil acquainted with the nature and end of every cuſtom before you point out its abuſe. If you attempt to explain to children in what manner ſigns are ſubſtituted for things, that money hath been productive of the numerous chimeras of prejudice and caprice, and that countries abounding in ſilver and gold muſt be proportionably deſtitute of real wealth; in doing this, you abſurdly treat them, not only as if they were profeſſed philoſophers, but alſo as men of experience; and attempt to give them exceptions of what even few philoſophers have clearly underſtood.

To what a variety of intereſting ſubjects may we not, by theſe means, direct the curioſity of our pupil, without ever quitting thoſe real and ſenſible relations, which are contained within the ſphere of his knowledge, or *exciting in his mind one idea beyond the reach of his capacity!* A judicious preceptor will not dwell, with heavy prolixity, on frivolous ſubjects, but be conſtantly preparing his pupil for the knowledge of thoſe important relations, which will one day be neceſſary for him, in order to his forming a right judgement of the good or evil cuſtoms of ſociety. He will endeavour to adapt his converſation and amuſements to the turn of mind he has given him. A queſtion that would ſcarce excite the attention of another child, will perplex our pupil for ſix months together:

Rouſſeau illuſtrates this in the following happy manner. "I take an opportunity," ſays he, "to carry him to dinner at the houſe of ſome opulent family; where, when we arrive, we find great preparations making for an elegant entertainment, much company, a number of ſervants, a variety of diſhes, and a ſuperb ſide-board of plate. There is ſomething intoxicating, to thoſe who are unaccuſtomed to it, in this appearance of ſplendour and feſtivity. I foreſee the effect it will have on my pupil; and, therefore, in the midſt of the hurry and clamour that prevail round the table, I whiſper in his ear, and aſk him, how many hands he thinks were employed in furniſhing the entertainment before us? What a crowd of ideas will thoſe few words bring thronging into his mind! In an inſtant his delirium vaniſhes. He muſes, reflects, begins to calculate, and puzzles himſelf with thinking. While grave philoſophers, inſpired by the wine, or perhaps by the charms of the ladies, degrade themſelves by talking idly, and, in the gaiety of their hearts, behave like children, Emilius ſits philoſophiſing by himſelf at one corner of the table; he applies to me with an interrogation, which I refuſe to anſwer, deferring it to another opportunity. At this he grows uneaſy, he cannot eat a morſel, nor drink a drop more, but burns with impatience to get away from table, in order to converſe with me more freely. What an object this for his curioſity to work upon! What a text, pregnant with inſtruction! With a ſound judgement, unbiaſſed by prepoſſeſſion and untainted with prejudice, what ideas muſt he form of luxury, when he comes to find that all the countries in the world have been laid under contribution, that twenty millions of hands have been for a long time employed, that thouſands of men, perhaps, have loſt their lives, and all this to preſent him, in ſuch public pomp at noon, what he may privately diſburthen himſelf of before night.

"Be very attentive to thoſe concluſions which the heart of a child will deduce in ſecret from all his obſervations. If you have taken leſs pains with yours than have been preſcribed, he may be tempted, in ſuch a caſe as the above, to give his reflections quite a different turn, and look upon himſelf as a

perſon of very great importance in the world, in ſeeing ſo much pains taken to provide for his dinner. If you foreſee this ſentiment, you may eaſily prevent it, or at leaſt preſently efface the impreſſion it makes on him. Being as yet ignorant of the means of appropriating any thing to himſelf, except by actual poſſeſſion and enjoyment, he cannot judge of their convenience or inconvenience to him, but by the pleaſure they afford him. Now the ſimple compariſon, between ſuch a ſplendid and formal repaſt, and a plain and homely dinner provided by his own labour, and ſeaſoned by appetite, liberty, and eaſe, is ſufficient to make him ſenſible that all that magnificent appearance of feſtivity had been of no real uſe, and that, his hunger being as fully ſatisfied at the table of the peaſant as at that of a lord, he enjoys nothing at the one more than the other, which he can truly call his own.

"Let us imagine what a polite governor would ſay to a child on ſuch an occaſion. Recollect the circumſtances, he would ſay, of each repaſt, and determine within yourſelf which afforded you the greateſt pleaſure. At which have you demonſtrated the greateſt expreſſions of joy? At which have you ſhewn the keeneſt appetite, drunk the moſt cheerfully, and laughed the moſt heartily? Which laſted the longeſt without making you weary, or kept you longeſt from being again hungry? Yet, ſee the difference: this brown bread, which you reliſh ſo well, comes from the corn, ſown and reaped by the peaſant; this pure wine, ſo refreſhing and wholeſome, is produced from his own vine; his table-cloth is made of his own flax, ſpun in the winter by his wife and children: no other hands than thoſe of the family have been employed in providing for his table; the neareſt mill and the next market-town are to him the extremities of his univerſe. What then have you really enjoyed of all that profuſion, with which the moſt diſtant parts of the earth, and the complicated induſtry of man, ſo ſplendidly furniſh the table at which you lately dined? If that ſplendour did not add to the ſatisfaction of your repaſt, what did you gain by that ſuperfluity? What did you find there made for you? Had you even been the maſter of the houſe, might he add, the magnificence would be ſtill leſs, with any propriety, to be called yours: for your ſolicitude to diſplay to others the wealth and plenty you enjoyed, would abſolutely deprive you of ſuch enjoyment: you only would have all the trouble, and your gueſts the pleaſure.

"This diſcourſe may be very fine, but it would be of no uſe to our pupil; being above his comprehenſion, and, moreover, to dictate his reflections is not our cuſtom. Speak to him, therefore, in a more ſimple manner. Having made both the above experiments, ſay to him ſome fine morning, Where ſhall we dine to-day? round that mountain of plate which covered three-fourths of the table, and the deſſert of artificial flowers and looking-glaſs? among thoſe women with their great hoop-petticoats, who treated you like a puppet, and wanted to make you talk what you did not underſtand? or ſhall we rather go to the village two leagues off, where the good people received us ſo joyfully, and gave us ſuch excellent cream? Emilius will not heſitate a moment to determine; for he is neither given to babbling, nor puffed up by vanity; beſides this, he hates reſtraint, and has no reliſh for high-ſeaſoned ragouts; but he is always ready to run about the fields, and loves fine fruit, freſh vegetables, good cream, and good people. There is no doubt, but the reflection you want to inculcate, will ſuggeſt itſelf, during your excurſion, and that our pupil will obſerve, that the people who furniſh out ſuch grand entertainments throw away their labour, or that they are quite ignorant of our enjoyments."

The examples here introduced by way of illuſtration, though proper for one ſubject, may be improper for a thouſand others. If the reader enters into the ſpirit of them, however, he will ſee they may be varied as occaſion requires; their application depending on the genius and diſpoſition of the pupil; a knowledge of which is acquired by the opportunities given them to diſplay themſelves. It cannot be expected, that, in the ſpace of three or four years, we ſhould give a child, even of the moſt happy turn and diſpoſition, ſuch an idea of the arts and ſciences as is ſufficient to enable him to ſtudy them without farther aſſiſtance. In thus bringing him acquainted, however, with the various objects requiſite for him to know, we put him in a ſituation to diſplay his genius and taſte by degrees, to make the firſt advances to their proper objects, and to indicate the route which muſt be taken to ſecond the deſigns of nature.

Another advantage ariſing from our thus giving him a juſt, but limited, ſeries of ideas, is that of ſhewing him their proper relations and connection, of placing every thing in a due order in his eſtimation, and of preventing the riſe of thoſe prepoſſeſſions which moſt men entertain, in favour of the talents they cultivate, and to the prejudice of ſuch as they have neglected. He who perceives the order of the whole, ſees the due place of every part, and, though a man, who knows only a part, if intimately acquainted with it, may be ſtyled a man of knowledge, the other only is the man of judgement; and it is to be remembered that the great object in view, in our method of education, is judgement, and not ſcience. But however this be, our method is independent of the examples made uſe of to illuſtrate it. It is founded on *the progreſs of the human faculties at different periods*, and *on the choice of thoſe proper objects* on which ſuch faculties ſhould be employed. It will be very eaſy, perhaps, to find another method which will promiſe better: but, if it be leſs adapted to our ſpecies, age, and ſex, it will not, probably, be attended with the ſame ſucceſs.

Sect. XXXVI. *Of the ſocial Relations.*

In the commencement of this ſecond period of childhood, we took the advantage of our abilities exceeding our wants, to extend our views beyond our own perſons: we ſoared into the expanſe of the heavens, took meaſure of the earth, deduced the laws of nature; in a word, we have explored our whole iſland: let us now, therefore, return home to our immediate habitation; happy to find at our entrance, that no enemy hath taken poſſeſſion, or threatens to wreſt it from us by force!

What remains for us to do after obſerving every thing that ſurrounds us?—To make uſe of every thing we can appropriate, and to employ our curioſity to our advantage. Hitherto we have made a proviſion of tools and implements of every kind, without knowing to what uſes we ſhall have occaſion to put them. Perhaps, uſeleſs to ourſelves, they might yet be of ſervice to others; and perhaps we, in our turn, may have need of theirs. Hence we ſhould all find our account in making an exchange. In order to do this, however, it is neceſſary to learn our reciprocal wants; every one ſhould know what the other poſſeſſes that might be of uſe to himſelf, and what he might be willing to accept in return. Let us ſuppoſe, for inſtance, ten men, each of whom ſtands in need of ten different things. If they go about ſeparately to ſupply their wants, each muſt apply himſelf to ten different kinds of occupation; but, on account of their different turn and genius, ſome will ſucceed better at one occupation, and others at another: thus, though collectively they might ſucceed equally in all; yet, each attempting it ſeparately, they are every one but ill ſerved. Let us form a little ſociety, therefore, of theſe ten individuals, and let each apply himſelf ſolely to that kind of occupation at which he is moſt expert; by this expedient each will profit as much by the talents of the reſt as if he had poſſeſſed them all. By continued application, alſo, to one kind of employment, they would all acquire additional dexterity, and thus would

not only be completely provided for themſelves, but ſoon acquire a ſuperfluity for the uſe of others. This is the apparent principle on which are founded our various mechanical and other inſtitutions.

On this principle, a man who ſhould be deſirous to conſider himſelf as a ſolitary and independent being, could not fail of being miſerable. It would be even impoſſible for him to ſubſiſt; for, finding the earth already occupied and divided into *meum* and *tuum*, and having no implements or property, by what means would he provide himſelf with the neceſſaries of life? In departing ourſelves from a ſtate of nature, we oblige all our fellow-creatures to do the like; no one can remain therein, in ſpite of the reſt; and it would be to act moſt prepoſterouſly againſt nature to be obſtinately tenacious of a ſituation, in which it is impoſſible we ſhould exiſt: for the firſt law of nature is that of ſelf-preſervation. Thus may we form, by degrees, in the mind of a child, ideas of ſocial relations, even before he becomes an active member of ſociety. Our pupil ſees already, that, to acquire implements for his own uſe, he muſt poſſeſs ſome for the uſe of others, which he may exchange for thoſe he ſtands in need of. Thus we lead him eaſily to perceive the neceſſity of this commercial intercourſe, and prepare him, when occaſion offers, to turn it to his advantage.

Sir, I muſt live, was the ſaying of a wretched libeller to a miniſter of ſtate, who reproached him with the infamy of his profeſſion. *I cannot ſee the neceſſity of it*, replied the miniſter very coldly. This reply, excellent as it was from a ſecretary of ſtate, had been unjuſt and inhuman from any other perſon. Every man muſt live. This argument, which every one thinks more or leſs cogent, in proportion to his humanity, appears to be unanſwerable, with reſpect to the perſon who urges it. Of all natural antipathies, our averſion to die is the ſtrongeſt: it follows, therefore, that neceſſity has no law, and that nature authoriſes a man who hath no other poſſible means of living, to take any ſtep for his preſervation. The principles on which a virtuous man acquires a contempt for life, and learns to ſacrifice his exiſtence to his duty, are very different from this primitive ſimplicity. Happy people, among whom goodneſs requires no ſelf-denial, and men may be juſt without virtue! If there be ſo miſerable a ſtate in the world, as that wherein men cannot ſubſiſt without injuſtice, and whoſe citizens muſt of neceſſity be knaves, it is not their criminals who ought to be hanged, but thoſe who made them ſuch.

As ſoon as our pupil knows what life is, our firſt care ſhould be to teach him to preſerve it. Hitherto we have made no diſtinction of ſituation, rank, or fortune, nor ſhall we diſtinguiſh them otherwiſe in the ſequel; for man is the ſame in every rank and ſituation. The rich have no better appetites than the poor, nor quicker digeſtion: the maſter has not longer arms or ſtronger than his ſervant: a great man is no taller than the meaneſt artiſan: in a word, our natural wants being the ſame in every ſituation of life, the means of providing for them ought to be in all the ſame. Adapt the education of a man to his perſonal, and not accidental abilities. Do not you ſee, that, by bringing him up only to fill one ſtation in life, you make him unfit for every other? and that mere accident may render all the pains you have taken uſeleſs, or deſtructive to him? Is there a more ridiculous being on earth than a lord become a beggar, and retaining in his miſery the prejudices attached to his birth? What is more vile and contemptible than a rich man become poor, ſenſible of the diſgrace of poverty, and reduced to the loweſt of the human ſpecies? The one hath no other reſource than to turn common cheat, and the other ſervilely to put on a livery, with this fine phraſe in their mouths, *We muſt live.*

You make a dependence on the actual order of ſociety, without thinking that order ſubject to unavoidable revolutions, and that it is impoſſible to foreſee or prevent that which may affect your children. The high may be reduced low, and the rich may become poor, and even the monarch dwindle into a ſubject. Are theſe changes of fortune ſo unfrequent, that you can flatter yourſelf that your pupil will be exempt from them? We certainly are approaching the criſis of human eſtabliſhments, the age of political revolutions. Who can aſſure you what will be your lot? All that men have made, they may deſtroy. There are no characters indelible but thoſe imprinted by nature, and nature never made man royal, noble, or rich. What then will become of the pupil you have educated to live only with ſplendour, when debaſed into indigence and meanneſs? How miſerable muſt be the ſituation of that pampered helpleſs being, who, deſtitute of every thing, is incapable of providing in the leaſt for himſelf, and places all his ſatiſfaction in things dependent on others? Happy is he who knows how to quit a rank that is quitting him, and to remain ſtill a man in ſpite of fortune! Let others laviſh what encomiums they pleaſe on the frantic behaviour of the vanquiſhed monarch, who wanted to bury himſelf alive in the ruins of his throne; he is moſt decidedly an object of contempt. His exiſtence depended on his *crown*, and had he not been a king, he would have been nothing at all. But the monarch who can throw aſide the robes of royalty and be ſtill himſelf, is infinitely *ſuperior* to a crown. From the rank of a king, which may be filled up by a coward, a knave, or a fool, he *riſes* to that of *a man*, which ſo few are able to fill with decency and dignity.

Sect. XXXVII. *Of Labour and the Manual Arts.*

Whether we conſider ourſelves as men or citizens, or whatever be our ſtation in life, we can contribute nothing more than our own perſonal abilities to ſociety; all our other acquirements belong to it, in ſpite of ourſelves: hence, when a man becomes rich, he muſt either not enjoy his wealth himſelf, or the public will enjoy it alſo. In the firſt caſe, he only robs others of what he alſo deprives himſelf; and even in the laſt he gives them nothing. Thus the debt he owes ſociety remains undiſcharged ſo long as he pays it only with the uſe of his property. Man, in a ſtate of ſolitude, not being indebted to the aſſiſtance or good offices of others, hath a right to live as he pleaſes: but in a ſtate of ſociety, where he muſt be neceſſarily maintained at the expence of the community, he certainly owes the ſtate ſo much labour as will pay for his ſubſiſtence; and this without exception to rank or perſons. To labour, then, is the indiſpenſable duty of ſocial or political man. Rich or poor, ſtrong or weak, every idle citizen is a knave.

Now, of all the occupations which ſerve to furniſh ſubſiſtence to mankind, thoſe which approach neareſt to a ſtate of nature are the manual arts: of all conditions of life, the moſt independent of fortune or the caprices of mankind, is that of the artiſan. The artiſan depends only on his own labour; he is as free as the huſbandman is a ſlave; for the latter depends on the produce of his fields, which lies at the diſcretion of others. The enemy, the ſovereign, a powerful neighbour, a law-ſuit, may run away with the crop, which he hath laboriouſly toiled for. He may be diſtreſſed a thouſand ways by means of the local ſtability of his property; whereas, if an artiſan be oppreſſed in one place, his baggage is eaſily packed up, he folds his arms about him, and diſdainfully marches off to another. Agriculture is, nevertheleſs, the principal profeſſion of mankind; it is the moſt honeſt, the moſt uſeful, and of courſe the moſt creditable in the world. We have no need to bid our pupil apply himſelf to agriculture: it is already his ſtudy. His firſt application was to the labours of the huſbandman, and it is in thoſe he regularly exerciſes himſelf. We ſay to him, therefore, cultivate the land thou inheriteſt from thy fathers. But it may be ſaid, ſuppoſe this to be loſt, or that a

child has no paternal inheritance, what muſt he do then?—*Learn a trade*; a mechanical art, in the exerciſe of which the hands are more employed than the head; an art by which he will never get a fortune, but may be enabled to live without one.

How often has it happened, in families far enough removed from all appearance of wanting bread, that a provident father has been very anxious to furniſh his children with various kinds of knowledge, in order that, at all events, they might be capacitated to earn a ſubſiſtence. In doing this, ſuch parents conceived they did a great deal in the way of making proviſion for their offspring, in caſe of the worſt accidents. In fact, however, they did nothing; becauſe the reſources, with which they thus provided their children, depended on the ſame good fortune, of which they wanted to render them independent. So that a man poſſeſſed of the fineſt talents, unleſs he find himſelf in favourable circumſtances to diſplay them, is as liable to periſh for want as he that hath none.

Ever ſince the intrigues of party have been in faſhion, it requires as much art and aſſiduity to live genteelly by a liberal profeſſion, as to regain the eſtate you may have loſt. If you have cultivated thoſe arts whoſe ſucceſs depends on the reputation of the artiſt; if you have fitted yourſelf for ſuch employments as are in the gift of the great; of what uſe to you will be all your acquirements, when, diſguſted with the world, you diſdain to make uſe of thoſe means, without which it is impoſſible you ſhould ſucceed? Let us ſuppoſe you may have ſtudied politics, and made yourſelf perfectly acquainted with the intereſts of princes; all this is very well. But what will you do with your knowledge, if you know not how to get acceſs to miniſters of ſtate, have no patroneſs in a woman of quality; if you have not the art of making yourſelf agreeable to them, or the baſeneſs to do all the dirty buſineſs in which they might find you employment? But you are an architect or painter, we will ſay. It is very well; they are noble arts: but you muſt make your abilities known to the public. Do you think to carry your point merely by expoſing your deſigns at an exhibition? No, no, this will not do. You muſt be previouſly admitted into the academy; you muſt be honoured by the protection of the great; you muſt throw aſide your pencil and rule, keep a coach, and drive about from houſe to houſe, to make intereſt for reputation in your profeſſion. At the ſame time you are to obſerve, that the houſes you are to viſit, have all their porters, who underſtand nothing but facts, and have the gift of hearing only in their hands. Are you deſirous of teaching any of the arts and ſciences you have learned; to become a teacher of geography, of the mathematics, of languages, of muſic or deſign? To do this you muſt find ſcholars, and of courſe advocates and puffers. It is of more conſequence to be acquainted with the arts of quackery and impoſition, than to excel in your profeſſion; and you may depend on it, if you know nothing but what you profeſs, you will ever be treated as a blockhead.

Thus you ſee how unſerviceable will be all thoſe fine accompliſhments on which you depend, and how much you ſtand in need of others to profit by theſe. What then muſt become of you in this humiliating ſtate of depreſſion? The rebuffs you meet with will debaſe without inſtructing you. Subject more than ever to the caprice of public prejudice, how will you raiſe yourſelf above it, when it is become the arbiter of your fortune? How will you be able to deſpiſe that meanneſs and vice which are neceſſary to your ſubſiſtence? You would depend on the encouragement of wealth, and would ſoon become dependent on the perſons of the rich; you would only have added mortification to ſervility, and loaded yourſelf with miſery. Thus would you behold yourſelf poor without being free; the moſt wretched and contemptible ſtate into which it is poſſible to fall.

But if, inſtead of recurring to theſe ſublime profeſſions, which are rather calculated to nouriſh the mind than the body, you apply yourſelf, when occaſion requires, to *the uſe of your hands*, all theſe difficulties will diſappear; the arts of ſervility are needleſs; your reſources are at hand the moment you want to profit by them. Probity and honour are no obſtacles to your ſubſiſtence; you have no need to fear or flatter the great, to creep or cringe to knaves, to be complaiſant to the world, or to be either a borrower or a thief, which is much the ſame thing when a man ſees no proſpect of paying what he borrows. The opinion of others will not affect you; you will be under no neceſſity of paying your court to any one. Let knaves joſtle each other, and thruſt themſelves into preferment; it is nothing to you; this will not hinder you, in your obſcure ſituation, from being an honeſt man, or gaining a livelihood. You have only to go into the firſt ſhop, of the trade you have learned, and deſire employment, and it will be readily given you. Before noon you will have earned your dinner; and, if you are ſober and induſtrious, before the week is out you will have earned enough to ſubſiſt on a fortnight; thus may you live free, healthy, ſincere, diligent, and honeſt. A man's time is not thrown away in learning to make this proviſion.

We determine, therefore, that our pupil ſhall learn a trade. A *creditable* one, to be ſure! you will ſay. What is the meaning of that word? Is not every employment creditable that is uſeful? It were as well that he ſhould not learn to be an embroiderer, a gilder, or a varniſher, like the fine gentleman of Mr. Locke: neither ſhould he be a fiddler, a player, or a pamphleteer. Except theſe profeſſions, and a few of a ſimilar nature, let him take his choice of all others; confine him to nothing. It were better he ſhould be a cobler than a poet; that he ſhould learn to pave the highway, than enamel or paint the flowers on china. But, you will ſay, ſpies, bailiffs' followers, and even hangmen are uſeful people in their way. That they are ſo, is the fault of government, which might render them uſeleſs. But to give up this point: We were indeed miſtaken; it is not enough to fix on a trade uſeful to ſociety, it ſhould be ſuch a one as doth not require thoſe who exerciſe it to be poſſeſſed of thoſe deteſtable qualities of mind which are incompatible with humanity. We will recur, therefore, to the term you made uſe of, and chooſe a creditable employment, always remembering, however, that nothing ſhould be called creditable that is not at the ſame time uſeful.

By theſe views ſhould we be conducted in chooſing a trade for our pupil; or rather, we ought to leave that choice entirely to him; as the maxims he hath already imbibed give him a natural contempt for things that are uſeleſs, he will never think of throwing away his time in an unprofitable employment; and he judges of their being profitable by their real utility. He would chooſe a trade that might have been of uſe to Robinſon Cruſoe in his deſert iſland.

By giving a child a ſucceſſive view of the various productions of nature and art, by exciting his curioſity and tracing its tendency, we may be enabled to ſtudy his taſte, inclinations, and propenſities; to diſcover the firſt ſpark of his genius, if he have one of any particular turn. But it is a common error, which you ought carefully to avoid, that of attributing to the warmth of genius the mere effect of opportunity, and to conſtrue into an inclination for a particular art, that ſpirit of imitation which is as common to the ape as the human ſpecies, and leads him mechanically to do what he ſees done by others, without very well knowing to what purpoſe. The world is full of artiſans, and particularly of artiſts, who have no natural talents for the arts they profeſs, to which they have been trained from their infancy, either from motives of convenience, or from ſome apparent zeal which had operated as well in favour of any other art, had the ſame opportunities offered of ſeeing

it exercifed One youth hears the beat of a drum, and conceives himfelf born to be a general ; another fees the mafons at work, and immediately forms the defign of being an architect. Every one is tempted to make choice of that profeffion which offers itfelf, and appears to be held in efteem. Who is there has not been mifled by his inclinations, and miftaken them for real abilities ? There is a confiderable difference between being pleafed with any occupation, and being capable of it. It requires much nicer obfervation than is generally imagined, to afcertain the tafte and genius of children ; their cafual inclinations difplay themfelves oftener than their innate difpofitions, and we judge from the firft, for want of knowing how to ftudy the laft. It is a pity but fome judicious hand would give us a treatife on the art of ftudying children ; an art of the greateft importance, though fathers and preceptors know not as yet even its fimple elements.

But, perhaps, we here make the choice of our employment of too great confequence. As it relates only to fome handicraft bufinefs, our pupil need not hefitate ; he hath already ferved half his apprenticefhip in the exercifes to which he has been accuftomed. He is ready to turn his hand to whatever you may require of him : he knows how to handle the fpade and the hoe, to make ufe of the mallet, the plane, and the file ; the tools of all kinds of workmen are familiar to him. All that he needs farther is to acquire the fame dexterity and facility in the ufe of them, as a good artift in that peculiar branch to which he may apply. To this end, alfo, he hath a great advantage above moft other children, in the agility of his body and the fupplenefs of his limbs, by means of which he can throw himfelf into any attitude, and continue any kind of exercife for a long time without tiring. Add to this, that his fenfes are acute and experienced ; and all the mechanifm of the arts already known to him. To turn the work out of his hands like a mafter, he requires nothing but practice ; and practice is to be gained only by time. All that we have to do therefore, is to determine what kind of mechanic employment we fhall beftow fo much time on, as to make ourfelves expert in the exercife of it.

Let every man apply himfelf to one that is becoming his fex and age. A clofe and fedentary profeffion, which enervates the body, will neither pleafe nor be proper for youth. No one ever yet naturally afpired to be a tailor ; artificial motives are required to induce our fex, for whom fuch bufinefs was never defigned, to embrace fo effeminate an employment. The fword and the needle are not made for the fame hands. None but women, or maimed and deformed perfons, fhould be allowed to follow any fuch kind of trade. We prohibit our pupil following any unhealthy bufinefs, but not thofe which are laborious, or even dangerous. The latter exercife at once both his ftrength and his courage ; they are proper for the men only ; the women making no pretenfions to them. How comes it then the men are not afhamed to encroach on thofe properly exercifed by the women ?

A young man fhould learn to exert a ftrong arm ; to handle the axe and the faw ; to fquare a piece of unhewn timber, to mount the roof of a houfe, to lay on the ridge, and to fit the joifts and fcantlings. If any man whatever be afhamed of this, he is only a flave to prejudice, and one that would be afhamed of the moft commendable actions, if they were ridiculed as unfafhionable. We may give up neverthelefs to the prepoffeffions of parents, whatever be not injurious to the underftanding of the child. It is not neceffary to exercife indifcriminately fuch profeffions as are ufeful, merely to do honour to them all ; it is fufficient not to hold any one in lefs efteem than it deferves. He who can make choice of which he pleafes, ought at leaft to have fome regard to cleanlinefs and neatnefs ; for which reafon no one would make his fon a brazier or a blackfmith. One would certainly avoid with no lefs care, any of thofe ftupid profeffions, in the exercife of which the workmen need neither induftry nor ingenuity ; but, like mere machines, employ their hands conftantly in the fame manner. Such are cloth and ftocking-weavers, ftone-fawyers, and the like. To what purpofe fhould a man of any underftanding be put to fuch trades, wherein the workman and his engine are only one machine moving another ? All things duly confidered then, the trade moft fuitable perhaps for our pupil is that of a joiner ; which is neat, ufeful, and may be carried on within doors. It is fufficiently laborious too to keep the body in exercife, and requires both diligence and dexterity : at the fame time, tafte and elegance are not excluded from being difplayed on the form and contrivance of the work. If it fhould fo happen, indeed, that your pupil has a natural turn for the fpeculative fciences, you cannot be blamed for teaching him a mechanic art conformable to his inclinations ; let him learn, for example, to defign and conftruct mathematical inftruments, quadrants, telefcopes, and the like.

When your pupil learns a trade, you alfo will learn it with him ; for he will never learn as it fhould be, what you do not learn together. You muft not affect to be treated as gentlemen, but as real workmen, who are not trifling with a profeffion. Czar Peter worked as a common fhip-carpenter in the yard, and ferved as a drummer in his own troops. Do you think, reader, that prince was not your equal, at leaft, either in birth or merit ? Unfortunately, however, we cannot fpend all our time at the work-bench ; as we have not only to learn the profeffion of a joiner, but alfo that of man, the latter of which is by much the moft tedious and difficult. What then fhall we do ? Shall we hire a mafter-joiner, for an hour in a day, as we do the dancing-mafter ? No : That would not be making ourfelves his apprentices, but his fcholars ; and our ambition is not fo much to learn the trade, as to *raife ourfelves to the condition* of a joiner. We fhould therefore go once or twice a-week at leaft, and fpend the whole day at his fhop. We fhould rife at his hour in the morning, and be at our work before him. We fhould eat at his table, work according to his orders, and, after having had the honour of fupping with his family, return, if we pleafed, to fleep on our own hard mattreffes. Thus you fee how we might learn feveral trades at once, and exercife ourfelves with manual labour, without neglecting our other accomplifhments.

Be fimple in well-doing. Let us not encourage vanity by the means we are taking to deftroy it. To take a pride in having overcome prejudice, is to fubmit to it. It is faid, that from an ancient cuftom peculiar to the Ottoman race, the Grand Signior is obliged to practife fome mechanical employment, and every one knows the fuperior merit of fuch workmanfhip. A prince can turn nothing out of his hands but a mafter-piece. Thefe curious productions of his ingenuity he diftributes about magnificently to the grandees of the court, and the work is paid for according to the quality of the workman. The real evil of this cuftom is not in the pretended impofition of it, againft which fome have fo loudly exclaimed. This, on the contrary, is a benefit. For in thus obliging the bafhaws and other petty tyrants of his empire to divide with him the fpoils of the people, the prince is excufed from doing it directly himfelf. This is a neceffary relief to defpotifm, without which that horrible mode of government could not poffibly fubfift.

The real inconvenience of fuch a cuftom lies in the idea it gives the poor wretch of his princely merit. Like Midas, he fees every thing he touches changed into gold ; but perceives not the long ears fprouting out and expofing the afs. To preferve our pupil from being expofed in the like manner, we fhall not give him any fuch valuable talent ; the price of his labour

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ſhall not depend on the workmen, but on the work. We ſhall never ſuffer him to judge of the merit of his workmanſhip, but by comparing it with that of the beſt artiſans. Of any thing that is well executed, we may ſay to him, *This is well made;* but it will be wrong to add, *Who made it?* And if he ſhould ever himſelf add, with an air of triumph and ſatisfaction, *It was I that made it*, it will be requiſite to anſwer coldly, *Whether you or any body elſe, it is no matter; the work is very well done.*

Let every careful and well-meaning mother guard againſt the impoſitions to which ſhe may be liable in reſpect to the improvement of her child. If her ſon pretends to much knowledge, let her diſtruſt every thing he affects to know: if he has the misfortune to be rich, and to be educated at Paris, he is undone. So long as he is in the midſt of able artiſts, he will be poſſeſſed of all their talents; but, when he is at a diſtance from them, he will have none at all. At Paris, a man who is rich knows every thing; there is nobody ignorant there that is not poor. That capital is full of pretended connoiſſeurs, and ſuperficial judges, of both ſexes. We know but three honourable exceptions amongſt the men, though there may be more. But we know not of one among the women, and much doubt that there is really any. In general, a name is acquired in the arts as in the law.

Sect. XXXVIII. *Of Ideas and the Exerciſe of the Judgment.*

If we have hitherto made ourſelves underſtood, the reader will perceive, that, while we have accuſtomed our pupil to corporeal exerciſe and manual labour, we have given him inſenſibly a taſte for reflection and meditation; in order to counterbalance that indolence which would be the natural reſult of his indifference for the opinions of mankind and the tranquillity of his paſſions. It is neceſſary that he work like a peaſant, and think like a philoſopher, leſt he become as idle as a ſavage. The great ſecret of education is, to make the exerciſes of the body and the mind ſerve as a relaxation to each other. We have ſucceeded in the formation of an active, thinking being; to complete the man we have nothing more to do than to render him affectionate and ſuſceptible; that is to ſay, to perfect his reaſon by ſentiment. But before we enter upon this new diſpoſition of things, let us take a retroſpect of that we are about to leave, and trace, as exactly as poſſible, how far we have proceeded. Our pupil had at firſt only ſenſations, at preſent he has ideas; he once did nothing but perceive, he can now form a judgment of things. It is from the compariſon made between ſeveral ſucceſſive or ſimultaneous ſenſations, and the judgment formed thereon, that a kind of complex or mixed ſenſation ariſes, which may be called an idea.

The peculiar manner in which we form ideas, is that which conſtitutes the genius and character of the mind. To form our ideas of things on their actual relations only, betokens a ſolid underſtanding; whereas, to be contented with their apparent relations, betrays a ſuperficial one. To conceive theſe relations as they really exiſt, diſplays a right judgment; to conceive miſtaken notions of them, denotes a wrong one. Thoſe who ſee imaginary relations, that have neither reality nor appearance, are madmen, while thoſe who make no compariſon between them are idiots. The leſs or greater aptitude to compare theſe ideas, and diſcover ſuch relations, is what conſtitutes a greater or leſs degree of genius and underſtanding.

Simple ideas are only the reſult of comparative ſenſations. A judgment is to be formed from ſimple as well as complex ſenſations; and this we may call a ſimple idea. In judging of our ſenſations, the judgment is merely paſſive: it deduces only the perception of what is immediately perceived. But in the ideas ariſing from thoſe ſenſations, the judgment is active; it collects, compares, and determines thoſe relations which the ſenſes could not. This is all the difference, but this is very conſiderable. Nature never deceives us; we are always deceived by ourſelves.

A child, eight years old, hath ſome freezing milk ſet before him. He puts the ſpoon up to his mouth without knowing what it is, and no ſooner does the ice touch his lips than he cries out, *he is burnt.* He feels a very acute ſenſation, and knowing none more ſharp and painful than that of heat, he imagines that to be the cauſe. He is nevertheleſs miſtaken; the ſudden cold may hurt, but not burn him, nor are the ſenſations of heat and cold alike, thoſe who are more accuſtomed to both never confounding them together. It is not the ſenſation, therefore, that deceives him, but the judgment he forms of it.

We are liable to the ſame kind of deception the firſt time we ſee a mirror, or make uſe of any optical machine; when we go into a vault in the depth of winter, or in the height of ſummer; when we put a very warm or cold hand into water of a middle temperature; or when we hold a round ball between the finger and thumb of each hand held croſswiſe. Should we content ourſelves, in any of theſe caſes, with declaring ſimply what we perceive or feel, the judgment would be merely paſſive; but when we judge of the thing itſelf by its appearance, the judgment is active, it compares, and reaſons on thoſe relations which are not perceived, and thence we become liable to deception. It is from experience only we learn to prevent, or connect ſuch errors.

Shew your pupil, in the night, the clouds paſſing over the moon, and he will at firſt think the moon moves the contrary way, and that the clouds ſtand ſtill. He will conclude ſo from a precipitate induction, becauſe he is more accuſtomed to ſee little objects move than great ones, and the clouds appear to him much bigger than the moon, of whoſe diſtance he cannot judge. When ſtanding ſtill in a ſhip in full ſail, he views the ſhore at a ſmall diſtance, he falls into a contrary error; the trees and houſes on the beach appear to move, becauſe, not perceiving his own motion, he conceives the ſhip and the ſea as one immoveable object, of which the leſs objects on ſhore are only a part.

The firſt time a child ſees a ſtick plunged half-way into the water, he ſees it broken; he is not deceived by his ſenſation, which is a true one, and would be ſo were we even ignorant of the cauſe of this phenomenon. If you aſk him, therefore, what he ſees, he will tell you a broken ſtick; and it is very true, for it is very certain ſuch is the object of his perception. But if, deceived by his judgment, he ſhould go farther; and, after having affirmed that he ſees a broken ſtick, maintain that what he ſees is actually ſuch, or that the ſtick ſo placed in the water is really broken, he would then maintain a falſehood. And why ſo? Becauſe then his judgment becomes active; he judges not from immediate inſpection, but rational deduction, in affirming what he does not perceive, viz. that the conception ſuggeſted by one ſenſe would be confirmed by another.

All other miſtakes thus ariſing from error in judgment, it is clear, that if we were under no neceſſity of judging, we ſhould have no occaſion to learn any thing; we ſhould never be liable to be deceived, and ſhould be much happier in our ignorance than we can be in our knowledge. We do not deny that the learned know a thouſand things to be true, of which the ignorant will never know any thing. Are the learned, therefore, nearer the truth in general? Quite the contrary; the more they advance, the farther off they find themſelves; becauſe the vanity of judging of things making greater progreſs than our abilities to judge, we form an hundred erroneous concluſions for one that is juſt. Nothing is more evident than that the learned ſocieties of Europe are public ſchools of falſehood; and it is very certain that the academy of ſciences

have adopted more errors than are to be found among the whole nation of Hurons.

Since our errors thus increafe with our knowledge, the only method to avoid error is to remain in ignorance. So long as you *fufpend your judgment*, you will not be deceived. This leffon is inculcated by nature, as well as authorifed by reafon. If we except a very few of thofe ftriking relations, which things immediately bear to ourfelves, we have naturally a very great indifference for all the reft. A favage will not ftep a foot out of his way to view the mechanifm of the fineft machine, or the moft aftonifhing phenomenon of electricity. *What is it to me?* is a phrafe the moft familiar with the ignorant, and the moft proper for the learned. Unhappily, however, this phrafe is now ufelefs. Every thing is fomething to us, fince we are become dependent on all things; and our curiofity neceffarily extends with our defires. For this reafon we attribute great curiofity to a philofopher, and none at all to a favage. The latter ftands in need of nobody, and the former of every one, and particularly of numerous admirers.

Will it be faid that we here deviate from nature? By no means. Natural maxims, it is true, are founded on neceffity, and not opinion; but our neceffities vary with our fituations. There is a great deal of difference between the natural man in a ftate of folitude, and the natural man in a ftate of fociety. Our pupil is not a favage, deftined to prowl the woods, but to inhabit towns and cities. It is requifite for him, therefore, to know how to manage his fellow-citizens, and to live among, if not like them. Amidft the variety of connections and dependences of fuch a ftate, he will be under a neceffity of forming various judgments concerning them; let us inftruct him, therefore, to judge of them aright.

The beft way to effect this, is that which tends to reduce our experience to bare matters of fact, and enable us even to proceed, though wanting fuch experience, without falling into error. Hence it follows, that, after we have long accuftomed ourfelves to explain and confirm the evidence of one fenfe by another, we fhould further learn to verify the teftimony of each fenfe by itfelf, without having recourfe to the others; by which means every fenfation will ftand in the place of an idea, and that idea will be always conformable to truth. Such are the acquirements which I have pointed out for this third ftage of human life.

This manner of proceeding, no doubt, requires a degree of patience and circumfpection of which few tutors are capable, and without which the pupil will never learn to judge properly. If, for example, when the latter is deceived in the appearance of the broken ftick, you are in hafte to convince him of his error, by precipitately taking it out of the water, you may undeceive him, it is true; but *what will you teach him by it?* Nothing, but what he would foon have learned as well of himfelf. This, therefore, is not the thing you are to do. The point aimed at is lefs to teach him what is actually and particularly true, than to teach him *how to difcover the truth in general*, or at *any other time*. To inftruct him properly on this occafion, therefore, you fhould not undeceive him fo foon. Let the following ferve for your example:

In the firft place, we will fuppofe that a child educated in the ordinary manner, on being afked, if the ftick be broken, will readily anfwer in the affirmative. Our pupil, however, will not be fo ready to determine it. As he fees no neceffity either to be or to appear knowing, he is in no hafte to judge of the matter: his judgment of things is founded on evidence; and he who fo well knows how liable we are to deception in the objects of fight, is very far from thinking the evidence in the prefent cafe fufficient. Add to this, that knowing from experience that the moft frivolous queftions put to him have always fome material object though not immediately perceived, he is not ufed to reply carelefsly and without thinking. On the contrary, he is fufpicious and attentive, examining fuch queftions very carefully before he ventures to anfwer them. Hence he never makes a reply that he is not well fatisfied with himfelf, and it is no eafy matter to fatisfy him in this particular. In a word, neither of us are accuftomed to pique ourfelves on knowing the truth of things, but only in not falling into error. We fhould be much more afhamed of fitting down fatisfied with an infufficient reafon for a thing, than of our incapacity to find any reafon for it at all. *I do not know*, is an anfwer fo fatisfactory to both, and which we repeat fo often, that it now cofts us nothing. But, whether fuch an abfurd affirmative fhould efcape, or he fhould avoid it by our convenient negative, *I do not know*; the reply to him would be ftill the fame: our way fhould be to look and examine.

The ftick, half immerfed in water, ftands, we will fuppofe, in a vertical pofition: to know whether it be really broken as it appears, we have many things to do before we take it out of the water, or even touch it with the hand. In the firft place, we fhould move round the ftick, and in fo doing we fhould fee the apparent fracture turn with us; the eye appearing to occafion the change; but it is well known our looks cannot alter the form of the ftick. Secondly, we fhould look down it from end to end, in which cafe we fhould not fee it broken or crooked. But can our eye have reunited or ftraightened it? Thirdly, on giving the water an undulating motion, we fhould fee the apparent fracture take different fides, the ftick appearing to bend backwards and forwards with the motion given to the water fufficient to break, foften, or bend the ftick. Fourthly, we take and pour out the water; by doing which we fee the ftick become gradually whole and ftraight in proportion as the water decreafes. Can any thing farther be required, to explain the nature of this fact, and lead us to the difcovery of the refraction? It is not true, therefore, that the fight deceives us, fince we have no need to ufe any other fenfe, to rectify thofe errors we attribute to it.

But fuppofe a child fo great a blockhead, as not to perceive the refult of thefe experiments; in fuch a cafe it will be proper to call in the touch to the affiftance of the fight. Inftead, however, of taking the ftick out of the water, let it remain fome time in the fame fituation, and let the child carry his hand down it from the top to the bottom, by doing which he will find there is no angle; the ftick is not bent or broken.

It may be faid, perhaps, that this is not fimply forming a judgment of things, but reafoning on them in form. It is very true; but is it not plain, that as foon as we arrive at ideas, to *form a judgment of any thing* is to reafon upon it? The confcioufnefs of a fenfation is a propofition, an opinion; and as foon as we compare one fenfation with another, we reafon. The arts of judging and reafoning are one and the fame.

Our pupil can never learn dioptrics, if we cannot teach it him by means of this ftick. He fhall not to this end diffect infects, or count the fpots in the fun; he fhall not ever know the ufe of microfcopes and telefcopes. More polite and learned pupils may poffibly laugh at his ignorance; for before he knows how to make ufe of thefe things, it is our purpofe that he fhall invent them; and this you doubt if he will compafs fo foon.

The fpirit that governs our fyftem, cannot but be obvious. If a child holding a little ball between the fingers crofswife, imagines he holds two, you will not permit him to look, before he has otherwife convinced himfelf that he holds but one.

It is likely thefe explanations will fuffice, to denote precifely the progrefs of our pupil's underftanding, and the route he hath taken. But you are alarmed, perhaps, at the multitude of objects which have been prefented to him. You are afraid his underftanding fhould be depreffed or bewildered by fuch a variety of knowledge. On the contrary, however, we have

taught him to be ignorant of many more things than he knows. We have opened for him a way to fcience, fmooth and eafy indeed, but long, extenfive, and tedious; we have inftructed him at his firft fetting out, that he may know the entrance.

Obliged to learn of himfelf, he makes ufe of his own reafon, and not of that of others; for to give no influence to prepoffeffion, no weight fhould be given to authority; and it is certain that our errors arife lefs from ourfelves than from others. From this continual exercife of the underftanding will refult a vigour of mind, like to that which is acquired by the body from conftant labour and fatigue. Another advantage is, that we advance in knowledge only in proportion to our capacity of digefting it. The mind may be overloaded as well as the body: but when the underftanding makes every thing perfectly clear and familiar, before it commits it to the memory, whatever it deduces thence afterwards, is properly its own. Whereas in overcharging the mind with the remembrance of a heap of confufed ideas, we expofe ourfelves to the inconvenience of never recollecting any thing that can properly be called our own.

Our pupil has but little knowledge; but what he has, is *truly his own:* he knows nothing by halves. Among the few things he knows, and with which he is well acquainted, the moft important is, that there are many things he is now ignorant of, which he may one day know; that there are many more which others know, and he will never be acquainted with; and that there is an infinity of others which neither he nor any body elfe will ever know. He poffeffes an univerfal capacity, not in point of actual knowledge, but in the faculties of acquiring it; an open, intelligent genius, adapted to every thing; and, as Montagne fays, if not inftructed, capable of receiving inftruction. It is fufficient for us that he knows how to difcover the utility of his actions, and the reafon for his opinions. Once again let it be obferved, that our object is not to furnifh his mind with fcience, but *to teach him the method of acquiring it where he has occafion for it;* to inftruct him how to hold it in eftimation, and to infpire him, above all, with a love for truth. By this method, indeed, we make no great advances; but then we never take an ufelefs ftep, nor are we obliged to turn back again.

Our pupil is acquainted with no other fcience than that which is merely phyfical. He knows not even the name of hiftory, nor what is meant by metaphyfics and morality. He hath ftudied the effential relations between men and things, but no moral relations between man and man. He is ill qualified to generalife his ideas, or form abftract notions of things; contenting himfelf with obferving the general qualities of certain bodies, without reafoning on thofe qualities themfelves. He has a notion of abftract fpace, by the help of geometrical figures; and of abftract quantity, by the means of the figns in algebra. Thofe figures and figns, however, are the fupport of thofe abftractions, on which he refts without feeking any further. He does not endeavour to find out the effence of things, or what they are in their own nature; but only their relations, and particularly thofe in which he is interefted. He holds nothing external in eftimation, but from its relation to himfelf; but then the degree of this eftimation is very correct.

The caprice of cuftom, or general agreement, ftamp no value on any thing with him. He holds that in the higheft eftimation which is the moft ufeful; and, never departing from this method of eftimating the value of things, pays no regard to fancy or prepoffeffion. He is laborious, temperate, patient, refolute, and bold. His imagination never exaggerates danger; he is fufceptible of few evils; and knows how to fuffer with patience, becaufe he has never learned to contend againft deftiny. With refpect to death, he is hardly fenfible what it is; but, accuftomed to yield without refiftance to neceffity, when it is his lot to die, he will fubmit to his fate without murmur or complaint. This is the utmoft that our nature will permit in that dreadful moment. To live independent and unattached to life by human connections, is the beft way to learn to die.

In a word, our pupil is virtuous in every thing relating to himfelf. To poffefs the focial virtues alfo, he only requires to be made acquainted with thofe relations that give rife to them; he only wants that information, which his mind is already formed to receive. At prefent he confiders himfelf as entirely unconnected with others. He requires nothing of any one, and thinks no one hath a right to require any thing of him. He ftands alone, and independent, in the midft of fociety. Indeed his pretenfions to independence are better founded than thofe of any other; as he is in himfelf every thing man is capable of being, at his age. He lies under no errors but thofe which are inevitable: He has no vices but fuch as no mortal was ever free from. He hath an healthy conftitution, agility of body, perfpicuity of mind, and a difpaffionate heart. Self-love, the firft and moft natural of all the paffions, as yet hardly exerts itfelf. Without difturbing the repofe of others, he has hitherto lived as content, happy, and free as was poffible for his nature. Do you think a youth, thus arrived at his fifteenth year, hath mifemployed the term of his infancy?

Sect. XXXVIII. *Of the Paffions.*

All human wifdom, as far as it concerns the ufe of the paffions, confifts, firft, in perceiving the true relations of a man, both with regard to the fpecies and to the individual; and fecondly, in regulating the different affections of the mind according to thefe relations. But it may be afked, whether man has it in his power to regulate his affections according to this or that particular relation? Moft certainly he has, if it be in his power to direct his imagination to any particular object, or to give it this or that particular turn. Befide, the prefent queftion does not fo much regard man's power over himfelf, as what may poffibly be done with our pupil, by a proper choice of the circumftances in which he is placed.

Whilft his fenfibility is confined merely to himfelf, there can be nothing moral in his actions: it is only when it begins to extend to others that he acquires the perception and idea of good and evil, which conftitutes him really man, and an integral part of his fpecies; to this period therefore let us confine our obfervations. Poffibly it may be attended with fome difficulty, becaufe we fhall be obliged to reject the examples which are before our eyes, and go in fearch of others, where the faculties of the mind gradually difplay themfelves in their natural order.

A child educated in the accomplifhments of the polite world, who waits only for the power of putting in practice the premature inftructions he has received, never miftakes the moment when that power begins; but, inftead of waiting for that period, accelerates its progrefs; he knows what will be the object of his defires, long before they exift. Nature, when fhe makes him a man, has nothing more to teach him. He was a man, in idea, long before he became one in effect.

The real progrefs of nature is gradual and flow; the motion of the blood quickens; the fpirits begin to ferment, and the conftitution forms by flow and more certain degrees. The fagacious artift, who directs the machine, takes care that each part fhall be perfect before it is put in motion; a long inquietude precedes our firft defires, a long ignorance diverts them various ways, and we defire we know not what. The blood flows quick, the pulfe beats high, and a fuperabundance of life feems impatient to extend its limits. The eye acquires vivacity, and inquifitively explores all other beings; we begin to

have an intereſt in thoſe by whom we are ſurrounded; we begin to perceive that we were not made to live alone. Thus the heart begins to open to human affections, and becomes capable of attachment.

The firſt ſentiment of which a youth, carefully educated, is ſuſceptible, is not love, but friendſhip. The firſt act of his youthful imagination, is to inform him that there are beings ſimilar to himſelf, and the ſpecies affects him before the ſex. Another advantage ariſing from prolonging his innocence is, that it enables us, by means of his growing ſenſibility, to ſow the firſt ſeeds of humanity in his heart; an advantage of infinite importance, becauſe it is the only time of his life when this care will be attended with equal ſucceſs.

It is a fact, that young people, early corrupted, and addicted to debauchery, are inhuman and cruel; the heat of their conſtitution renders them impatient, vindictive, and impetuous. Their imagination, ingroſſed by one particular object, rejects every other; they have neither tenderneſs nor pity, and would ſacrifice all the world, to the moſt trifling gratification. On the contrary, a youth educated in ſimplicity and innocence, is inclined to the tender paſſions by the firſt impulſe of nature. His ſympathetic heart feels the ſufferings of his fellow-creatures; it leaps with joy at the unexpected ſight of a beloved companion, his arms fly open to embrace him with ardour, and his eyes overflow with gladneſs. He is ſenſible of ſhame for giving diſpleaſure, of regret for having offended. If the natural warmth of his conſtitution renders him haſty and paſſionate, you will immediately perceive the extreme goodneſs of his heart, in the effuſion of his repentance; he weeps, he ſighs over the wound he has given; he would gladly compenſate with his own blood, that which he has ſhed; his anger ſubſides, and his pride is humbled in the ſenſe of his fault. If he is offended, one ſingle word of apology diſarms him, though in the height of reſentment; he pardons the faults of others as willingly as he makes reparation for his own. Youth is not the age of revenge and hatred; on the contrary, it is that of compaſſion, clemency, and generoſity. We may aſſert without fear of contradiction, from experience, that a youth, not meanly bred, who has preſerved his innocence to the age of twenty, is at that period the moſt generous, the beſt, the moſt affectionate, and the moſt amiable of mankind.

Man is rendered ſociable by his weakneſs; it is our common miſery which inclines the heart to humanity. Every attachment is a ſign of inſufficiency. If we ſtood in no need of aſſiſtance, we ſhould hardly think of uniting ourſelves to each other, ſo that human felicity, uncertain as it is, proceeds from our infirmities. A being abſolutely happy, muſt be alone and independent. God only enjoys abſolute happineſs; but of that happineſs who can have any idea? If an imperfect being could be ſuppoſed to have an independent exiſtence, what, according to our ideas, would be his enjoyment? In being alone he would be miſerable. He who wants nothing, will love nothing, and it cannot be conceived that he who loves nothing can be happy.

Hence it follows, that our attachment to our fellow-creatures is rather owing to our ſympathiſing with their pains, than with their pleaſures; for in the firſt we more evidently perceive the identity of our nature, and a ſecurity for their attachment to us. If our common neceſſities unite us from a principle of intereſt, our common miſeries unite us by affection. The ſight of a happy man is more apt to inſpire envy than love; we readily accuſe him of uſurping a privilege to which he has no excluſive right, and our ſelf-love ſuffers in the idea, that he has no need of our aſſiſtance. But who does not bemoan the unhappy ſufferer? Who would not releaſe him from his misfortunes, if it coſt no more than a wiſh? It is eaſier to imagine ourſelves in the ſituation of the wretched, than in that of the happy; becauſe we perceive ourſelves more nearly allied to the one, than to the other. Compaſſion is a grateful ſenſation, becauſe, though we ſympathiſe with the ſufferer, we ſecretly rejoice that his pains are not our own. Envy, on the contrary, is painful, becauſe, ſo far from ſympathiſing in the happineſs of others, we grudge them their enjoyments. The firſt ſeems to exempt us from the evil he ſuffers, and the latter to deprive us of the bleſſings he enjoys.

If you would encourage the firſt impulſes of a growing ſenſibility in the heart of a young man, and incline his diſpoſition towards virtue and benevolence, be careful not to ſow the ſeeds of pride, vanity, and envy, by a falſe repreſentation of human felicity. Let him remain unacquainted with the pomp of courts, the magnificence of palaces, and the charms of public entertainments; let him not appear in polite circles and brilliant aſſemblies. Give him not a ſuperficial view of ſociety till he is able to make a proper eſtimate of its intrinſic value. To ſhew him the world in general, before he knows ſomething of man in particular, would be to corrupt, inſtead of forming his mind; to deceive inſtead of inſtructing him.

Men are not naturally opulent, courtiers, nobles, or kings. We come into the world naked and poor; we are all ſubject to the miſeries of life, to grief, neceſſity, and evils of various kinds: in ſhort, we are all condemned to die. Such is the true picture of man. Let us therefore begin by ſtudying thoſe things which are inſeparable from human nature, that which moſt eſſentially conſtitutes humanity. At the age of ſixteen we know what it is to ſuffer, for we ourſelves have already ſuffered: but we are hardly ſenſible of the ſufferings of other beings: to ſee without feeling them, is not to know them; and a child has no idea of what others feel; he knows no evils but his own: but, when the firſt diſplay of his faculties kindles the fire of his imagination, he begins to perceive that he does not exiſt independent of his fellow-creatures; he feels their complaints, and ſympathiſes in their ſorrow. At this time the tragical picture of our exiſtence ſhould excite in his heart the firſt feelings of humanity.

We now return to our ſyſtem, and proceed. When that critical age approaches, which indicates the exiſtence of thoſe deſires that are natural to the ſexes, exhibit to your pupil ſuch ſcenes as may reſtrain, rather than accelerate the growth of his paſſions. Carry him from the town, where the immodeſt dreſs and behaviour of the women anticipate the inſtructions of nature; where every ſcene preſents him with pleaſures, with which he ought to remain unacquainted till he is able to chooſe with propriety. Carry him back to his firſt habitation, whoſe rural ſimplicity will ſuffer his paſſions to unfold in their natural gradation. But if a taſte for the arts ſhould attach him to the town, let that taſte ſerve to prevent a dangerous inactivity. Be extremely circumſpect in the choice of his companions, his employments, his pleaſures. Shew him ſuch pictures as are affecting, but modeſt; ſuch as will nouriſh his ſenſibility, without inflaming his deſires. But let us not forget, that whilſt we endeavour to avoid one extreme, there is a poſſibility of falling into the other. It is not our intention to afflict your young pupil continually with objects of horror and diſtreſs; to carry him from hoſpital to hoſpital, and from one priſon to another. We muſt not, by too frequent repetition, harden, inſtead of ſoftening, his heart, at the ſight of human woes. What we too often behold we ceaſe to imagine, and it is in imagination only that we feel the miſeries of others. Hence, from their conſtant viſits to the dying and the ſick, the hearts of prieſts and phyſicians grow callous and obdurate. Let your pupil, therefore, be made acquainted with the lot of man, and the ſufferings of his ſpecies; but let him not be too frequent a witneſs of ſuch calamity. A ſingle object, judiciouſly choſen, and ſhewn at a proper time, will inſpire him

with tendernefs, and afford him reflection for a whole month. It is not fo much the object itfelf, as his return to it in idea, which determines his judgement; and the permanence of the impreffion upon his mind depends alfo lefs upon the object than the point of view in which it is recalled to his mind. By this management of our examples, leffons, and images, we fhall for a long time blunt the dangerous edge of inclination, and divert the attention of nature whilft we follow her own dictates.

In proportion as he becomes more enlightened, let the ideas which you mean to excite be adapted to his underftanding; and in proportion as his defires take fire, make choice of fuch objects as will moft effectually ftifle the flame. It has been told by an old military gentleman, who was as much diftinguifhed for his morals as for his courage, that his father, who was a fenfible man, but extremely devout, feeing that he was naturally too much inclined to women, fpared no pains to curb this propenfity; but finding, notwithftanding all his care, that his fon ftill perfifted in his vices, he carried him to an hofpital eftablifhed for the cure of the people in the venereal difeafe, and, without any previous intimation of his defign, led him into a gallery full of thofe unhappy wretches, who were feverely expiating the folly which had brought them thither. At this hideous fpectacle, fo offenfive to all his fenfes, the young man grew fick. "Go, thou wretched debauchee," faid the father, with a fignificant look and emphafis, "follow thy loofe inclinations; it will not be long before thou wilt think thyfelf happy in being admitted into this place; or perhaps a victim to the moft infamous fufferings, thou wilt compel thy father to thank God for thy death."

Thefe few words, joined to the affecting fcene before him, made an impreffion upon the young man which time could never efface. Condemned by his profeffion to fpend his youth in garrifons, he chofe rather to bear the raillery of his companions than imitate their vices. "I was a man," faid he, "and have had my foibles; but during my whole life I never could behold a public proftitute without horror." Tutors! let me advife you to put little confidence in words; but learn to make a proper choice of time, place, and circumftances: let examples be your lectures, and reft affured of their effect.

During infancy our employment is inconfiderable: the neglects or miftakes of that age are not without remedy, and the good we imbibe might be communicated at a later period: but it is otherwife with regard to the age when man firft begins really to live. This age is always too fhort for the ufe which we ought to make of it, and its importance requires an unwearied attention. Our inftructors complain, that the natural fire of this age renders youth ungovernable. Very true; but is it not entirely their own fault? Can they be ignorant, that when they have once fuffered this fire to make its way through the fenfes, it is not in their power to divert its courfe? Will the tedious, frigid fermons of a pedant efface from the mind of his pupil the idea of pleafure which he has conceived? will they banifh from his heart the defires which torment him? will they quench the ardour of a flame of which he already knows the ufe? will he not be enraged at thofe obftacles which oppofe the only happinefs of which he has any idea? and in the fevere law prefcribed without explanation, what can he difcover except the caprice and hatred of a man who choofes to torment him? Is it therefore wonderful that he fhould oppofe and hate the pedagogue in his turn?

It is eafy to conceive, that, by relaxing his feverity, a tutor may render himfelf lefs difagreeable to his pupil, and yet preferve an apparent authority: but we do not perceive the ufe of that authority which ferves only to foment the vices which it ought to reprefs: it is much the fame as if a rider, in order to tame an unruly horfe, were to leap him down a precipice. This fire of youth, fo far from being an obftacle in his education, is the proper inftrument of its accomplifhment; it is that which gives you an advantage over the heart of your pupil, when he ceafes to be lefs powerful than yourfelf. His firft affections are the reins with which you fhould direct all his motions. He was before at liberty; but now he is enflaved. Whilft he was incapable of affection, he was dependent only on himfelf and his neceffities; but the moment he loves, he depends on his attachments. Thus are formed the firft bonds which unite him to his fpecies; but we are not to fuppofe that his new-born fenfibility will be univerfal, or that he will conceive any meaning in the word mankind. No; that fenfibility will be firft confined to his equals, and his equals are thofe only with whom he is acquainted; thofe whom cuftom has rendered dear to him, or ufeful; thofe in whom he perceives a fimilitude of ideas and fenfations; thofe who are expofed to the pains, and are fenfible of the pleafures, which he has experienced; in a word, thofe in whom the more manifeft identity of nature increafes his difpofition to felf-love. It is not till after having cultivated his difpofition in a thoufand forms, after much reflection on his own fentiments, as well as thofe of others, that he will be able to generalife his notions under the abftract idea of humanity, and add to his particular affections thofe which are to unite him to the whole fpecies.

If you have judgment, reader, to accomplifh your tafk completely thus far, the reft is eafy. By a prudent application of the fame principles, you will conduct your pupil to the period of manhood, and render fociety an important fervice, by having introduced into its bofom a well educated, happy, and benevolent individual. We fhall not conclude, however, till we have fpoken on a fubject which the devout reader will wonder we have deferred fo long.

Sect. XXXIX. *Of Religion.*

The reader will doubtlefs be furprifed to find that we have attended our pupil throughout the whole firft age of life, without once fpeaking to him of religion. He hardly knows at fifteen years of age whether or not he hath a foul, and perhaps it will not be time to inform him of it when he is eighteen; for, if he learns it too foon, he runs a rifk of never knowing it at all.

Were we to defign a picture of the moft deplorable ftupidity, we would draw a pedant teaching children their catechifm: and if refolved to crack the brain of a child, it is only neceffary to oblige him to explain what he faid when he repeated his catechifm. It may be objected, that the greater part of the dogmas of chriftianity being myfterious, to expect the human mind fhould be capable of conceiving them, is not fo much to expect children fhould be men, but that man fhould be fomething more. To this we anfwer, in the firft place, that there are myfteries, which it is not only impoffible for man to comprehend, but alfo to believe; and we do not fee what we get by teaching them to children, unlefs it be to learn them betimes to tell lies. We may fay farther, that before we admit of myfteries, it is neceffary for us to comprehend, at leaft, that they are incomprehenfible, and children are not even capable of this. At an age when every thing is myfterious, there are no fuch things, properly fpeaking, as myfteries.

Believe in God, and thou fhalt be faved.—This dogma, mifunderftood, is the principle of fanguinary perfecution, and the caufe of all thofe futile inftructions which have given a mortal blow to human reafon, by accuftoming it to be fatisfied with words. Doubtlefs not a moment is to be loft when we are running the race of eternal falvation; but if, to obtain this important prize, it be fufficient to learn to repeat a fet form of words, what fhould hinder us from peopling

heaven with magpies and parroquets, as well as with children?

To impofe an obligation of believing, fuppofes the poffibility of it. The philofopher who does not believe, is certainly in the wrong; becaufe he mifufes the underftanding he has cultivated, and is capacitated to comprehend the fublime truths he rejects. But though a child fhould profefs the chriftian religion, what can he believe? He can believe only what he conceives, and he conceives fo little of what is faid to him, that if you tell him directly the contrary, he adopts the latter dogma as readily as he did the former. The faith of children, and indeed of many grown perfons, is merely an affair of geography. Are they to be rewarded in heaven, becaufe they were born in Britain, and not at Mecca? One man is told that Mahomet was a prophet fent by God, and he accordingly fays, that Mahomet was a prophet fent by God; and the other is told that Mahomet was an impoftor, and he alfo in like manner fays Mahomet was an impoftor. Had thefe two perfons only changed places, each would alfo have changed his tone, and affirmed what he now denies. Can we infer from two difpofitions fo much alike, that one will go to heaven and the other to hell? When a child fays he believes in God, it is not in God he believes, but in Peter or James, who tells him there is fomething which is called God: thus he believes in the manner of Euripides, when Jupiter was thus addreffed in one of his tragedies:

O Jupiter! though nothing I know of thee but thy name,——

We proteftants hold, that no child who dies before he arrives at the age of reafon is deprived of falvation; the Roman Catholics believe the fame of every child that is baptized, though it fhould never once have heard the name of God. There are fome cafes therefore in which men may be faved without believing in God, as in infancy or imbecility of mind, as in idiocy or madnefs, where the underftanding is incapable of the operations requifite to infer an acknowledgement of the Deity. All the difference that exifts here between us and the reader is, that he thinks children of feven years of age capacitated to believe in God, and we do not think them capable of it even at fifteen. Whether we are right or wrong in this particular, it is not in itfelf an article of faith, but only a fimple obfervation in natural hiftory.

On the fame principles, it is evident, that if a man fhould arrive at old age without believing in God, he would not be deprived of his prefence in the other world, provided his infidelity was not wilful; and this doubtlefs may fometimes happen You will admit, that, with refpect to madmen, a malady deprives them of their intellectual faculties, but not of their condition as men, nor of courfe of their claim to the beneficence of their Creator. Why then will you not admit the fame claim in thofe who, fequeftered in their infancy from all fociety, have lived the real life of a favage, deprived of that information which is to be acquired only by converfation with mankind? For it is a demonftrable impoffibility that fuch a favage fhould ever raife his ideas to the knowledge of the true God. Reafon tells us, that man is punifhable only for his wilful errors, and that invincible ignorance can never be imputed to him as a crime. Hence it fhould follow, that in the eyes of Eternal Juftice every man who would have believed had he had the opportunities of information, will appear as a believer; and that none will be punifhed for infidelity but thofe whofe hearts refufe to admit the truth.

Let us beware of *divulging the truth to thofe who are incapable of underftanding it*: for this is the way to *fubftitute error in the room of it.* It were better to have no ideas of God at all, than to entertain thofe which are mean, fantaftical, injurious, and unworthy a divine object; it is a lefs crime to be ignorant of, than to infult him. "I had much rather," fays the amiable Plutarch, "that people fhould believe there is no fuch perfon as Plutarch in the world, than that they fhould fay, he is unjuft, envious, jealous, and fo tyrannical as to require of others what he has not left them power to perform."

The great evil of thofe prepofterous images of the Deity, which we may trace in the minds of children, is, that they remain indelible during their whole lives; and that when they are men, they have no better conceptions of God than they had when they were children. We need be under no fuch apprehenfions, however, with refpect to our pupil, who, conftantly refufing to pay any attention to objects above his capacity, hears with the moft perfect indifference thofe things he doth not underftand. There are fo many of thefe, of which he is accuftomed to fay, "This matter is not my concern," that he will not be embarraffed about any one that may be propofed to him: and even when he begins to intereft himfelf in thefe important queftions, it is not becaufe he may have happened to hear them propofed, but when the progrefs of his underftanding leads him to fuch difquifitions.

We have feen by what means a cultivated underftanding makes its approaches to the knowledge of thefe myfteries; and we readily agree that it does not naturally arrive at fuch knowledge, even in the midft of fociety, before we reach a very advanced age. But, as there are numerous and inevitable caufes in fociety, from which the progrefs of the paffions is accelerated; if the progrefs of the underftanding, which ferves to regulate thofe paffions, be not accelerated in the fame proportion, then it is that we depart from the order of nature, and that the equilibrium between our reafon and our paffions is deftroyed. If we are not fufficiently our own mafters to moderate a too rapid development of certain faculties, it is neceffary to hurry on with the fame rapidity thofe which ought to correfpond with them, fo that the order in which they fhould all be naturally difplayed, be not perverted; that thofe which ought to go together, be not feparated; and that man, as the fame confcious individual during every moment of his life, fhould not be advanced to a certain degree by one of his faculties, and to a different degree by another.

What a difficulty is there here rifing up againft us? a difficulty by fo much the greater as it depends lefs on the things themfelves, than on the pufillanimity of thofe who dare not venture to refolve it. Let us begin at leaft by daring to propofe it. A child fhould be educated in the religion of his father; it is always eafy to convince him that fuch a faith, be it what it will, is the only true one; and that all others are abfurd and extravagant. The force of the arguments on this head, depends abfolutely on this point, to wit, on the country in which they are propofed. Let a Turk, who finds Chriftianity fo ridiculous at Conftantinople, go and fee how ridiculous Mahometanifm is in England. Cuftom and prejudice triumph particularly in matters of religion. But how fhall we, who, on all occafions, pretend to fhake off its yoke; we, who pay no regard to the authority of opinion; who would teach our pupil nothing but what he might have learned himfelf, in any country; in what religion fhall we educate our pupil? To what fect fhall we unite the man of nature? The anfwer appears to be very fimple. We will unite him neither to one nor another; but place him in a proper fituation, and qualify him to make choice of that which the beft ufe of his reafon may induce him to adopt.

To what can we attribute the prevailing fcepticifm with regard to chriftianity, but to the erroneous impreffions made on the minds of children? The dogmata forced as it were upon them by well-meaning but inconfiderate tutors, appear, at a more advanced period, *when reafon will exercife her province*, fo irreconcilable, that the mind is tempted to reject altogether a

ſyſtem which in ſome of its parts wears to them the appearance of *fallacy*. Parents, would you chooſe that your children ſhould be really Chriſtians, be content to make them virtuous and happy till that period when the ſublime truths of the doctrine you would have them believe *are capable of being comprehended*. Guard them here, as in all other caſes, againſt *error*, which, notwithſtanding any thing that bigots may ſay to the contrary, is far more fatal in its conſequences than the blindeſt ignorance. You aſk what God is; it is not an eaſy matter to tell you. God can neither be heard, ſeen, nor touched; he is known only by his works. In order to judge what he is, ſtay till you know what he has done. If the articles of our religion are equally true, yet they are not all of equal importance. It is very indifferent to the divine glory, whether it be manifeſted to us in every particular; but it is of the utmoſt conſequence to human ſociety, and to each of its members, that every man ſhould know and fulfil the ſeveral duties towards his neighbour, and towards himſelf, which are injoined him by divine law. This is what we ought conſtantly to teach one another; and in this particularly are parents obliged to inſtruct their children. Whether a virgin were the mother of Chriſt, whether ſhe brought forth the Deity, or only a man to whom the divine nature was conjoined; whether the ſubſtance of the father and the ſon be the ſame, or only ſimilar; whether the Holy Ghoſt proceeds from one of the two, who are both the ſame, or from both jointly; perhaps, the determination of theſe queſtions, in appearance ſo eſſential, is not of more importance to the human ſpecies, than to know on which day of the month we ought to ſolemniſe Eaſter; whether it be proper to faſt, &c. Let every one think of theſe matters as he pleaſes: the matter of conſequence to us and our fellow creatures is, that every man ſhould know, that there is an arbiter of the fate of human beings, on whom we all depend as his children; that he commands us all to be juſt, to love each other, to be beneficent and merciful, to keep our engagements with all the world, even with our enemies and his; that the apparent felicity of this life is nothing; that there is another to come, in which the Supreme Being will diſtribute rewards to the good, and puniſhments to the wicked. Theſe, and the like doctrines, are proper to be inculcated to children, and inſtilled into the minds of all mankind. Whoſoever oppoſes them, is inconteſtably deſerving of puniſhment, becauſe he is a common diſturber, and an enemy to ſociety. Whoſoever overlooks them, and wants to ſubject us to his private opinions, drives towards the ſame point by an oppoſite road; *to eſtabliſh order after his manner, he diſturbs the public tranquillity*; in the pride and raſhneſs of his heart, he ſets himſelf up for *an interpreter of the Deity*; he demands the homage and praiſe of men in the divine name; he erects *himſelf*, to the beſt of his power, in the place of God; he ought to be puniſhed for ſacrilege, if not for the guilt of perſecution.

Keep your children, therefore, while they *are* children, within the narrow circle of the doctrine of morality. Make them fully ſenſible that there is no other knowledge uſeful to man, but that which teaches him to do good. Do not make your daughters philoſophers and divines; learn them nothing, in regard to celeſtial things, but what contributes to human wiſdom: Let them be accuſtomed to feel themſelves always in the preſence of the Deity, to have him for a witneſs to their actions, to their thoughts, to their virtues, and their pleaſures; to do good without oſtentation, becauſe he loves it; to ſuffer evil without repining, becauſe he will make them amends; in ſhort, to be every day of their lives the ſame as they would deſire to have been, when they are to appear in his preſence. This is a ſyſtem that at leaſt is unſuſceptible of abuſe, impiety, or fanaticiſm. Let others preach ſublimer ſyſtems as long as they pleaſe; for our part, we acknowledge none but this.

Sect. XL. *Of the Education of Females.*

It cannot but have occurred to the intelligent reader, that much of what has been pointed out as a ſuitable plan of education for the infant part of our ſpecies, is no leſs applicable to either ſex. The abilities common to both, however, are not equally divided between them; yet, upon the whole, the difference is compenſated: woman has a much greater weight by the qualities of her own ſex, than by thoſe of ours; wherever ſhe aſſerts her own rights, ſhe has the advantage of us; wherever ſhe attempts to uſurp ours, the advantage then is on our ſide. It is impoſſible to anſwer this general truth any other way than by exceptions; a manner of arguing conſtantly uſed by the gallant admirers of the fair ſex.

Were women after a certain age to cultivate the manly qualities, and to neglect thoſe which belong to their ſex, they would evidently act contrary to their own intereſt. Of this they are perfectly ſenſible, and they have too much art to be caught in ſuch a ſnare. While they endeavour to uſurp our rights, they do not relinquiſh their own. But from thence it follows, that, not being able to manage them both, becauſe they are incompatible, they remain below their own ſtandard, without coming up to ours, and decreaſe in one half of their value.

But if the peculiar duties of the ſex render it neceſſary at a proper period to run counter to the plan we have recommended for males, does it follow from thence, that a woman ought to be educated in abſolute ignorance, and confined to the interior management of a family? Shall man make a ſervant of his help-mate, and deprive himſelf in her company of the greateſt endearment to ſociety? The better to keep her under ſubjection, ſhall he debar her from all ſenſation and knowledge? Shall he make a mere machine of her? No ſurely; this was never the intent of nature, who endowed the ſex with ſo much wit and ſprightly fancy; on the contrary, nature requires they ſhould think, they ſhould judge, they ſhould learn, and improve their underſtandings as well as their perſons: theſe are the arms with which ſhe has ſupplied them, to compenſate for their want of that ſtrength with which our ſex has been inveſted. They ought not to learn a great many things, but only ſuch as it is proper for them to know.

Whether we conſider the particular deſtination of the ſex, with their inclinations and duties, all concur in pointing out that form of education which ſuits them beſt. Man and woman are formed for one another, but their mutual dependence is not equal: the men depend on the women by their deſires; the women on us, both by their deſires and their wants; we could ſubſiſt much better without them, than they without us. It is impoſſible for them to have neceſſaries, or to live agreeably to their condition, unleſs they are ſupplied by our ſex, and we think them worthy of our aſſiſtance. They are dependent on our opinions, on the price we ſet upon their merit, and on the eſtimation we make of their charms and virtues. Even the law of nature, notwithſtanding the late fanciful doctrines of the *Rights of Women*, has ſubjected both them and their offspring to the juriſdiction of the male ſex. It is not ſufficient for them to be worthy of eſteem, they muſt be actually eſteemed; it is not enough for them to be beautiful, it is neceſſary they ſhould give pleaſure; it is not ſufficient that they are endowed with wiſdom and virtue, they muſt be acknowledged to be wiſe and virtuous: their honour does not ſolely depend on their conduct, but on their reputation; and it is impoſſible that ſhe who conſents to part with her good name, ſhould ever be an honeſt woman. The good actions of a man depend ſolely on himſelf; he may bid defiance to the

public judgment: but those of women depend also upon others, since her reputation, which is nothing but opinion, is as dear to her as life. The consequence is, that their system of education ought to be different from ours. Opinion is the grave of virtue among men, but its throne with women.

The good habit and disposition of children is derived from that of their mothers; the early education of the males is connected with the care taken of us by females; and on them also depend our manners, our passions, our tastes, our pleasures, and even happiness itself. Thus *the education of the fair sex should be entirely relative to ours.* To esteem, to rear us when young, to attend us when grown up, to advise, to console us, to sooth our pains, and to soften life with every kind of blandishment; these are the duties of the sex at all times, and what they ought to learn from their infancy. Unless they are guided by this principle, they will miss their aim, and all the instructions bestowed on them will neither contribute to their happiness or to ours.

But although every woman should be willing, both by inclination and duty, to please our sex, yet there is a wide difference between desiring to oblige a man of worth, who is really deserving of love, and endeavouring to be agreeable to those little effeminate fops, who are the disgrace of their own sex, and of that which they foolishly attempt to rival. Neither nature nor reason can induce a woman to love a man for those qualities in which he resembles herself; neither is it by imitating our manner, that she is to endeavour to conciliate our affection.

Whenever, therefore, the women lay aside the modesty and decorums of their own sex, to affect the airs of those fribbles, instead of acting according to nature, they greatly deviate from her, and forfeit the very rights which they would fain usurp. Were we to behave otherwise, say they, we should not be agreeable to the men: but they are mistaken. They must be fools, to be in love with fools; the desire of gaining the affection of such men shews the taste of those women. If we had no silly fellows among our sex, the women would soon make us such; and our weaknesses would be much more owing to them, than theirs to us. The women who love real men, and desire to please them, pitch upon such means as are agreeable to their design. Woman is by nature a coquette, but her coquetry changes its form and its object, according to her different views: let us regulate these by nature, and then she will have the education suitable to her sex.

Girls, almost from their cradle, are fond of dress; not content with being pretty, they would be thought so: by their airs we perceive, that this is already an object of their attention; and scarce are they capable of understanding us, when they are governed by what is said concerning their person and behaviour. But no such consideration has any influence on boys. Provided they can have their pleasure, and be independent, they give themselves but very little trouble about what the world may think of their conduct. It requires time, and a good deal of trouble, to subject them to the same law, as that by which the girls are entirely directed.

From whatever quarter the women receive this first lesson, it is a very good one. Since the body is born in some measure before the mind, it requires the first culture; the above order is common to both sexes, but the object is different; in one, this object is the improving its strength; in the other, its charms. Not that these ought to be exclusive qualities in each sex, but only the order is inverted: women must have a sufficient power to perform all their actions with a graceful air; men must have sufficient dexterity to do theirs with ease.

From the too great delicacy of women, that of men is derived. The former ought not to be robust for themselves, but for our sake, to the end that their male offspring may be strong and vigorous. On this account, it is preferable by far to educate young girls in situations, where they have a very simple diet, but are permitted to play, to jump, and run about in the open air, and in the garden; than to bring them up at home, where they are fed with dainties, where they are constantly flattered or reprimanded; where seated under their mother's eye, in a close apartment, they neither dare to rise, nor to speak, nor hardly to draw their breath; where of course they have not a moment's liberty to play, to run about, to make a noise, and fall into the little levities so natural to their age: they are either indulged in such liberties as are dangerous, or checked by an injudicious severity. In this manner are young people ruined, both in body and mind.

Children of both sexes have a great many amusements in common, and this must ever be the case; but it is not the same, when they grow up to maturity. They have likewise their peculiar tastes, by which the sex is distinguished. The boys like whatever is productive of motion and noise, as drums, tops, and hobby-horses; the girls are fonder of decorations that please the eye, such as looking-glasses, toys, and baby-cloaths. Dolls are the favourite amusement of the sex, which plainly indicates the design for which they were formed. The natural part of the art of pleasing consists in dress, and this is all that children are capable of learning.

It is curious to see how a little girl will spend whole days about her baby, continually changing its attire, dressing and undressing it a hundred times, ever contriving modes of ornament, whether well or ill chosen, it does not signify. Her fingers are not supple, her taste is not formed, and yet her turn of mind begins to shew itself. Amidst this incessant occupation, the time insensibly glides away, the hours pass unknown to her; she even forgets her repast, and has a greater appetite for fine cloaths, than for nourishment. But it will be said, perhaps, that her care is about dressing her *doll*, and not her own person; no doubt, because she sees her doll, and does not view herself; she is incapable of entering upon any action on her own account; her taste is not yet formed; she has neither power nor abilities; in short, she herself is nothing, she is entirely absorbed in her child, on that she places all her coquetry: but it will not abide there for ever; she waits for the happy minute, when she herself is to be the baby. Here we have therefore an original taste, of which there can be no sort of doubt. Your business is only to trace it, and bring it under a proper regulation. Most girls shew an aversion to reading and writing; but it is with the greatest pleasure they learn their needle-work. They imagine themselves grown women, and are delighted with the notion, that these abilities will one day contribute to render their persons more agreeable by the decorations of dress.

When once this road is open, it is very easy to follow: needle-work, lace, &c. come of themselves; and these voluntary improvements may extend as far as designing, an art somehow connected with that of dressing in taste. But there is little need for them to apply themselves to landscapes, much less to portrait painting. It is sufficient for them to design foliage, fruits, flowers, drapery, and whatever is capable of giving an embellishment to dress; and to draw a pattern of embroidery after their own fancy, when they cannot meet with one to their liking. If it be incumbent on men in general, to confine their studies to practical knowledge, this is a point of still greater importance to women: for the latter, from their manner of life, which, though less laborious, either is or ought to be filled up with far different cares, cannot possibly indulge their inclination for any particular amusement, to the prejudice of their domestic employments.

That the duties of women are more easily seen, than fulfilled, need not be insisted on. The first thing they ought

to learn, is to be fond of thofe duties, from a confideration of their utility; this is the only way to facilitate their practice. Every ftate, and every age, has its particular functions. The knowledge of them is foon learned, provided we love them. Women, be fure to honour your ftate, and in whatever fituation of life you are placed by Providence, you will be always refpected. The effential point is to be what nature defigned you; then there is no doubt of your anfwering the expectations of man.

An inquiry into abftract and fpeculative truths, into the principles and axioms of fciences, and every thing that tends to render our ideas more general, is not the province of women. Their ftudies ought to be all practical: it is their bufinefs to apply the principles difcovered by man, and to make the obfervations by which our fex is induced to eftablifh thofe principles. The reflections of women, on fubjects not immediately connected with their duty, ought all to be directed to the knowledge of man, or to fuch agreeable branches of fcience that have tafte for their object. With regard to works of genius, they furpafs their comprehenfion; neither have they fufficient attention and precifion to fucceed in the mathematics; and as for natural philofophy, it belongs only to that fex, which is moft active, fees moft objects, is poffeffed of moft ftrength, and exercifes it the moft, to judge of the relations of fenfible beings, and of the laws of nature. The woman being the weaker veffel, and feeing nothing abroad, eftimates and determines the means fhe is capable of employing at home to fupply her weaknefs; and thefe are the paffions of man. Her mechanical powers are more confiderable than ours; all her engines are at work, to fhake the human heart. Whatever is either neceffary or agreeable to her inclination, and is not in the power of her own fex to procure, fhe muft obtain by means of ours: and for that end it is incumbent on her to enter into a deep ftudy of the human mind; not by confidering it abftractedly, and in general, but by obferving the minds of thofe men by whom fhe is furrounded, and to whofe authority, founded either in pofitive law, or the prejudices of opinion, fhe is obliged to fubmit. She muft learn to difcover their fentiments by their difcourfe, by their actions, by their looks, their geftures. She muft endeavour to direct her own difcourfe, her actions, her looks, her geftures, in fuch a manner as to infpire them with what fentiments fhe pleafes, without appearing to have any fuch defign. They will philofophize better than fhe in regard to the human heart; but fhe will be able to read it much better than they. The difcovery of experimental morality, if it may be fo called, is properly their province; ours is to reduce it to a fyftem. The women have more wit, men more genius; women obferve, and men reafon; this concurrence of both is productive of the cleareft and moft adequate idea of the human mind, of the moft undoubted knowledge of ourfelves and of our fpecies, that we are capable of acquiring: and thus it is, that art and ingenuity may inceffantly improve our natural abilities.

The world is a book open to women; when they read any thing wrong therein, it is their own fault, and they are blinded by fome irregular paffion. Yet a prudent mother of a family, inftead of being a woman of the world, lives as reclufe a life as a nun. It would be therefore very proper to behave in the fame manner to young women who are going to be married, as is practifed, or ought to be practifed, in regard to thofe who take the veil; they fhould be made to fee the pleafures of the world before they relinquifh them, left a falfe reprefentation fhould fome time hence feduce their hearts, and difturb the tranquillity of their retreat. In France the young girls lived in convents, and married women were continually rambling abroad. Among the ancients it was quite the contrary; the girls were prefent at public fports and entertainments; the married women fpent their days in retirement. The latter cuftom was more rational, and contributed more to the fupport of morality. Young girls are allowed in fome meafure to be coquettes; their main bufinefs is to amufe and divert themfelves. The married women have affairs to mind at home, and no hufbands to feek for; but they would not find their account in a reformation of this kind, which muft therefore drop to the ground, fince unfortunately it is they that take the lead. Mothers, at leaft, make your daughters your companions. Endeavour to give them a right fenfe of things, and an honeft heart; after which conceal nothing from their view, that is proper for a chafte eye to behold. Balls, affemblies, public fports, and even theatrical entertainments; in fhort, every thing that deludes imprudent youth, only by being beheld through a wrong medium, may, without rifk, be expofed to the view of a perfon of found judgment. The earlier they are made acquainted with thofe tumultuous pleafures, the fooner they will be furfeited with them.

But here we have raifed a very ftrong party againft us. "Where," fay they, "are the girls capable of refifting fuch temptations?" The very firft profpect of the world is fufficient to turn their heads, and to intoxicate them for ever; when once they have tafted its gaieties, they will never choofe to leave it. That may be; but before you have exhibited this deceitful reprefentation to their eye, *have you affifted them with preparatory inftructions, to behold it without emotion?* Have you given them proper notice of the objects it reprefents? Have you defcribed them in their real colours? Have you guarded them againft the illufions of vanity? Have you infufed into their youthful hearts a tafte for fuch folid pleafures, as are not to be found in thofe gaudy fcenes? What ftep have you taken to preferve them from that vicious tafte, by which they are corrupted? Perhaps, inftead of oppofing the public prejudices, which began to take root in their minds, you have rather encouraged them; you have excited their curiofity to fee every frivolous amufement. You have confirmed their tafte, or rather their folly, by initiating them into thofe pleafures. Many a young lady, upon coming into life, has no other directrefs or governante than her own mother, who is oftentimes more fimple and foolifh than her daughter, and confequently incapable of exhibiting the objects to her view in any other light, than as fhe beholds them herfelf. The mother's example and authority, more prevalent than reafon, juftifies the daughter in her own eye, and is a fufficient apology for her conduct. When we advife a mother to introduce her daughter into the world, it is under a fuppofition that fhe is to fhew it to her in *its real colours*.

But the mifchief is derived from a higher fource. Boarding fchools are the real fchools of coquetry, productive of the moft extravagant affectation, and of all the croffes and untoward accidents which befal the fair fex. As foon as the young women are taken out of thofe houfes, and introduced into the world, they find themfelves in their right element. They were educated for this kind of life; is it then at all furprifing they fhould like it fo well? To love a quiet domeftic life, it is neceffary to know it, and to have been, from the time of one's infancy, accuftomed to its fweets. The tafte for retirement is acquired only by having been brought up at home: and every woman who was not educated by her mother, will not choofe to educate her own children. But unfortunately there is no fuch thing, at prefent, as a private education in large cities. The mixture of companies is fo general, that there is no place of retreat; and people lead a public life even in their own houfes. By intermixing with all the world, they ceafe to have any idea of a family; they hardly know their own relations; they behave towards them as ftrangers; and the fimplicity of domeftic manners, together with that familiarity which ren-

dered it ſo endearing, is entirely exploded. Thus, even in their infancy, they imbibe a taſte for faſhionable pleaſures, and for the prevailing maxims of this degenerate age.

It would be by no means adviſeable that a mother ſhould bring her daughter to London, in order to ſhew her thoſe exhibitions which have proved ſo deſtructive to the ſex; but *when this happens*, it is certain, that either the young lady has had a bad education, or ſhe will be in no great danger. Thoſe who are poſſeſſed of taſte, good ſenſe, and the love of virtue, will not find thoſe repreſentations ſo alluring, as they appear to perſons deluded by their charms. The people in the Metropolis are apt to paſs their cenſure on thoſe giddy girls, who hurry away from the country, to learn the air and manners of the beau monde, and ſpend half a year in acquiring new modes, only to render themſelves ridiculous during the remainder of their lives. But who is it that takes notice of thoſe diſcreet young women, who are ſurfeited with all thoſe tumultuous pleaſures, and return to their reſpective countries, happy and content with their ſtate, upon comparing it with that of higher life? How many have been brought to the capital by their good-natured huſbands, and at liberty to ſettle there, yet have perſuaded the good men from any ſuch deſign, and returned back with greater cheerfulneſs than they expreſſed upon their firſt ſetting out? It is not known what a number of good people there are ſtill remaining, that have not bowed their knee to the idol, and who deſpiſe that prepoſterous worſhip. None but thoughtleſs, giddy girls, delight in noiſe; prudent women act a different part.

But if, notwithſtanding the general corruption and prejudice as well as the bad education of the fair ſex, there are ſeveral whoſe judgment has not yet been depraved, what muſt it be where their good ſenſe is confirmed by proper inſtructions, or, to ſpeak more correctly, where it is not altered by vicious principles? for the whole buſineſs conſiſts in preſerving or reſtoring the natural principles. It is not neceſſary for this purpoſe, to tire young girls to death with long diſcourſes, or to oblige them to liſten to dry lectures of morality. Moral preachings are to both ſexes the bane of education. Melancholy inſtructions are good for nothing but to make young people deteſt the doctrine, together with thoſe who deliver it. In ſpeaking to girls, there is no occaſion to frighten them with their duties, nor to increaſe the weight of that yoke, to which nature has already obliged them to ſubmit. In explaining their duties to them, be clear and preciſe; do not make them believe that the practice is a melancholy thing; do not aſſume a diſmal face yourſelf, nor an air of ſeverity. Whatever you intend to convey to the hearts of others, ought to come from your own; the catechiſm of their moral duties ſhould be as ſhort and as clear, but not ſo grave, as that of their religion. Let them ſee that thoſe very duties are the real ſource of all their pleaſures, and the foundation of all their rights. Is it ſo painful to love, in order to be beloved again; or to be amiable, with a view of being happy; to be worthy of eſteem, for the ſake of being obeyed; to act honourably, in hopes of meeting with honourable treatment? How engaging, how reſpectable are thoſe rights! how ſacred to the human heart, when a woman knows how to aſſert them properly! She has no occaſion to wait for years or old age to enjoy them. Her empire begins with her virtue; her charms are ſcarce unfolded, when her ſweet temper and modeſt carriage have already eſtabliſhed her dominion. Where is the man ſo brutiſh and inſenſible, as not to be diſarmed, and to alter the rudeneſs of his behaviour in the preſence of a young lady of ſixteen, amiable in her perſon, and prudent in her behaviour; who ſays but little, and pays attention to what others ſay; whoſe deportment is moſt decent, whoſe diſcourſe moſt reſerved, who is no way elated with her beauty, ſo as to forget either her ſex or her youth; who engages your favour even by her timidity, and attracts the reſpect which ſhe ſhows to all the world?

EDULCORATION, properly ſignifies the rendering ſubſtances more mild. Chemical edulcoration conſiſts almoſt always in taking away acids and other ſaline ſubſtances; and this is effected by waſhing the bodies to which they adhere in a large quantity of water. The waſhing of diaphoretic antimony, powder of algaroth, &c. till the water comes off quite pure and inſipid, are inſtances of chemical edulcoration.—In pharmacy, juleps, potions, and other medicines, are ſaid to be *edulcorated*, by adding ſugar or ſyrup to them.

EDWARDS (George), the father of all ornithologiſts, was born at Stratford in Suſſex, April 3, 1694. Being deſigned for buſineſs, he was put apprentice to a tradeſman in Fenchurch-ſtreet, London; but, meeting with ſome books of natural hiſtory, ſculpture, painting, &c. he loſt all taſte for the ſhop, and devoted himſelf to quite different objects. On the expiration of his apprenticeſhip, he conceived a deſign of travelling into foreign countries: in 1716 he viſited Holland, and two years after made a voyage to Norway. He contemplated the natural furniture of this curious region; and, what is worthy of attention, experienced in this almoſt barbarous country, an hoſpitality not to be found in general among people who reckon themſelves civilized and polite. He viſited other countries, for the ſame purpoſe of contemplating whatever is curious in nature and art; and, on his arrival in England, ſat cloſely down to his favourite ſtudy of natural hiſtory, which he cultivated with ſuch ſucceſs, as to become greatly diſtinguiſhed. In 1733, recommended by Sir Hans Sloane, he was choſen librarian of the college of Phyſicians, and had apartments in the college. He was eſteemed one of the moſt eminent ornithologiſts in this or any country. He publiſhed four volumes in 4to. of the "Hiſtory of Birds," 1743, 1747, 1750, 1751; and three more volumes in 4to. under the title of "Gleanings of Natural Hiſtory," in 1758, 1760, 1764. He died July 23, 1773, in his eighty-firſt year; after having become a fellow of the Royal and Antiquarian Societies of London; and alſo a member of many of the academies of ſciences and learning in different parts of Europe.

EDYSTONE LIGHT-HOUSE, lying off Plymouth harbour, was firſt erected by the corporation of the Trinity-houſe in 1696; in conſideration of which, the maſters, &c. of Engliſh ſhipping agreed to pay one penny a ton outwards and inwards. It was demoliſhed by the ſtorm of 1703, and re-erected by act of parliament in the 4th of queen Anne, and the ſame duty on tonnage of ſhips granted for its ſupport; which law was enforced on the 8th of June. It has been ſince deſtroyed and rebuilt.

EECKHOUT (Gerbrant Vander), hiſtory and portrait painter, was born at Amſterdam in 1621, and was a diſciple of Rembrandt; whoſe manner of deſigning, colouring, and pencilling, he imitated ſo nearly, that it is difficult to diſtinguiſh between ſeveral of his paintings and thoſe of his maſter. He

painted after nature, and with fuch a force as only nature can equal: his touch and his colouring are the fame as Rembrandt's; but he rather excelled him in the extremities of his figures. His principal employment was for portraits; and in thofe he was admirable: but he furpaffed all his contemporaries in the power he had of painting the mind in the countenance. But although Eeckhout painted portraits to fo great a degree of perfection, yet was he much more pleafed to paint hiftorical fubjects, and he executed them with equal fuccefs. In that ftyle his compofition is rich and full of judgment; the diftribution of his maffes of light and fhadow is truly excellent; and in the opinion of many connoiffeurs, he had more tranfparence in his colouring, and better expreffion than his mafter. He died in 1674.

EEL, in ichthyology, a fpecies of MURÆNA.

EEL-*fifhing*. See BOBBING and SNIGGLING.

The filver-eel may be catched with feveral forts of baits, as powdered-beef, garden-worms, minnows, hen-guts, fifh-garbage, &c. The moft proper time for taking them is in the night, faftening your line to the bank fides, with your laying-hook in the water: or a line may be thrown with a number of hooks, baited and plumbed, with a float to difcover where the line lies, that they may be taken up in the morning.

Microfcopic EELS. See ANIMALCULE.

EELS *in Vinegar*. See ANIMALCULE.

EEL-*Spear*, a forked inftrument with three or four jagged teeth, ufed for catching eels: that with the four teeth is beft, which they ftrike into the mud at the bottom of the river, and if it ftrike againft any eels it never fails to bring them up.

EFFARE', or EFFRAYE', in heraldry, a term applied to a beaft rearing on its hind-legs, as if it were frighted or provoked.

EFFECT, in a general fenfe, is that which refults from, or is produced by, any caufe. See CAUSE.

EFFEMINATE, *effeminati*, according to the vulgate, are mentioned in feveral parts of fcripture. The word is there ufed to fignify fuch as were confecrated to fome profane god, and proftituted themfelves in honour of him. The Hebrew word *kadefh*, tranflated *effeminatus*, properly fignifies *confecrated*, and hence was attributed to thofe of either fex, who publicly proftituted themfelves in honour of Baal and Aftarte. Mofes exprefsly forbids thefe irregularities among the Ifraelites; but the hiftory of the Jews fhows, that they were notwithftanding frequently practifed. Levit. xxiii. 18.

EFFENDI, in the Turkifh language, fignifies *mafter*: and accordingly it is a title very extenfively applied; as, to the mufti and emirs, to the priefts of mofques, to men of learning, and of the law. The grand chancellor of the empire is called *reis-effendi*.

EFFERVESCENCE, an inteftine motion excited between the parts of two bodies of different natures, when they reciprocally diffolve or act on each other. It is attended with bubbles, vapours, fmall jets of the liquid, and a hiffing noife; and thefe phenomena are occafioned by the air which at that time difengages itfelf. Sometimes alfo it is accompanied with a great degree of heat. This term we fometimes find confounded with *fermentation*, which is altogether a different thing.

EFFIGY, the portrait, figure, or exact reprefentation of a perfon. It is alfo ufed for the print or impreffion of a coin, reprefenting the prince's head who ftruck it.

EFFLORESCENCE, among phyficians, the fame with exanthema. See EXANTHEMA. In chemiftry, it denotes the formation of a kind of mealy powder on the furface of certain bodies. Efflorefcence is occafioned either by decompofition or drying. The efflorefcence which happens to cobalt and martial pyrites is of the firft; and that obferved on the cryftals of foffil alkali, Glauber's falt, &c. of the latter kind. An efflorefcence is fometimes alfo a fpecies of cryftallization, the nature of which is not well underftood; as, the beautiful vegetations which fhoot up from vitriolated tartar acidulated either with the vitriolic or nitrous acids, the faline fpiculæ which are obferved to fhoot from falt butter, &c.

EFFLORESCENTIA, in botany, from *efflorefco, to bloom*; the precife time of the year and month in which every plant fhows its firft flowers. Some plants flower twice a-year, as is common between the tropics; others oftener, as the monthly rofe. The former are called by botanifts *biferæ*; the latter, *multiferæ*. The time of flowering is determined by the degree of heat which each fpecies requires. Mezereon and fnow-drop produce their flowers in February; primrofe, in the beginning of March; the greater number of plants, during the month of May; corn, and other grain, in the beginning of June; the vine, in the middle of the fame month; feveral compound flowers, in the months of July and Auguft; laftly, meadow-faffron flowers in the month of October, and announces the fpeedy approach of winter. Grafs of Parnaffus always flowers about the time of cutting down the hay; and in Sweden, the different fpecies of thiftle, mountain-lettuce, fuccory, and balfam, feldom flower till after the fummer folftice: the countrymen even know, as by a kalendar, that the folftice is paft when thefe plants begin to produce their flowers. All plants are earlier in warm countries: hence fuch as are cultivated out of their native foil, never flower till the heat of the climate, or fituation into which they are removed, is equal to that under the influence of which they produced flowers in their own country. For this reafon, all exotics from warm climates are later in this country than many plants which it naturally produces.

In general, we may obferve, that the plants of the coldeft countries, and thofe produced on the mountains in all climates, being of equal temperature, flower about the fame time, viz. during our fpring in Europe. Plants that grow betwixt the tropics, and thofe of temperate climates, flower during our fummer. Plants of temperate climates, fituated under the fame parallel of latitude with certain parts of Europe, but removed much farther to the weft, fuch as Canada, Virginia, and Miffiffippi, do not produce flowers till autumn. Plants of temperate climates in the oppofite hemifphere to Europe, flower during our winter, which is the fummer of thefe regions. Linnæus and Adanfon have given a fketch of the different times in which plants flower at Upfal and Paris.

EFFLUVIUM, in phyfiology, a term much ufed by philofophers and phyficians, to exprefs the minute particles which exhale from moft, if not all, terreftrial bodies, in form of infenfible vapours.

EFFRONTES, in church-hiftory, a fect of heretics, in 1534, who fcraped their foreheads with a knife till it bled, and then poured oil upon the wound. This ceremony ferved them inftead of baptifm. They are likewife faid to have denied the divinity of the Holy Spirit.

EFFUSION, the pouring out of any liquid thing with fome degree of force. In the ancient heathen facrifices there were various effufions of wine and other liquors, called *libations*.

EFFUSION, or FUSION, in aftronomy, denotes that part of the fign Aquarius, reprefented on celeftial globes and planifpheres, by the water iffuing out of the urn of the water-bearer.

EFT, in zoology, the Englifh name of the common lizard. See BASILISCUS.

EGERIA, or ÆGERIA, a nymph held in great veneration by the Romans. She was courted by Numa Pompilius; and, according to Ovid, fhe became his wife. This prince fre-

quently visited her; and that he might introduce his laws and new regulations into the state, he solemnly declared before the Roman people, that they were previously sanctified and approved by the nymph Egeria. Ovid says, that Egeria was so disconsolate at the death of Numa, that she melted into tears, and was changed into a fountain by Diana. She is reckoned by many as a goddess who presided over the pregnancy of women; and some maintain that she is the same as Lucina.

EGG, in physiology, a body formed in certain females, in which is contained an embryo or fetus of the same species, under a cortical surface or shell. The exterior part of an egg is the shell; which in a hen, for instance, is a white, thin, and friable cortex, including all the other parts. The shell becomes more brittle by being exposed to a dry heat. It is lined every where with a very thin but a pretty tough membrane, which dividing at, or very near, the obtuse end of the egg, forms a small bag, where only air is contained. In new laid eggs this follicle appears very little, but becomes larger when the egg is kept.

Within this are contained the albumen or white, and the vitellus or yolk; each of which have their different virtues. The albumen is a cold, viscous, white liquor in the egg, different in consistence in its different parts. It is observed, that there are two distinct albumens, each of which is inclosed in its proper membrane. Of these one is very thin and liquid: the other is more dense and viscous, and of a somewhat whiter colour; but, in old and stale eggs, after some days incubation, inclining to a yellow. As this second albumen covers the yolk on all sides, so it is itself surrounded by the other external liquid. The albumen of a fecundated egg is as sweet and free from corruption, during all the time of incubation, as it is in new-laid eggs; as is also the vitellus. As the eggs of hens consist of two liquors separated one from another, and distinguished by two branches of umbilical veins, one of which goes to the vitellus, and the other to the albumen; so it is very probable that they are of different natures, and consequently appointed for different purposes. When the vitellus grows warm with incubation, it becomes more humid, and like melting wax or fat; whence it takes up more space. For, as the fetus increases, the albumen insensibly wastes away and condenses: the vitellus, on the contrary, seems to lose little or nothing of its bulk when the fetus is perfected, and only appears more liquid and humid when the abdomen of the fetus begins to be formed.

The chick in the egg is first nourished by the albumen; and when this is consumed, by the vitellus, as with milk. If we compare the chalazæ to the extremities of an axis passing through the vitellus, which is of a spherical form, this sphere will be composed of two unequal portions, its axis not passing through its centre; consequently, since it is heavier than the white, its smaller portion must always be uppermost in all positions of the egg. The yellowish white round spot, called *cicatricula*, is placed on the middle of the smaller portion of the yolk; and therefore, from what has just been said, must always appear on the superior part of the vitellus. Not long before the exclusion of the chick, the whole yolk is taken into its abdomen; and the shell, at the obtuse end of the egg, frequently appears cracked some time before the exclusion of the chick. The chick is sometimes observed to perforate the shell with its beak. After exclusion, the yolk is gradually wasted, being conveyed into the intestines by a small duct.

Eggs differ very much according to the birds that lay them, as to their colour, form, bigness, age, &c. Those most used in food are hens eggs; of which, such as are new-laid are best. As to the preservation of eggs, it is observed that the egg is always quite full when it is first laid by the hen; but from that time it gradually becomes less and less so, to its decay: and however compact and close its shell may appear, it is nevertheless perforated with a multitude of small holes, though too minute for the discernment of our eyes, the effect of which is a daily decrease of matter within the egg, from the time of its being laid; and the perspiration or evaporation is much quicker in hot weather than in cold. To preserve the egg fresh, therefore, there needs no more than to preserve it full, and stop its transpiration; the method of doing which is, by stopping up those pores with matter which is not soluble in watery fluids: and on this principle it is, that all kinds of varnish, prepared with spirit of wine, will preserve eggs fresh for a long time, if they are carefully rubbed all over the shell. Tallow, or mutton fat, is also good for this purpose; for such as are rubbed over with this, will keep as long as those coated over with varnish.

Artificial Method of Hatching EGGS. See HATCHING.

EGINHART, secretary to the emperor Charles the Great, was a German. He is the most ancient historian of that nation, and wrote very eloquently for a man of the 9th century. It is said, that he insinuated himself so far into the favour of Imma, daughter of Charles the Great, that he obtained from her whatever he desired. Charles the Great, having found out the intrigue, did not do as Augustus, who is thought to have banished Ovid because he believed him to be too much favoured by Julia; for he married the two lovers together, and gave them a fine estate in land.

EGLANTINE, in botany. See ROSA.

EGRA, a handsome and strong town of Bohemia, formerly imperial. It was taken by the French in 1742, but they were forced to evacuate it the next year. It contains a number of ingenious artists, and its mineral waters are famous. It is seated on the river Eger, 90 miles W. of Prague. E. lon. 12. 40. N. lat. 50. 9.

EGRET, in ornithology, a species of ardea. See ARDEA.

EGYPT, a country of Africa, 600 miles in length, and 250 in breadth, where broadest; bounded on the N. by the Mediterranean, on the S. by Nubia, on the E by the Red Sea and the isthmus of Suez, and on the W. by the deserts to the E. of Fezzan. The broadest part is from Alexandria to Damietta, and thence it gradually grows narrower, till it approaches Nubia. This country, so famous in history, has not an extent proportionable to the description the ancients have given of it; namely, that it contained 20,000 towns, or cities; that the number of the inhabitants amounted to several millions; that the kings kept armies of 300,000 men, and executed the prodigious works whose magnificent ruins are still remaining: but when we consider the fertility of the country, that not a foot of ground remained uncultivated, and that there was a great number of canals, which are now filled up, their accounts do not seem improbable. Egypt is divided into the Upper, the Middle, and the Lower; which last comprehends the Delta. Since Egypt has been under the dominion of the Turks, it has been governed by a bashaw, who resides at Cairo. Under him are inferior governors, in the several parts of this country; those in Upper Egypt are generally Arabs, who pay tribute to the Grand Signior, and make presents to the bashaw, living like little tyrants, and being frequently at war with each other. Beside these, there are several sheiks, who preside over particular places, and are masters of a few villages. Though the air of Egypt is naturally hot, and not very wholesome, it enjoys so many other advantages, that it has been always extremely populous. Their ancient kings governed Egypt, till Cambyses became master of it, 525 years B. C. and in their time all those wonderful structures were raised, which we cannot behold without astonishment. These are the pyramids, the labyrinth, the immense grottos of the Thebais; the obe-

lisks, temples, and pompous palaces; the lake Mœris, and the vast canals, which served both for trade, and to render the land fruitful. After this conquest, Cambyses demolished the temples, and persecuted the priests. This country continued under the Persian yoke till the time of Alexander the Great, who, having conquered Persia, built the city of Alexandria. He was succeeded by Ptolemy, the son of Lagus, 324 years B. C. Ten kings of that name succeeded each other, till Cleopatra, the sister of the last Ptolemy, ascended the throne; when Egypt became a Roman province, and continued so till the reign of Omar, the second calif of the successors of Mahomet, who drove away the Romans, after it had been in their hands 700 years. When the power of the califs declined, Saladine set up the empire of the Mamlouks, which became so powerful in time, that they extended their dominions over a great part of Africa, Syria, and Arabia. Last of all, Selim, a Turkish emperor, conquered Egypt. The present population of Egypt is computed at 2,300,000. The inhabitants are composed of four different races of people; the Turks, who *pretend* to be masters of the country; the Arabs, who were conquered by the Turks; the Cophts, who are descended from the first Egyptians that became Christians; and the Mamlouks, who were originally Circassian or Mingrelian slaves, but being the only military force, are the real masters of the country. Of these last, M. Volney observes, that during the 550 years they have been established in Egypt, not one of them has founded a subsisting family; not one family exists in the second generation; but all their children perish in the first or second year. The method of perpetuating them is the same as that by which they were established; that is, they are kept up by slaves transported from the original country. The Russians have, therefore, rendered a very important service to the Turks, by checking the traffick of slaves in Mount Caucasus. Egypt has been, for many years, distracted by the civil wars between the different contending beys, by which its 24 provinces were governed. The famous Hassan Ali, the Turkish admiral, gained several victories over them in 1786; but though he repressed, he could not totally subdue them; and the Ottoman power in this country is now supposed to be extremely precarious. Egypt has been ever noted for plenty of corn, and they had vineyards on the banks of the Nile; but since the Turks came, they are neglected. A considerable trade was carried on here in E. India commodities, till the Portuguese found the way round the Cape of Good Hope. However, the merchants of Europe visit the harbours in the Mediterranean, and import and export several sorts of merchandise; and from other parts the natives get elephants teeth, ebony, gold dust, musk, civet, ambergris, and coffee. The gold dust is brought from Negroland to Fez and Morocco, and thence to Cairo, over immense deserts. The principal commodities which the merchants purchase here, are coffee, senna, cassia, rhubarb, sal ammoniac, myrrh, saffron, saltpetre, aloes, opium, indigo, sugar, sandal wood, dates, cotton cloth, &c. The complexion of the Egyptians is tawny, and the farther S. the darker, insomuch, that those on the confines of Nubia are almost black. They are most of them indolent and cowardly. The richer sort do nothing all day but drink coffee, smoke tobacco, and sleep; and they are ignorant, proud, haughty, and ridiculously vain. M. Volney observes, that during eight months of the year, from March to November, the heat, to an European, is almost insupportable. During the whole of this season, the air is inflamed, the sky sparkling, and the heat oppressive to all unaccustomed to it. The other months are more temperate. The S. winds are by the natives called "poisonous winds," or "the hot winds of the deserts." They are of such extreme heat and aridity, that no animated body exposed to it can withstand its fatal influence. During the three days that it generally lasts, the streets are deserted; and woe to the traveller whom this wind surprises remote from shelter. When it exceeds three days, it is insupportable. The inhabitants are often almost blinded by drifts of sand. It rains very seldom in Egypt: but that want is happily supplied by the annual inundation of the Nile. When the waters retire, all the ground is covered with mud; then they only harrow their corn into it, without farther trouble, and, in the following March, they have usually a plentiful harvest. Their rice fields are supplied with water from canals and reservoirs; because rice never thrives but in watery grounds. There is no place in the world better furnished with corn, flesh, fish, sugar, fruits, and all sorts of garden-stuff; and in Lower Egypt they have oranges, lemons, figs, dates, almonds, cassia, and plantains, in great plenty. The sands are so subtile here, that they insinuate themselves into the closets, chests, and cabinets, which, together with the hot winds, are probably the cause of sore eyes being so very common here. The largest of the pyramids takes up ten acres of ground, and is, as well as the rest, built upon a rock; the external part is chiefly of large square stones, of unequal sizes, and the height of it about 700 feet. There are caverns, out of which they get the mummies, or embalmed dead bodies, which are found in coffins set upright in the niches of the walls, and have continued there at least 4000 years. Many of these have been brought to England, and were formerly deemed of great use in medicine. The animals found in Egypt are tigers, hyenas, antelopes, apes with the head like a dog's, camels, black cattle, fine horses, and large asses; crocodiles, which were once thought peculiar to this country; the hippopotamus, or river-horse; the camelion, and a kind of rat called ichneumon; ostriches, eagles, hawks, pelicans, water-fowls of all kinds, and the ibis, which resembles a duck, and was deified by the ancient Egyptians, on account of its destroying serpents and noxious insects. They have a serpent here called the cerastes, or horned viper (perhaps the aspic which Cleopatra employed to procure her death) whose bite is fatal to those who have not the secret of guarding against it. But both M. Volney and Mr. Bruce have expatiated on the curious subject of the incantation of serpents, and have no doubt of its reality: it is certainly alluded to in Holy Writ. (See Psal. lviii. 4, 5. Eccles. x. 11. and Jerem. viii. 17.) Some of the natives can play with the cerastes, which to them is perfectly harmless; for it will not attempt to bite them; but when applied to a hen, or any other animal, they have instantly bit and killed them; so that the secret certainly consisted, not in depriving the serpent of its noxious powers, but in some irresistible charm. The principal city is Cairo. Egypt lies between 20° and 36° E. lon. and 23° and 31° N. lat. For a description of those stupendous and almost indestructible monuments of human grandeur, the pyramids, so often taken notice of and described by travellers; see the article Pyramids.

EGYPTIANS, or Gypsies. See Gypsies.

EHRETIA, in botany; a genus of the monogynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 41st order, *Asperifoliæ*. The fruit is a bilocular berry; the seeds solitary and bilocular; the stigma emarginated.

EHRHARTA, in botany; a genus of the monogynia order, belonging to the hexandria class of plants. The calyx is a two-valved, abbreviated, and one-flowered glume; the corolla is a double glume, each two-valved; the exterior one compressed, and scymetar-shaped, transversely wrinkled, and gashed at the base. There are six stamina, three on each side the pistil, in a parallel line. The stigma is simple, compressed, four-tufted, and torn at the top.

EIA, or Ey, in our old writers, are used for an island. Hence the names of places ending in *ey*, denotes them to be

iſlands. Thus, Ramſey, the iſle of rams; Shepey, the iſle of ſheep, &c. Eia is alſo ſometimes uſed for water; and hence the names of places near waters or lakes terminate in *ey*.

EJACULATOR, in anatomy, a name applied to two muſcles of the penis from their office in the ejection of the ſeed.

EICETÆ, called alſo Heicetæ and Hicetæ, heretics of the ſeventh century, who made profeſſion of the monaſtic life. —From that paſſage in Exodus, where Moſes and the children of Iſrael are ſaid to have ſung a ſong in praiſe of the Lord, after they had paſſed the Red Sea, wherein their enemies had periſhed; the eicetæ concluded, that they muſt ſing and dance to praiſe God aright; and as Mary the propheteſs, ſiſter of Moſes and Aaron, took a drum in her hand, on the ſame occaſion, and all the women did the like, to teſtify their joy, by playing, beating, and dancing; the eicetæ, the better to imitate their conduct herein, endeavoured to draw women to them to make profeſſion of the monaſtic life, and aſſiſt in their mirth.

EICK. See Bruges.

EIDER-duck. See Anas.

Eider-*Down*. See Down.

EJECTA, a term uſed by lawyers for a woman deflowered or caſt from the ſociety of the virtuous.

EJECTION, in the animal economy, evacuation, or the diſcharging any thing through ſome of the emunctories, as by ſtool, vomit, &c.

EJECTMENT, in Engliſh law, a writ or action which lies for the leſſee for years, on his being ejected or put out of his land, before the expiration of his term, either by the leſſor or a ſtranger. It may alſo be brought by the leſſor againſt the leſſee, for rent in arrears, or holding over his term, &c. Ejectment of late years is become an action in the place of many real actions, as writs of right, formedons, &c. which are very difficult, as well as tedious and expenſive; and this is now the common action for trial of titles, and recovering of lands, &c. illegally held from the right owner; yet where entry is taken away by deſcents, fines, recoveries, diſſeiſins, &c. an ejectment ſhall not be brought; whereby we find that all titles cannot be tried by this action. The method of proceeding in the action of ejectment is to draw up a declaration, and feign therein a leaſe for three, five, or ſeven years, to him that would try the title; and alſo feign a caſual ejector or defendant; and then deliver the declaration to the ejector, who ſerves a copy of it on the tenant in poſſeſſion, and gives notice at the bottom for him to appear and defend his title; or that he the feigned defendant will ſuffer judgment by default, whereby the true tenant will be turned out of poſſeſſion; to this declaration the tenant is to appear at the beginning of next term by his attorney, and conſent to a rule to be made defendant, inſtead of the caſual ejector, and take upon him the defence, in which he muſt confeſs leaſe, judgment, entry, and ouſter, and at the trial ſtand upon the title only: but in caſe the tenant in poſſeſſion does not appear, and enter into the ſaid rule in time, after the declaration ſerved, then, on affidavit being made of the ſervice of the declaration, with the notice to appear as aforeſaid, the court will order judgment to be entered againſt the caſual ejector by default; and thereupon the tenant in poſſeſſion, by writ *habere facias poſſeſſionem*, is turned out of his poſſeſſion. On the trial in ejectment, the plaintiff's title is to be ſet forth from the perſon laſt ſeiſed in fee of the lands in queſtion, under whom the leſſor claims down to the plaintiff, proving the deeds, &c. and the plaintiff ſhall recover only according to the right which he has at the time of bringing his action. And here, another who hath title to the land, upon a motion made for that purpoſe, may be defendant in the action with the tenant in poſſeſſion, to defend his title; for the poſſeſſion of the lands is primarily in queſtion, and to be recovered, which concerns the tenant; and the title thereto is tried collaterally, which may concern ſome other.

ELÆAGNUS, Oleaster, or *Wild Olive*; a genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 16th order, *Calyciſloræ*. There is no corolla; the calyx is campanulated, quadrifid, ſuperior; the fruit is a plum below the campanulated calyx. There are three ſpecies: 1. The *ſpinoſa*, or eaſtern broad-leaved olive with a large fruit, is a native of the Levant and ſome parts of Germany. The leaves are about two inches long, and one and a half broad in the middle. They are placed alternate, and of a ſilver colour: at the footſtalk of every leaf there comes out a pretty long ſharp thorn, which are alternately longer: the flowers are ſmall, the inſide of the empalement is yellow, and they have a ſtrong ſcent when fully open. 2. The *inermis*, without thorns, is that kind commonly preſerved in the gardens of this country. The leaves are more than three inches long, and half an inch broad, and have a ſhining appearance like ſatin. The flowers come out at the footſtalks of the leaves, ſometimes ſingly, at other times two, and ſometimes three, at the ſame place. The outſide of the empalement is ſilvery and ſtudded: the inſide of a pale yellow, and having a very ſtrong ſcent. The flowers appear in July, and are ſometimes ſucceeded by fruit. 3. The *latifolia*, with oval leaves, is a native of Ceylon, and ſome other parts of India. In this country it riſes with a woody ſtem to the height of eight or nine feet, dividing into many crooked branches, garniſhed with oval and ſilvery leaves, which have ſeveral irregular ſpots of a dark colour on the ſurface. They are placed alternately on the branches, and continue all the year.

The two firſt may be propagated by laying down the young ſhoots in autumn. They will take root in one year; when they may be cut off from the old trees, and either tranſplanted into a nurſery for two or three years to be trained up, or into places where they are to remain. The proper time for this is in the beginning of March or early in the autumn. They ſhould be placed where they may be ſcreened from high winds; for they grow very freely, and are apt to be ſplit by the wind if they are too much expoſed. The third ſort is too tender to endure the open air of this country; and therefore muſt be kept in a warm ſtove, except during a ſhort time in the warmeſt part of the ſummer. From the flowers of theſe plants an aromatic and cordial water has been drawn, which is ſaid to have been ſucceſsfully uſed in putrid and peſtilential fevers. The genus elæagnus is not to be confounded with the oleaſter or wile olive of Gerard, Parkinſon, and Ray. The laſt is only a particular ſpecies of olive, called by Tournefort and Caſpar Bauhine *olea ſylveſtris*. See Olea.

ELÆOCARPUS, in botany; a genus of the monogynia order, belonging to the polyandria claſs of plants; and in the natural method ranking with thoſe of which the order is doubtful. The corolla is pentapetalous and lacerated; the calyx is pentaphyllous; and the fruit is a plum, with a wrinkled kernel.

ELÆOTHESIUM, in antiquity, the anointing-room, or place where thoſe who were to wreſtle or had bathed anointed themſelves. See Gymnasium.

ELAIS, in botany; a genus belonging to the natural order of *Palmæ*. The male calyx is hexaphyllous; the corolla ſexfid; the ſtamina ſix: The female calyx is hexaphyllous; the corolla hexapetalous; the ſtigma three; the fruit a fibrous plum, with a three-valved nut or kernel.

ELAPHEBOLIA, in Grecian antiquity, a feſtival in honour of Diana the huntreſs. In the celebration a cake was made in the form of a deer (λαφος), and offered to the goddeſs. It owed its inſtitution to the following circumſtance:

When the Phocians had been feverely beaten by the Theffalians, they refolved, by the perfuafion of one Deiphantus, to raife a pile of combuftible materials, and burn their wives, children, and effects, rather than fubmit to the enemy. This refolution was unanimoufly approved by the women, who decreed Deiphantus a crown for his magnanimity. When every thing was prepared, before they fired the pile, they engaged their enemies, and fought with fuch defperate fury, that they totally routed them, and obtained a complete victory. In commemoration of their unexpected fuccefs, this feftival was inftituted to Diana, and obferved with the greateft folemnity.

ELAPHEBOLIUM, in Grecian antiquity, the ninth month of the Athenian year, anfwering to the latter part of February and beginning of March. It confifted of 30 days; and took its name from the feftival elaphebolia, kept in this month, in honour of Diana the huntrefs, as mentioned in the preceding article.

ELASMIS, in natural hiftory, a genus of tales, compofed of fmall plates in forms of fpangles; and either fingle, and not farther fiffile; or, if complex, only fiffile to a certain degree, and that in fomewhat thick laminæ. Of thefe tales there are feveral varieties, fome with large and others with fmall fpangles, which differ alfo in colour and other peculiarities.

ELASTIC, in natural philofophy, an appellation given to all bodies endowed with the property of elafticity. See ELASTICITY.

ELASTIC *Fluids*. See AIR, ELECTRICITY, GAS, and ELASTIC *Vapours*, &c.

ELASTIC *Refin*. See CAOUTCHOUC.

ELASTIC *Vapours* are fuch as may, by any external mechanical force, be compreffed into a fmaller fpace than what they originally occupied; reftoring themfelves, when the preffure is taken off, to their former ftate with a force exactly proportioned to that with which they were at firft compreffed. Of this kind are all the aerial fluids without exception, and all kinds of fumes raifed by means of heat whether from folid or fluid bodies.

Of thefe, fome retain their elafticity only when a confiderable degree of heat is applied to them or the fubftance which produces them; while others remain elaftic in every degree of cold, either natural or artificial, that has yet been obferved. Of the former kinds are the vapours of water, fpirit of wine, mercury, fal ammoniac, and all kinds of fublimable falts; of the latter, thofe of fpirit of falt, mixtures of vitriolic acid and iron, nitrous acid, and various other metals, and in fhort the different fpecies of aerial fluids indifcriminately.

The elaftic force with which any one of thefe fluids is endowed has not yet been calculated, as being ultimately greater than any obftacle that we can put in its way. Thus, if we comprefs the atmofpherical air, we fhall find that for fome little time it will eafily yield to the force we apply; but every fucceeding moment the refiftance will become ftronger, and a greater and greater force muft be applied in order to comprefs it farther. As the compreffion goes on, the veffel containing the air becomes hot; but no power whatever has been able to deftroy the elafticity of the contained fluid in any degree; for upon removing the preffure, it is always found to occupy the very fame fpace that it did before. The cafe is the fame with aqueous fteam, to which a fufficient heat is applied to keep it from condenfing into water. This will yield to a certain degree; but every moment the refiftance becomes greater, until at laft, it will overcome any obftacle whatever. An example of the power of this kind of fteam we have every day in the fteam engine; and the vapours of other matters, both folid and fluid, have frequently manifefted themfelves to be endowed with an equal force. Thus the force of the vapours of fpirit of wine has occafioned terrible accidents when the worm has been ftopped, and the head of the ftill abfurdly tied down to prevent an explofion; the vapours of mercury have burft an iron box: and thofe of fal ammoniac, volatile falts, nitrous acid, marine acid, phofphorus, &c. have all been known to burft the chemical veffels which confined them with great force, in fuch a manner as to endanger thofe who ftood near them. In fhort, from innumerable obfervations, it may be laid down as an undoubted fact, that there is no fubftance whatever capable of being reduced into a ftate of vapour, but what in that ftate is endowed with an elaftic force ultimately fuperior to any obftacle we can throw in its way.

It hath been a kind of defideratum among philofophers to give a fatisfactory reafon for this aftonifhing power of elafticity in vapour, feemingly fo little capable of accomplifhing any great purpofe when in an unconfined ftate. As air is that fluid in which, from the many experiments made upon it by the air-pump and otherwife, the elaftic property has moft frequently been obferved, the refearches of philofophers were at firft principally directed towards it. The caufes they affigned, however, were very inadequate; being founded upon an hypothefis concerning the form of the particles of the atmofphere itfelf, which they fuppofed to be either rolled up like the fprings of watches, or that they confifted of a kind of elaftic flakes. This was followed by another hypothefis concerning their fubftance, which was imagined to be perfectly elaftic, and fo ftrong that they could not be broken by any mechanical power whatever; and thus they thought the phenomenon of the elafticity of the air might be explained. But an infuperable difficulty ftill attended their fcheme, notwithftanding both thefe fuppofitions; for it was obferved, that the elaftic power of the air was augmented not only in proportion to the quantity of preffure it was made to endure, but in proportion to the degree of heat applied to it at the time. Sir Ifaac Newton was aware of this difficulty; and juftly concluded, that the phenomena of the air's elafticity could not be folved on any other fuppofition but that of a repulfive power diffufed all around each of its particles, which became ftronger as they approached, and weaker as they removed from each other. Hence the common phenomena of the air-pump and condenfing-engine received a fatisfactory explanation; but ftill it remained to account for the power fhown in the prefent cafe by heat, as it could not be denied that this element had a very great fhare in augmenting the elafticity of the atmofphere, and feemed to be the only caufe of elafticity in other vapours. It does not appear that Sir Ifaac entered into this queftion, but contented himfelf with attributing to heat the property of increafing repulfion, and afcribing this to another unexplored property called *rarefaction*. Thus matters ftood till the great difcovery made by Dr. Black, that fome bodies have the power of abforbing in an unknown manner the element in queftion, and parting with it afterwards, fo that it flows out of the body which had abforbed it with the very fame properties it had before abforption. Hence many phenomena of heat, vapour, and evaporation, were explained in a manner much more fatisfactory than had ever been attempted or even expected before. One of thefe was that remarkable property of metals becoming hot by hammering; during which operation, in the Doctor's opinion, the element of heat is fqueezed out from between the particles of the metal as water is from the pores of a fponge by preffing it between the fingers. Of the fame nature is the phenomenon above mentioned, that air when violently compreffed becomes hot, by reafon of the quantity of more fubtle elements fqueezed out from among the particles. In this manner it appears that heat and the repulfive power of Sir Ifaac Newton are the very fame; that by diminifhing the heat of any quantity of air, its elafticity is effectually dimi-

niſhed, and it will of itſelf ſhrink into a ſmaller ſpace as effectually as by mechanical preſſure. In one caſe we have what may be called ocular demonſtration of the truth of this doctrine, viz. that by throwing the focus of a ſtrong burning lens upon a ſmall quantity of charcoal *in vacuo*, the whole will be converted into inflammable air, having even a greater power of elaſticity than common air in an equal degree of heat. Here there is nothing elſe but heat or light to produce the elaſtic power, or cauſe the particles of charcoal which before *attracted* now to repel each other. In another caſe we have evidence equally ſtrong, that the element of heat by itſelf, without the preſence of that of light, is capable of producing the ſame effect. Thus when a phial of ether is put into the receiver of an air-pump, and ſurrounded by a ſmall veſſel of water, the ether boils violently, and is diſſipated in vapour, while the water freezes, and is cooled to a great degree. The diſſipation of this vapour ſhows that it has an elaſtic force; and the abſorption of the heat from the water ſhows, that this element not only *produces* the elaſticity, but actually enters into the ſubſtance of the vapour itſelf; ſo that we have not the leaſt reaſon to conclude that there is any other repulſive power by which the particles are kept at a diſtance from one another than the ſubſtance of the heat itſelf. In what manner it acts, we cannot pretend exactly to explain, without making hypotheſes concerning the form of the minute particles of matter, which muſt always be very uncertain. All known phenomena, however, concur in rendering the theory juſt now laid down extremely probable. The elaſticity of the ſteam of water is exactly proportioned to the degree of heat which flows into it from without: and if this be kept up to a ſufficient degree, there is no mechanical preſſure which can reduce it into the ſtate of water. This, however, may very eaſily be done by abſtracting a certain portion of the latent heat it contains; when the elaſtic vapour will become a denſe and heavy fluid. The ſame thing may be done in various ways with the permanently elaſtic fluids. Thus the pureſt dephlogiſticated air, when made to part with its latent heat by burning with iron, is converted into a gravitating ſubſtance of an unknown nature, which adheres ſtrongly to the metal. If the decompoſition is performed by means of inflammable air, both together unite into an heavy, aqueous, or acid fluid: if by mixture with nitrous air, ſtill the heat is diſcernible, though leſs violent than in the two former caſes. The decompoſition is ſlower, but equally complete, and the dephlogiſticated air becomes part of the nitrous acid, from which it may be again expelled by proper means: but of theſe means heat muſt always be one; for thus only the elaſticity can be reſtored, and the air be recovered in its proper ſtate. The ſame thing takes place in fixed air, and all other permanently elaſtic fluids capable of being abſorbed by others. The concluſion therefore which we can only draw from what data we have concerning the compoſition of elaſtic vapours is, that all of them are formed of a terreſtrial ſubſtance, united with the element of heat in ſuch a manner that part of the latter may be ſqueezed out from among the terreſtrial particles; but in ſuch a manner, that as ſoon as the preſſure is taken off, the ſurrounding fluid ruſhes in, and expands them to their original bulk; and this expanſion or tendency to it will be increaſed in proportion to the degree of heat, juſt as the expanſion of a ſponge would be exceedingly augmented, if we could contrive to convey a ſtream of water into the heart of it, and make the liquid flow out with violence through every pore in the circumference. In this caſe, it is evident that the water would act as a *power of repulſion* among the particles of the ſponge, as well as the fire does among the particles of the water, charcoal, or whatever other ſubſtance is employed. Thus far we may reaſon from analogy; but in all probability the internal and eſſential texture of theſe vapours will for ever remain unknown. Their obvious properties, as well as ſome of their more latent operations in many caſes, are treated of under a variety of articles in this work, as AEROLOGY, EVAPORATION, VOLCANO, &c.

It has been imagined by ſome, that the artificial elaſtic fluids have not the ſame mechanical property with common air, viz. that of occupying a ſpace inverſely proportional to the weights with which they are preſſed: but this is found to be a miſtake. All of them likewiſe have been found to be non-conductors of electricity, though probably not all in the ſame degree. Even aqueous vapour, when intimately mingled with any permanently elaſtic fluid, refuſes to conduct this fluid, as is evident from the highly electrical ſtate of the atmoſphere in very dry weather, when we are certain that aqueous vapour muſt abound very much, and be intimately mixed with it. The colour of the electric ſpark, though it may be made viſible in all kinds of permanently elaſtic vapours, is very different in different fluids. Thus in inflammable and alkaline air it is red or purple, but in fixed air it appears white.

ELASTICITY, or ELASTIC *Force*, that property of bodies wherewith they reſtore themſelves to their former figure, after any external preſſure. The cauſe or principle of this important property is variouſly aſſigned. The Carteſians account for it from the materia ſubtilis making an effort to paſs through pores that are too narrow for it. But others, ſetting aſide the precarious notion of a materia ſubtilis, account for elaſticity from that great law of nature ATTRACTION, or the cauſe of the COHESION of the parts of ſolid and firm bodies. Thus, ſay they, when a hard body is ſtruck or bent, ſo that the component parts are moved a little from each other, but not quite disjointed or broke off, or ſeparated ſo far as to be out of the power of that attracting force whereby they cohere; they muſt certainly, on the ceſſation of the external violence, ſpring back to their former natural ſtate. Others reſolve elaſticity into the preſſure of the atmoſphere: for a violent tenſion, or compreſſion, though not ſo great as to ſeparate the conſtituent particles of bodies far enough to let in any foreign matter, muſt yet occaſion many little vacuola between the ſeparated ſurfaces; ſo that upon the removal of the force they will cloſe again by the preſſure of the aërial fluid upon the external parts. See ATMOSPHERE. Laſtly, others attribute the elaſticity of all hard bodies to the power of reſilition in the air included within them; and ſo make the elaſtic force of the air the principle of elaſticity in all other bodies.

The ELASTICITY *of Fluids* is accounted for from their particles being all endowed with a centrifugal force; whence Sir Iſaac Newton, prop. 23. lib. 2. demonſtrates, that particles, which naturally avoid or fly off from one another by ſuch forces as are reciprocally proportioned to the diſtances of their centre, will compoſe an elaſtic fluid, whoſe denſity ſhall be proportional to its compreſſion; and *vice verſa*, if any fluid be compoſed of particles that fly off and avoid one another, and hath its denſity proportional to its compreſſion, then the centrifugal forces of thoſe particles will be reciprocally as the diſtances of their centres.

ELASTICITY *of the Air*, is the force wherewith that element dilates itſelf, upon removing the force whereby it was before compreſſed. See AIR, and ATMOSPHERE. The elaſticity or ſpring of the air was firſt diſcovered by Galileo, who proved its exiſtence by the following experiment: If an extraordinary quantity of air be intruded by means of a ſyringe into a glaſs or metal ball, till ſuch time as the ball, with this acceſſion of air, weighs conſiderably more in the balance than it did before; upon opening the mouth thereof, the air ruſhes out, till the ball ſinks to its former weight. From hence we argue, that there is juſt as much air gone out, as compreſſed air had been crowded in. Air, therefore, returns to its former degree

of expanſion, upon removing the force that compreſſed or reſiſted its expanſion; conſequently it is endowed with an elaſtic force. It muſt be added, that as the air is found to ruſh out in every ſituation or direction of the orifice, the elaſtic force acts every way, or in every direction. The elaſticity of the air makes a conſiderable article in PNEUMATICS.

The cauſe of the elaſticity of the atmoſphere hath been commonly aſcribed to a repulſion between its particles; but this can give us only a very ſlight idea of the nature of its elaſticity. The term *repulſion*, like that of *attraction*, requires to be defined; and in all probability will be found in moſt caſes to be the effect of the action of ſome other fluid. Thus we find that the elaſticity of the atmoſphere is very conſiderably affected by heat. Suppoſing a quantity of air heated to ſuch a degree as is ſufficient to raiſe Fahrenheit's thermometer to 212, it will then occupy a conſiderable ſpace. If it is cooled to ſuch a degree as to ſink the thermometer to 0, it will ſhrink up into leſs than half the former bulk. The quantity of repulſive power therefore acquired by the air, while paſſing from one of theſe ſtates to the other, is evidently owing to the heat added to or taken away from it. Nor have we any reaſon to ſuppoſe, that the quantity of elaſticity or repulſive power it ſtill poſſeſſes is owing to any other thing than the fire contained in it. The ſuppoſing repulſion to be a primary cauſe independent of all others, hath given riſe to many erroneous theories, and been one very great mean of embarraſſing philoſophers in their accounting for the phenomena of ELECTRICITY.

ELATE, in botany, a genus belonging to the natural order of *Palmæ*. There is no male calyx; the corolla is tripetalous, with three ſtamina. There is no female calyx; the corolla is tripetalous, with one piſtil: the fruit is an oval acuminated plum.

ELATER, in zoology; a genus of inſects, belonging to the order of coleoptera. The antennæ are ſetaceous; and an elaſtic ſpring or ſpine projects from the hinder extremity of the breaſt or under ſide of the thorax. By means of this kind of ſpring, the animal, when turned upon his back, contrives to leap up into the air, and ſo turn itſelf. It varies in ſize; and when the inſect is young and newly metamorphoſed, its elytra are of a beautiful deep red; but in a few days they change to a much darker hue, and are nearly of a cheſnut colour. In the ſtate of larvæ it inhabits the trunks of decayed trees, and is there transformed. With the help of its wings it iſſues from its priſon, flutters upon flowers, wanders over the fields, and conceals itſelf in thickets or under the bark of trees.

ELATERIUM, in botany; a genus of the monandria order, belonging to the monœcia claſs of plants; and in the natural method ranking under the 34th order, *Cucurbitaceæ*. There is no male calyx; the corolla is ſalver-ſhaped; there is no female calyx; the corolla ſalver-ſhaped; the capſule inferior, unilocular, and bivalved.

ELATERIUM, Ελατηριον, in pharmacy, a violently purgative medicine, prepared from the juice of the wild cucumber.

ELATINE, in botany; a genus of the tetragynia order, belonging to the octandria claſs of plants; and in the natural method ranking under the 15th order, *Inundatæ*. The calyx is tetraphyllous; the petals four; the capſule quadrilocular, quadrivalved, and depreſſed.

ELATOSTEMA, in botany; a genus of the pentandria order, belonging to the monœcia claſs of plants. The male flowers have no calyx; the corolla is quinquepartite; the ſtamina are five filaments. There are female flowers on the ſame plant; theſe have no calyx nor corolla; the pericarpium is a very ſmall oblong, bivalve, monoſpermous capſule; the ſeeds are ſingle and egg-ſhaped.

ELBE, a large river in Germany, which, riſing on the confines of Sileſia, runs through Bohemia, Saxony, and Brandenburg; and afterwards dividing the duchy of Luxemburg from that of Mecklenburg, as alſo the duchy of Bremen from Holſtein, it falls into the German ocean, about 70 miles below Hamburg. It is navigable for great ſhips higher than any river in Europe.

ELBEUF, a town of France, in the department of Lower Seine and late province of Normandy. It has a manufacture of cloth, and is ſeated on the Seine, 10 miles S. of Rouen, and 65 N. W. of Paris. E. lon. 1. 8. N. lat. 49. 19.

ELBING, a handſome, rich, and ſtrong town of Weſtern Pruſſia, in the palatinate of Marienburg. It carries on a conſiderable trade, and the inhabitants are a mixture of Papiſts and Proteſtants. It is ſeated near the Baltic Sea, 30 miles S. E. of Dantzic, and 100 N. by W. of Warſaw. E. lon. 19. 35. N. lat. 54. 9.

ELBOW, the outer angle made by the flexure or bend of the arm. That eminence whereon the arm reſts, called by us *elbow*, is by the Latins called *cubitus*, by the Greeks *αγκων*, and by others ολεκρανον.

ELBOW is alſo uſed by architects, maſons, &c. for an obtuſe angle of a wall, building, or road, which diverts it from its right line.

ELCESAITES, in church-hiſtory, ancient heretics, who made their appearance in the reign of the emperor Trajan, and took their name from their leader Elceſai. The Elceſaites kept a mean between the Jews, Chriſtians, and Pagans; they worſhipped but one God, obſerved the Jewiſh ſabbath, circumciſion, and the other ceremonies of the law. They rejected the Pentateuch, and the prophets; nor had they any more reſpect for the writings of the apoſtles, particularly thoſe of St. Paul.

ELDERS, or SENIORS, in Jewiſh hiſtory, were perſons the moſt conſiderable for age, experience, and wiſdom. Of this ſort were the 70 men whom Moſes aſſociated to himſelf in the government of his people; ſuch, likewiſe, afterwards were thoſe who held the firſt rank in the ſynagogue, as preſidents. In the firſt aſſemblies of the primitive Chriſtians, thoſe who held the firſt place were called *elders*. The word *preſbyter*, often uſed in the New Teſtament, is of the ſame ſignification: hence the firſt councils of Chriſtians were called *preſbyteria*, or *councils of elders*.

ELDERS is alſo a denomination ſtill retained in the Preſbyterian diſcipline. The elders are officers, who, in conjunction with the paſtors, or miniſters, and deacons, compoſe the conſiſtories or kirk-ſeſſions, meeting to conſider, inſpect, and regulate, matters of religion and diſcipline. They are choſen from among the people, and are received publicly with ſome degree of ceremony. In Scotland, there is an indefinite number of elders in each pariſh; generally about 12. See KIRK-*Seſſions*, and PRESBYTERY.

ELDER, in botany. See SAMBUCUS.

ELEATIC PHILOSOPHY, among the ancients; a name given to that of the STOICS, becauſe taught at Ελεα, in Latin *Velia*, a town of the Lucani. The founder of this philoſophy, or of the Eleatic ſect, is ſuppoſed to have been Xenophanes, who lived about the 56th Olympiad, or between 500 or 600 years before Chriſt. This ſect was divided into two parties, which may be denominated *metaphyſical* and *phyſical*; the one rejecting, and the other approving, the appeal to fact and experiment. Of the former kind were Xenophanes, Parmenides, Meliſſus, and Zeno, of Elea. They are ſuppoſed to have maintained principles not very unlike thoſe of Spinoza. They held the eternity and immutability of the world; that whatever exiſted was only one being; that there was neither any generation nor corruption; that this one being was immoveable and immutable, and was the true God; and whatever

changes seemed to happen in the universe, they considered as mere appearances and illusions of sense. The other branch of the Eleatic sect were the atomic philosophers, who formed their system from an attention to the phenomena of nature; of these the most considerable were Leucippus, Democritus, and Protagoras.

ELECAMPANE, in botany. See Inula.

ELECT, from *eligo*, " I choose," in the Scriptures, is applied to the primitive Christians; in which sense, the elect are those chosen and admitted to the favour and blessing of Christianity.

Elect, in some systems of theology, is a term appropriated to the saints, or the predestinated: in which sense the elect are those persons who are said to be predestinated to glory as the end, and to sanctification as the means.

Elect is likewise applied to archbishops, bishops, and other officers, who are chosen, but not yet consecrated, or actually invested with their office or jurisdiction. The emperor is said to be elect before he is inaugurated and crowned; a lord-mayor is elect, before his predecessor's mayoralty is expired, or the sword is put in his hands.

ELECTION, the choice that is made of any thing or person, whereby it is preferred to some other. There seems this difference, however, between choice and election, that election has usually a regard to a company or community, which makes the choice; whereas choice is seldom used but when a single person makes it.

Election, in British polity, is the people's choice of their representatives in parliament. (See Parliament.) In this consists the exercise of the democratical part of our constitution: for in a democracy there can be no exercise of sovereignty but by suffrage, which is the declaration of the people's will. In all democracies, therefore, it is of the utmost importance to regulate by whom, and in what manner, the suffrages are to be given. And the Athenians were so justly jealous of this prerogative, that a stranger, who interfered in the assemblies of the people, was punished by their laws with death; because such a man was esteemed guilty of high treason, by usurping those rights of sovereignty to which he had no title. In Britain, says Blackstone, where the people do not debate in a collective body, but by representation, the exercise of this sovereignty consists in the choice of representatives. The laws have therefore very strictly guarded against usurpation or abuse of this power, by many salutary provisions; which may be reduced to these three points, 1. The qualifications of the electors. 2. The qualifications of the elected. 3. The proceedings at elections.

1. As to the qualifications of the electors. The true reason of requiring any qualification, with regard to property, in voters, is to exclude such persons as are in so mean a situation, that they are esteemed to have no will of their own. If these persons had votes, they would be tempted to dispose of them under some undue influence or other. This would give a great, an artful, or a wealthy man a larger share in elections than is consistent with general liberty. If it were probable that every man would give his vote freely, and without influence of any kind; then, upon the true theory and genuine principles of liberty, every member of the community, however poor, should have a vote in electing those delegates to whose charge is committed the disposal of his property, his liberty, and his life. But since that can hardly be expected in persons of indigent fortunes, or such as are under the immediate dominion of others, all popular states have been obliged to establish certain qualifications; whereby some, who are suspected to have no will of their own, are excluded from voting, in order to set other individuals, whose will may be supposed independent, more thoroughly upon a level with each other.

And this constitution of suffrages is framed upon a wiser principle with us, than either of the methods of voting, by centuries or by tribes, among the Romans. In the method by centuries, instituted by Servius Tullius, it was principally property, and not numbers, that turned the scale: in the method by tribes, gradually introduced by the tribunes of the people, numbers only were regarded, and property entirely overlooked. Hence the laws passed by the former method had usually too great a tendency to aggrandize the patricians or rich nobles: and those by the latter had too much of a levelling principle. Our constitution steers between the two extremes. Only such are entirely excluded as can have no will of their own: there is hardly a free agent to be found, but what is intitled to a vote in some place or other in the kingdom. Nor is comparative wealth, or property, entirely disregarded in elections; for though the richest man has only one vote at one place, yet, if his property be at all diffused, he has probably a right to vote at more places than one, and therefore has many representatives. This is the spirit of our constitution: not that we assert it is in fact quite so perfect as we have endeavoured to describe it; for if any alteration might be wished or suggested in the present form of parliaments, it should be in favour of a more complete representation of the people.

But to return to the qualifications; and first those of electors for knights of the shire. 1. By statute 8 Hen. VI. c. 7. and 10 Hen. VI. c. 2. (amended by 14 Geo. III. c. 58.) the knights of the shire shall be chosen of people, whereof every man shall have freehold to the value of forty shillings by the year within the county; which (by subsequent statutes) is to be clear of all charges and deductions, except parliamentary and parochial taxes. The knights of shires are the representatives of the landholders, or landed interest of the kingdom: their electors must therefore have estates in lands or tenements within the county represented. These estates must be freehold, that is, for term of life at least; because beneficial leases for long terms of years were not in use at the making of these statutes, and copyholders were then little better than villeins, absolutely dependent upon their lords. This freehold must be of 40 shillings annual value; because that sum would then, with proper industry, furnish all the necessaries of life, and render the freeholder, if he pleased, an independent man: For bishop Fleetwood, in his *Chronicon preciosum*, written at the beginning of the present century, has fully proved 40 shillings in the reign of Henry VI. to have been equal to 12 pounds *per annum* in the reign of Queen Anne; and, as the value of money is very considerably lowered since the bishop wrote, we may fairly conclude, from this and other circumstances, that what was equivalent to 12 pounds in his days, is equivalent to 20 at present. The other less important qualifications of the electors for counties in England and Wales may be collected from statutes 7 and 8 Will. III. c. 25. 10 Ann. c. 23. 2 Geo. II. c. 21. 18 Geo. II. c. 18. 31 Geo. II. c. 14. 3 Geo. III. c. 24. which direct, 2. That no person under 21 years of age shall be capable of voting for any member. This extends to all sorts of members as well for boroughs as counties; as does also the next, viz. 3. That no person convicted of perjury, or subornation of perjury, shall be capable of voting in any election. 4. That no person shall vote in right of any freehold, granted to him fraudulently to qualify him to vote. Fraudulent grants are such as contain an agreement to reconvey, or to defeat the estate granted; which agreements are made void, and the estate is absolutely vested in the person to whom it is so granted. And, to guard the better against such frauds, it is farther provided, 5. That every voter shall have been in the actual possession, or receipt of the profits, of his freehold to his own use for 12 kalendar months before; except

it came to him by defcent, marriage, marriage-fettlement, will, or promotion to a benefice or office. 6. That no perfon fhall vote in refpect of an annuity or rent-charge, unlefs regiftered with the clerk of the peace 12 kalendar months before. 7. That in mortgaged or truft-eftates, the perfon in poffeffion, under the abovementioned reftrictions, fhall have the vote. 8. That only one perfon fhall be admitted to vote for any one houfe or tenement, to prevent the fplitting of freeholds. 9. That no eftate fhall qualify a voter, unlefs the eftate has been affeffed to fome land tax aid, at leaft 12 months before the election. 10. That no tenant by copy of court-roll fhall be permitted to vote as a freeholder. Thus much for the electors in counties.

As for the electors of citizens and burgeffes, thefe are fuppofed to be the mercantile part or trading intereft of the kingdom. But as trade is of a fluctuating nature, and feldom long fixed in a place, it was formerly left to the crown to fummon, *pro re nata*, the moft flourifhing towns to fend reprefentatives to parliament. So that as towns increafed in trade, and grew populous, they were admitted to a fhare in the legiflature. But the misfortune is, that the deferted boroughs continued to be fummoned, as well as thofe to whom their trade and inhabitants were transferred; except a few which petitioned to be eafed of the expence, then ufual, of maintaining their members; four fhillings a-day being allowed for a knight of the fhire, and two fhillings for a citizen or burgefs; which was the rate of wages eftablifhed in the reign of Edward III. Hence the members for boroughs now bear above a quadruple proportion to thofe for counties; and the number of parliament men is increafed fince Fortefcue's time, in the reign of Henry VI. from 300 to upwards of 500, exclufive of thofe for Scotland. The univerfities were, in general, not empowered to fend burgeffes to parliament; though once, in 28 Edw. I. when a parliament was fummoned to confider of the king's right to Scotland, there were iffued writs, which required the univerfity of Oxford to fend up four or five, and that of Cambridge two or three, of their moft difcreet and learned lawyers for that purpofe. But it was king James I. who indulged them with the permanent privilege to fend conftantly two of their own body; to ferve for thofe ftudents who, though ufeful members of the community, were neither concerned in the landed nor the trading intereft; and to protect in the legiflature the rights of the republic of letters. The right of election in boroughs is various, depending entirely on the feveral charters, cuftoms, and conftitutions of the refpective places; which has occafioned infinite difputes: though now, by ftatute 2 Geo. II. c. 24. the right of voting for the future fhall be allowed according to the laft determination of the houfe of commons concerning it; and, by ftatute 3 Geo. III. c. 15. no freeman of any city or borough (other than fuch as claim by birth, marriage, or fervitude) fhall be intitled to vote therein, unlefs he hath been admitted to his freedom 12 kalendar months before.

2. Next, as to the qualifications of perfons to be *elected* members of the houfe of commons. Some of thefe depend upon the law and cuftom of parliament, declared by the houfe of commons; others upon certain ftatutes. And from thefe it appears, 1. That they muft not be aliens born or minors. 2. That they muft not be any of the 12 judges, becaufe they fit in the lords' houfe; nor of the clergy, for they fit in the convocation; nor perfons attainted of treafon, or felony, for they are unfit to fit any where. 3. That fheriffs of counties, and mayors and bailiffs of boroughs, are not eligible in their refpective jurifdictions, as being returning officers; but that fheriffs of one county are eligible to be knights of another. 4. That, in ftrictnefs, all members ought to have been inhabitants of the places for which they are chofen; but this, having been long difregarded, was at length entirely repealed by ftatute 14 Geo. III. c. 58. 5. That no perfons concerned in the management of any duties or taxes created fince 1692, except the commiffioners of the treafury, nor any of the officers following (viz. commiffioners of prizes, tranfports, fick and wounded, wine-licences, navy, and victualling; fecretaries or receivers of prizes; comptrollers of the army-accounts; agents for regiments; governors of plantations, and their deputies; officers of Minorca or Gibraltar; officers of the excife and cuftoms; clerks or deputies in the feveral offices of the treafury, exchequer, navy, victualling, admiralty, pay of the army or navy, fecretaries of ftate, falt, ftamps, appeals, wine-licences, hackney-coaches, hawkers, and pedlars), nor any perfons that hold any new office under the crown created fince 1705, are capable of being elected or fitting as members. 6. That no perfon having a penfion under the crown during pleafure, or for any term of years, is capable of being elected or fitting. 7. That if any member accepts an office under the crown, except an officer in the army or navy accepting a new commiffion, his feat is void; but fuch member is capable of being re-elected. 8. That all knights of the fhire fhall be actual knights, or fuch notable efquires and gentlemen as have eftates fufficient to be knights, and by no means of the degree of yeomen. This is reduced to a ftill greater certainty, by ordaining, 9. That every knight of a fhire fhall have a clear eftate of freehold or copyhold to the value of 600l. *per annum*, and every citizen and burgefs to the value of 300l.: except the eldeft fons of peers and of perfons qualified to be knights of fhires, and except the members for the two univerfities: which fomewhat balances the afcendant which the boroughs have gained over the counties by obliging the trading intereft to make choice of landed men: and of this qualification the member muft make oath, and give in the particulars in writing, at the time of his taking his feat. But, fubject to thefe ftanding reftrictions and difqualifications, every fubject of the realm is eligible of common right: though there are inftances, wherein perfons in particular circumftances have forfeited that common right, and have been declared ineligible *for that parliament*, by a vote of the houfe of commons; or *for ever*, by an act of the legiflature. But it was an unconftitutional prohibition, which was grounded on an ordinance of the houfe of *lords*, and inferted in the *king's* writs, for the parliament holden at Coventry, 6 Hen. IV. that no apprentice or other man of the law fhould be elected a knight for the fhire therein: in return for which, our law-books and hiftorians have branded this parliament with the name of *parliamentum indoctum*, or the lack-learning parliament; and Sir Edward Coke obferves with fome fpleen, that there was never a good law made thereat.

3. The third point, regarding elections, is the method of proceeding therein. This is alfo regulated by the law of parliament, and various ftatutes; all which we fhall blend together, and extract out of them a fummary account of the method of proceeding to elections.

As foon as the parliament is fummoned, the lord chancellor (or if a vacancy happens during the fitting of parliament, the fpeaker, by order of the houfe, and without fuch order if a vacancy happens by death in the time of a recefs for upwards of 20 days) fends his warrant to the clerk of the crown in chancery; who thereupon iffues out writs to the fheriff of every county for the election of all the members to ferve for that county, and every city and borough therein. Within three days after the receipt of this writ, the fheriff is to fend his precept, under his feal, to the proper returning officers of the cities and boroughs, commanding them to elect their members; and the faid returning officers are to proceed to election within eight days from the receipt of the precept, giving four days notice of the fame; and to return the perfons chofen, together with the precept, to the fheriff.

But elections of knights of the fhire muft be proceeded to

by the ſheriffs themſelves in perſon, at the next county-court that ſhall happen after the delivery of the writ. The county-court is a court held every month or oftener by the ſheriff, intended to try little cauſes not exceeding the value of 40s. in what part of the county he pleaſes to appoint for that purpoſe: but for the election of knights of the ſhire, it muſt be held at the moſt uſual place. If the county-court falls upon the day of delivering the writ, or within ſix days after, the ſheriff may adjourn the court and election to ſome other convenient time, not longer than 16 days, nor ſhorter than 10; but he cannot alter the place, without the conſent of all the candidates: and, in all ſuch caſes, 10 days public notice muſt be given of the time and place of the election.

And, as it is eſſential to the very being of parliament that elections ſhould be abſolutely free, therefore all undue influences upon the electors are illegal, and ſtrongly prohibited. For Mr. Locke ranks it among thoſe breaches of truſt in the executive magiſtrate, which, according to his notions, amount to a diſſolution of the government, "if he employs the force, "treaſure, and offices of the ſociety to corrupt the repreſenta-"tives, or openly to pre-engage the electors, and preſcribe "what manner of perſons ſhall be choſen: For thus to regu-"late candidates and electors, and new-model the ways of elec-"tion, what is it (ſays he) but to cut up the government by "the roots, and poiſon the very fountain of public ſecurity?" As ſoon, therefore, as the time and place of election, either in counties or boroughs, are fixed, all ſoldiers quartered in the place are to remove, at leaſt one day before the election, to the diſtance of two miles or more; and not to return till one day after the poll is ended. Riots likewiſe have been frequently determined to make an election void. By vote alſo of the houſe of commons, to whom alone belongs the power of determining conteſted elections, no lord of parliament, or lord-lieutenant of a county, hath any right to interfere in the election of commoners; and, by ſtatute, the lord warden of the cinque-ports ſhall not recommend any members there. If any officer of the exciſe, cuſtoms, ſtamps, or certain other branches of the revenue, preſumes to intermeddle in elections, by perſuading any voter or diſſuading him, he forfeits 100l. and is diſabled to hold any office.

Thus are the electors of one branch of the legiſlature ſecured from any undue influence from either of the other two, and from all external violence and compulſion. But the greateſt danger is that in which themſelves co-operate, by the infamous practice of bribery and corruption. To prevent which it is enacted, that no candidate ſhall, after the date (uſually called the *teſte*) of the writs, or after the vacancy, give any money or entertainment to his electors, or promiſe to give any, either to particular perſons, or to the place in general, in order to his being elected; on pain of being incapable to ſerve for that place in parliament. And if any money, gift, office, employment, or reward be given, or promiſed to be given, to any voter, at any time, in order to influence him to give or with-hold his vote, as well he that takes as he that offers ſuch bribe forfeits 500l. and is for ever diſabled from voting and holding any office in any corporation; unleſs, before conviction, he will diſcover ſome other offender of the ſame kind, and then he is indemnified for his own offence. The firſt inſtance that occurs of election bribery, was ſo early as 13 Eliz. when one Thomas Longe (being a ſimple man, and of ſmall capacity to ſerve in parliament) acknowledged that he had given the returning officer and others of the borough for which he was choſen four pounds to be returned member, and was for that premium elected. But for this offence the borough was amerced, the member was removed, and the officer fined and impriſoned. But as this practice hath ſince taken much deeper and more univerſal root, it hath occaſioned the making of theſe wholeſome ſtatutes; to complete the efficacy of which, there is nothing wanting but reſolution and integrity to put them in ſtrict execution.

Undue influence being thus guarded againſt, the election is to be proceeded to on the day appointed; the ſheriff or other returning officer firſt taking an oath againſt bribery, and for the due execution of his office. The candidates likewiſe, if required, muſt ſwear to their qualification, and the electors in counties to theirs; and the electors both in counties and boroughs are alſo compellable to take the oath of abjuration, and that againſt bribery and corruption. And it might not be amiſs, if the members elected were bound to take the latter oath as well as the former; which, in all probability, would be much more effectual than adminiſtering it only to the electors.

The election being cloſed, the returning officer in boroughs returns his precept to the ſheriff, with the perſons elected by the majority: and the ſheriff returns the whole, together with the writ for the county and the knights elected thereupon, to the clerk of the crown in chancery; before the day of meeting, if it be a new parliament, or within 14 days after the election, if it be an occaſional vacancy; and this under penalty of 500l. If the ſheriff does not return ſuch knights only as are duly elected, he forfeits, by the old ſtatutes of Henry VI. 100l.; and the returning officer in boroughs, for a like falſe return, 40l.; and they are beſides liable to an action, in which double damages ſhall be recovered, by the later ſtatutes of king William: and any perſon bribing the returning officer ſhall alſo forfeit 300l. But the members returned by him are the ſitting members, until the houſe of commons, upon petition, ſhall adjudge the return to be falſe and illegal. The form and manner of proceeding upon ſuch petition are now regulated by ſtatute 10 Geo. III. c. 16. (amended by 11 Geo. III. c. 42. and made perpetual by 14 Geo. III. c. 15.), which directs the method of chooſing by lot a ſelect committee of 15 members, who are ſworn well and truly to try the ſame, and a true judgment to give, according to the evidence.

Election *of Scots Peers*. See Lords.

Election *of Eccleſiaſtical Perſons*. Elections for the dignities of the church ought to be free, according to the ſtat. 9 Ed. II. cap. 14. If any perſons, that have a voice in elections, take any reward for an election in any church, college, ſchool, &c. the election ſhall be void. And if any perſons of ſuch ſocieties reſign their places to others for reward, they incur a forfeiture of double the ſum; and both the parties are rendered incapable of the place. Stat. 31 Eliz. cap. 6.

Election *of a Verderor of the Foreſt* (*electione viridariorum foreſtæ*), in law, a writ that lies for the choice of a verderor, where any of the verderors of the foreſt are dead, or removed from their offices. This writ is directed to the ſheriff, and the verderor is to be elected by the freeholders of the county, in the ſame manner as coroners. New. Nat. Brev. 365.

Election is alſo the ſtate of a perſon who is left to his own free will, to take or do either one thing or another, which he pleaſes. See Liberty.

Election, in theology, ſignifies the choice which God, of his good pleaſure, makes of angels or men, for the objects of mercy and grace. The election of the Jews was the choice God made of that people to be more immediately attached to his worſhip and ſervice, and for the Meſſiah to be born of them. And thus particular nations were elected to the participation of the outward bleſſings of Chriſtianity.

Election alſo, in the language of ſome divines, ſignifies a predeſtination to grace and glory, and ſometimes to glory only. And it has been enjoined as an article of faith, that predeſtination to grace is gratuitous, merely and ſimply ſo; *gratia, quia gratis data*. But the clergy are much divided as to the point, whether election to glory be gratuitous, or whether it ſuppoſes obedience and good works, *i. e.* whether it be before or after

the provifion of our obedience. See GRACE, and REPROBATION.

ELECTIVE, fomething that is done, or paffes, by election. See ELECTOR. Some benefices are elective, others collative. Municipal offices in England are generally elective; in Spain, venal. Poland, when it exifted as a kingdom, was elective.

ELECTIVE *Attraction*. See CHEMISTRY, p. 338. Since the very extenfive changes which have taken place in the fcience of Chemiftry, a feries of Tables of Elective Attractions have been compofed by Bergman. Thefe, notwithftanding their nonconformity to the *new chemical nomenclature*, we fhall here give in their original form, adding only the judicious changes made by Mr. Nicholfon from Morveau, whofe Table, likewife, of Affinities by *Numerical* Expreffion, we fhall introduce. Thefe, together, form a fort of epitome of the whole fcience of Chemiftry, and as fuch, are of confiderable importance.

Thefe tables require no other explanation, than that the fubftances enumerated are confidered to be fimple, as far as relates to the facts exhibited in thefe fketches. The order of pofition denotes that the higher any fubftance ftands in any column, the ftronger is its elective attraction to the fubftance at the head of that column. The under part of each table exhibits the attractions in the *dry* way, and muft be confidered as entirely diftinct from the upper part. The horizontal lines between the fubftances denote that their pofitions, or comparative powers of attraction, are well determined; and, whenever thefe lines are wanting, the pofitions are more or lefs conjectural.

TABLE I. Simple Elective Attractions.

ACIDS.

IN THE HUMID WAY.

VITRIOLIC ACID.	NITROUS ACID.	MARINE ACID.	FIXED AIR.	ACID OF BORAX.	ACID OF AMBER.	ACETOUS ACID DISTILLED.
Barytes	Vegetable alkali ?	Vegetable alkali ?	Barytes	Lime	Barytes	Barytes
Vegetable alkali	Mineral alkali ?	Mineral alkali ?	Lime	Barytes	Lime	Vegetable alkali
Mineral alkali	Barytes ?	Barytes ?	Vegetable alkali	Magnefia	Magnefia	Mineral alkali
Lime	Lime	Lime	Mineral alkali	Vegetable alkali	Vegetable alkali	Volatile alkali
Magnefia	Magnefia	Magnefia	Magnefia	Mineral alkali	Mineral alkali	Lime
Volatile alkali	Volatile alkali	Volatile alkali	Volatile alkali	Volatile alkali	Volatile alkali	Magnefia
Clay	Clay	Clay	Clay	Clay	Clay	Clay
Metallic calces	Metallic calces	Metallic calces	Metallic calces	Metallic calces	Metallic calces	Metallic calces
Water	Water	Water	Water	Water	Water	Water
Ardent Spirit	Ardent fpirit	Ardent fpirit	Ardent fpirit	Ardent fpirit	Ardent fpirit	Ardent fpirit
Phlogifton	Phlogifton	Phlogifton		Phlogifton	Phlogifton	Phlogifton
N. B. The fulphureous or volatile vitriolic acid follows the fame order in the humid way.	N. B. The fuming nitrous acid follows the fame order in the humid way.	N. B. The dephlogifticated or aërated marine acid follows the fame order in the humid way.	In the DRY WAY.	N. B. The fame order is followed by the acids of fugar or forrel; tartar; and lemon.	The order in which the metallic calces precipitate each other in acids, is the reverfe of that in the column of phlogifton, in Table IV.	
Phlogifton	Phlogifton	Phlogifton	PRUSSIAN ACID.			
Vegetable alkali	Barytes	Barytes	In the HUMID WAY	Lime	Barytes	Barytes
Mineral alkali	Vegetable alkali	Vegetable alkali	Vegetable alkali	Barytes	Lime	Vegetable alkali
Barytes	Mineral alkali	Mineral alkali	Mineral alkali	Magnefia	Magnefia	Mineral alkali
Lime	Lime	Lime	Volatile alkali	Vegetable alkali	Vegetable alkali	Lime
Magnefia	Magnefia	Magnefia	Lime	Mineral alkali	Mineral alkali	Magnefia
Metallic calces	Metallic calces	Metallic calces	Barytes	Metallic calces	Metallic calces	Metallic calces
Volatile alkali	Volatile alkali	Volatile alkali	Magnefia	Volatile alkali	Volatile alkali	Volatile alkali
Clay	Clay	Clay	Clay	Clay	Clay	Clay
		N. B. Aqua regia follows the fame order both in the humid and dry way.	Metallic calces	N. B. The fame order both in the humid and dry way is followed by the acids of fpar; of arfenic; of benzoin; of fugar of milk; of fat; and of phofphorus; except that phlogifton occupies the firft place in the dry way with the arfenical acid.		N. B. The fame order both in the humid and dry way is followed by the acids of milk and of ants.
			Water			

TABLE II. Simple Elective Attractions.

ALKALIS AND EARTHS.

IN THE HUMID WAY.

Veg. Alkali.	Min. Alkali.	Clay.	Lime.	Barytes.	Magnesia.
Vitriolic acid	This alkali agrees with the vegetable in the order of its attractions, both in the humid and the dry way.	Vitriolic acid	Acid of ſugar	Vitriolic acid	Acid of ſugar
Nitrous acid		Nitrous acid	Vitriolic acid	Acid of ſugar	Phoſphor. acid
Marine acid		Marine acid	Acid of tartar	Acid of amber	Vitriolic acid
Acid of fat		Acid of ſugar	Acid of amber	Acid of ſpar	Acid of ſpar
Acid of ſpar		Arſenical acid	Phoſphoric acid	Phoſphor. acid	Acid of fat
Phoſphor. acid		Sparry acid	A. of ſ. of milk	A. of ſ. of milk	Acid of arſenic
A. of ſugar		Acid of fat	Nitrous acid	Nitrous acid	A. of ſ. of milk
A. of tartar		Acid of tartar	Marine acid	Marine acid	Acid of amber
A. of arſenic		A. of amber	Acid of fat	Acid of fat	Nitrous acid
A. of amber		A. of ſ. of milk	Acid of ſpar	Acid of lemon	Marine acid
A. of lemon	Vol. Alkali.	Acid of lemon	Acid of arſenic	Acid of tartar	Acid of tartar
A. of ants		Phoſphoric acid	Acid of ants	Acid of arſenic	Acid of lemon
A. of milk	This alkali agrees with the vegetable in the order of its attractions, both in the humid and dry way: but mere heat expels it from the acids of phoſphorus, borax, and arſenic.	Acid of ants	Acid of milk	Acid of ants	Acid of ants
A. of benzoin		Acid of milk	Acid of lemons	Acid of milk	Acid of milk
Acetous acid		Acid of benzoin	A. of benzoin	A. of benzoin	Acid of benzoin
A. of ſ. of milk		Acetous acid	Acetous acid	Acetous acid	Acetous acid
Acid of borax		Acid of borax	Acid of borax	Acid of borax	Acid of borax
Vol. vitr. acid		Vol. vitr. acid	Vol. vitr. acid	Vol. vitr. acid	Vol. vitr. acid
Fuming nitr. a.		Fuming nitr. a.	Fuming nitr. a.	Fuming nitr. a.	Fuming nitr. a.
Fixed air		Fixed air	Fixed air	Fixed air	Fixed air
Pruſſian acid		Pruſſian acid	Pruſſian acid	Pruſſian acid	Pruſſian acid
Water			Water	Water	
Fat oils			Fat oils	Fat oils	
Sulphur			Sulphur	Sulphur	Sulphur
Metallic calces					

IN THE DRY WAY.

Veg. Alkali.	Silex.	Clay.	Lime.	Barytes.	Magnesia.
Phoſphor. acid	In the Humid Way.	Phoſphor. acid	Phoſphor. acid	Phoſphor. acid	Phoſphor. acid
Acid of borax	A. of ſpar	A. of borax	A. of borax	A. of borax	A. of borax
Acid of arſenic	Vegetable alkali	A. of arſenic	A. of arſenic	A. of arſenic	A. of arſenic
Vitriolic acid	In the Dry Way	Vitriolic acid	Vitriolic acid	Vitriolic acid	Vitriolic acid
Nitrous acid	Fixed alkali	Nitrous acid	A. of amber	A. of amber	A. of ſpar
Marine acid	Phoſphor. acid	Marine acid	Nitrous acid	A. of ſpar	A. of fat
Acid of fat	Calx of lead	A. of ſpar	Marine acid	Nitrous acid	A. of amber
Acid of ſpar		A. of fat	A. of fat	Marine acid	Nitrous acid
Acid of amber		A. of amber	A. of ſpar	A. of fat	Marine acid
Acid of ants		A. of ants	A. of ants	A. of ants	A. of ants
Acid of milk		A. of milk	A. of milk	A. of milk	A. of milk
Acid of benzoin		A of benzoin	A. of benzoin	A. of benzoin	A. of benzoin
Acetous acid		Acetous acid	Acetous acid	Acetous acid	Acetous acid
Barytes		Fixed alkali	Fixed alkali	Fixed alkali	Fixed alkali
Lime		Sulphur	Sulphur	Sulphur	Sulphur
Magneſia		Calx of lead	Calx of lead	Calx of lead	Calx of lead
Clay					
Silex					
Sulphur					

TABLE III. Simple Elective Attractions.

COMBUSTIBLE SUBSTANCES AND WATER.

IN THE HUMID WAY.

WATER.	SULPHUR.	SALINE LIVER OF SULPHUR.	ARDENT SPIRIT.	ETHER.
Vegetable alkali	Calx of lead	Calx of gold	Water	Ardent ſpirit
Mineral alkali	C. of tin	C. of ſilver	Ether	Eſſential oils
Volatile alkali	C. of ſilver	C. of mercury	Eſſential oils	Expreſſed oils
Ardent ſpirit	C. of mercury	C. of arſenic	Volatile alkali	Water
Mild volatile alk.	C. of arſenic	C. of antimony	Fixed alkali	Sulphur
Glauber's ſalt	C. of antimony	C. of biſmuth	Saline hepar	
Ether	C. of iron	C. of copper	Sulphur	
	Vegetable alkali	C. of tin		
	Volatile alkali	C. of lead		
	Barytes	C. of nickel		
	Lime	C. of cobalt		
	Magneſia	C. of manganeſe		
Vitriolic acid		C. of iron		
Vitriolated tartar	Fat oils			
Alum	Eſſential oils	Ardent ſpirit		
Martial vitriol	Ether	Water		
Corroſive ſublimate	Ardent ſpirit			

EXPRESSED OIL.	ESSENTIAL OIL.
Ether	Ether
Eſſential oils	Ardent ſpirit
Fixed alkalis	Fat oils
Vol. alkali	Fixed alkalis
Sulphur	Sulphur

IN THE DRY WAY.

SULPHUR.	SALINE LIVER OF SULPHUR.
Fixed alkalis	Manganeſe
Iron	Iron
Copper	Copper
Tin	Tin
Lead	Lead
Silver	Silver
Cobalt	Gold
Nickel	Antimony
Biſmuth	Cobalt
Antimony	Nickel
Mercury	Biſmuth
Arſenic	Mercury
	Arſenic

TABLE IV. Simple Elective Attractions.

PHLOGISTON AND METALS.

IN THE HUMID WAY.

Phlogiston.	Calx of Gold.	C. of Silver.	C. of Platina.	C. of Mercury.	C. of Lead.
Nitrous acid	Ether	Marine acid	Ether	Acid of fat	Vitriolic acid
Vitriolic acid	Marine acid	Acid of fat	Marine acid	Marine acid	Acid of fat
Dephl. marine a.	Aqua regia	Acid of sugar	Aqua regia	Acid of sugar	A. of s. of milk
Arsenical acid	Nitrous acid	Vitriolic acid	Nitrous acid	Acid of amber	A. of sugar
Phosphor. acid	Vitriolic acid	A. of s. of milk	Vitriolic acid	Arsenical acid	Arsenical acid
	Arsenical acid	Phosphor. acid	Arsenical acid	Phosphoric acid	Acid of tartar
C. platina	Sparry acid	Nitrous acid	Sparry acid	Vitriolic acid	Phosphor. acid
C. gold	Acid of tartar	Arsenical acid	Acid of tartar	A. of s. of milk	Marine acid
C. silver	Phosphor. acid	Sparry acid	Phosphor. acid	Acid of tartar	Nitrous acid
C. mercury	Acid of fat	Acid of tartar	Acid of fat	Acid of lemon	Sparry acid
C. arsenic	Prussian acid	Acid of lemon	Acid of sugar	Nitrous acid	Acid of lemons
C. antimony		Acid of ants	Acid of lemons	Sparry acid	Acid of ants
C. bismuth		Acid of milk	Acid of ants	Acetous acid	Acid of milk
C. copper		Acetous acid	Acid of milk	Acid of borax	Acetous acid
C. tin		Acid of amber	Acetous acid	Prussian acid	Acid of borax
C. lead		Prussian acid	Acid of amber	Fixed air	Prussian acid
C. nickel		Fixed air			Fixed air
C. cobalt	Fixed alkali				Fixed alkali
C. manganese	Vol. alkali	Vol. alkali			
C. iron					
C. zinc					
Water					

N. B. In the antiphlogistic theory, the column intitled *Phlogiston* being taken in a reversed order, will express the elective attractions of *Vital Air*.

IN THE DRY WAY.

	Gold.	Silver.	Platina.	Mercury.	Lead.
C. of platina	Mercury	Lead	Arsenic	Gold	Gold
C. gold	Copper	Copper	Gold	Silver	Silver
Acid of arsenic	Silver	Mercury	Copper	Platina	Copper
C. silver	Lead	Bismuth	Tin	Lead	Mercury
C. mercury	Bismuth	Tin	Bismuth	Tin	Bismuth
C. arsenic	Tin	Gold	Zinc	Zinc	Tin
C. antimony	Antimony	Antimony	Antimony	Bismuth	Antimony
C. bismuth	Iron	Iron	Nickel	Copper	Platina
C. copper	Platina	Manganese	Cobalt	Antimony	Arsenic
C. tin	Zinc	Zinc	Manganese	Arsenic	Zinc
C. lead	Nickel	Arsenic	Iron	Iron	Nickel
C. nickel	Arsenic	Nickel	Lead		Iron
C. cobalt	Cobalt	Platina	Silver		
C. manganese	Manganese		Mercury		
C. iron	Sa. liv. of sulph.	S. l. of sulphur	S. l. of sulphur	S. l. of sulph.	S. l. of sulphur
C. zinc		Sulphur		Sulphur	Sulphur

TABLE V. Simple Elective Attractions.

METALLIC SUBSTANCES.

IN THE HUMID WAY.

Calx of Copper.	Calx of Iron.	Calx of Tin.	Calx of Bismuth.	Calx of Nickel.	Calx of Arsenic.
Acid of fugar	Acid of fugar	Acid of fat	Acid of fugar	Acid of fugar	Marine acid
Acid of tartar	Acid of tartar	Acid of tartar	Acid of arfenic	Acid of forrel	Acid of fugar
Marine acid	Vitriolic acid	Marine acid	Acid of tartar	Marine acid	Vitriolic acid
Vitriolic acid	A. of f. of milk	Vitriolic acid	Phofphor. acid	Vitriolic acid	Nitrous acid
A. of f. of milk	Marine acid	Acid of fugar	Vitriolic acid	Acid of tartar	Acid of fat
Nitrous acid	Nitrous acid	Arfenical acid	Acid of fat	Nitrous acid	Acid of tartar
Acid of fat	Acid of fat	Phofphor. acid	Marine acid	Acid of fat	Phofphor. acid
Arfenical acid	Phofphor. acid	Nitrous acid	Nitrous acid	Phofphor. acid	Acid of forrel
Phofphor. acid	Arfenical acid	Acid of amber	Fluor acid	Fluor acid	Fluor acid
Acid of amber	Sparry acid	Sparry acid		A. of f. of milk	A. of f. of milk
Sparry acid	Acid of amber	A. of f. of milk		Acid of amber	Acid of amber
Acid of lemon	Acid of lemons	Acid of lemons		Acid of lemon	Acid of lemon
Acid of ants	Acid of ants	Acid of ants		Acid of ants	Acid of ants
Acid of milk	Acid of milk	Acid of milk		Acid of milk	Acid of milk
Acetous acid	Acetous acid	Acetous acid		Acetous acid	Arfenical acid
Acid of borax	Acid of borax	Acid of borax		Arfenical acid	Acetous acid
Pruffian acid	Pruffian acid	Pruffian acid		Acid of borax	
Fixed air	Fixed air			Pruffian acid	Pruffian acid
Fixed alkali		Fixed alkali		Aerial acid	
Vol. alkali		Vol. alkali		Volatile alkali	Volatile alkali
Fat oils					Unctuous oils
					Water

IN THE DRY WAY.

Copper.	Iron.	Tin.	Bismuth.	Nickel.	Arsenic.
Gold	Nickel	Zinc	Lead	Iron	Nickel
Silver	Cobalt	Mercury	Silver	Cobalt	Cobalt
Arfenic	Manganefe	Copper	Gold	Arfenic	Copper
Iron	Arfenic	Antimony	Mercury	Copper	Iron
Manganefe	Copper	Gold	Antimony	Gold	Silver
Zinc	Gold	Silver	Tin	Tin	Tin
Antimony	Silver	Lead	Copper	Antimony	Lead
Platina	Tin	Iron	Platina	Platina	Gold
Tin	Antimony	Manganefe	Nickel	Bifmuth	Platina
Lead	Platina	Nickel	Iron	Lead	Zinc
Nickel	Bifmuth	Arfenic	Zinc	Silver	Antimony
Bifmuth	Lead	Platina		Zinc	
Cobalt	Mercury	Bifmuth			
Mercury		Cobalt			
Sal. liv. of fulph.	S. l. of fulphur	S. l. of fulphur	S. l. of fulphur	S. l. of fulphur	S. l. of fulphur
Sulphur	Sulphur	Sulphur	Sulphur	Sulphur	Sulphur

TABLE VI. Simple Elective Attractions.

METALLIC SUBSTANCES.

IN THE HUMID WAY.

Calx of Cobalt.	Calx of Zinc.	Calx of Antimony	Calx of Manganese.	Calx of Wolfram
Acid of sugar	Acid of sugar	Acid of fat	Acid of sugar	Lime
Acid of sorrel	Vitriolic acid	Marine acid	Acid of sorrel	Vegetable alkali
Marine acid	Marine acid	Acid of sugar	Acid of lemon	Volatile alkali
Vitriolic acid	Acid of s. of milk	Vitriolic acid	Phosphoric acid	
Acid of tartar	Nitrous acid	Nitrous acid	Acid of tartar	
Nitrous acid	Acid of fat	Acid of tartar	Fluor acid	
Acid of fat	Acid of sorrel	Acid of sorrel	Marine acid	In the Dry Way.
Phosphoric acid	Acid of tartar	Acid of s. of milk	Vitriolic acid	Fixed alkali
Fluor acid	Phosphoric acid	Phosphoric acid	Nitrous acid	Lime
Acid of s. of milk	Acid of lemon	Acid of lemon	Acid of s. of milk	Calx of iron
Acid of amber	Acid of amber	Acid of amber	Acid of amber	Calx of manganese
Acid of lemon	Fluor acid	Fluor acid	Acid of fat	
Acid of ants	Arsenical acid	Arsenical acid	Arsenical acid	This column is additional. It is deduced from De Luyart's Analysis.
Acid of milk	Acid of ants	Acid of ants	Acid of ants	
Acetous acid	Acid of milk	Acid of milk	Acid of milk	
Arsenical acid	Acetous acid	Acetous acid	Acetous acid	
Acid of borax	Acid of borax	Acid of borax		
Prussian acid	Prussian acid	Prussian acid	Prussian acid	
Aerial acid	Aerial acid	Aerial acid	Aerial acid	
Volatile alkali	Volatile alkali			

IN THE DRY WAY.

Cobalt.	Zinc.	Antimony.	Manganese.	Wolfram.
Iron	Copper	Iron	Copper	Iron
Nickel	Antimony	Copper	Iron	Silver
Arsenic	Tin	Tin	Gold	Tin
Copper	Mercury	Lead	Silver	Lead
Gold	Silver	Nickel	Tin	Antimony
Platina	Gold	Silver		Bismuth
Tin	Cobalt	Bismuth		Manganese
Antimony	Arsenic	Zinc		Gold
Zinc	Platina	Gold		Platina
	Bismuth	Platina		
	Lead	Mercury		
	Nickle	Arsenic		
	Iron	Cobalt		
Saline liv. of sulph.		Sal. liv. of sulphur	Sal. liv. of sulphur	
Sulphur		Sulphur		

In the expreſſion of compound affinities, it is clear, from what has already been ſaid in this article, that theſe ſketches muſt either be made from actual experiment in every inſtance, or by deduction from the numerical expreſſions of the forces of attraction. We have explained ſome of the difficulties which oppoſe the deduction of theſe numbers: but as a conjectural ſet of numbers, inferred from ſuch facts as we poſſeſs, may be uſeful in many inſtances to point out the probability of decompoſitions previous to trial, we have here inſerted Mr. Morveau's table of the numerical expreſſion of affinity between the alkalis and ſoluble earths and the five principal acids.

TABLE VII.
Numerical Expreſſion of Affinities
by M. Morveau.

	Vitrio. Acid.	Nitr. Acid.	Marine Acid.	Acet. Acid.	Aë. A. or Fi. Air.
Ponde. earth	65	62	36	29	14
Veget. alk.	62	58	32	26	9
Min. alkali	58	50	28	25	8
Lime	54	44	20	19	12
Volatile alk.	46	38	14	20	4
Magneſia	50	40	16	17	6
Argil. earth	40	36	10	15	2

The method of exemplifying or exhibiting ſimple or compound affinities by ſymbols, according to Bergman, conſiſts in placing thoſe ſubſtances which are applied to each other upon the ſame horizontal line of direction; the component parts of the ſubſtances being placed at the two extremities of a vertical bracket; and the new products, if any, are placed one above the other, at the middle part of an horizontal bracket, connecting their component principles. This will be rendered clearer by an example.

I. Suppoſe magneſia to be preſented to a ſolution of vitriolated tartar, it will be found that no decompoſition takes place. Theſe facts are expreſſed as follows:

Vitriolated tartar
Vegetable alkali
Vitriolic acid — Magneſia

In the above ſcheme, the vitriolated tartar is placed oppoſite the point of a vertical bracket, and its two component parts, vegetable alkali and vitriolic acid, are placed within the extremities of the ſame bracket. Horizontally oppoſite the vitriolic acid is placed magneſia, to denote that it is preſented to that acid. And as theſe two ſubſtances are not connected by a bracket, it is to be underſtood from the ſcheme, that they do not unite, and conſequently that the vitriolated tartar remains undecompoſed.

II. On the contrary, if to a ſolution of Epſom ſalt the vegetable alkali be added, a decompoſition will enſue, which is expreſſed as follows:

Epſom ſalt
Magneſia
Vitriolic acid — Vegetable alkali
Vitriolated tartar

The arrangements in this ſcheme depend on the ſame principles as thoſe of the foregoing: but the bracket underneath the vitriolic acid, and vegetable alkali, denotes that theſe two ſubſtances unite, and form vitriolated tartar, which is accordingly placed beneath the middle of the bracket. The point of the bracket being turned up, is made to denote that the compound remains ſuſpended, or in ſolution. The magneſia is of courſe diſengaged; and half a bracket, with the point downwards, is placed over it, to denote that it falls to the bottom, or is precipitated.

III. The above inſtances exhibit ſimple elective attractions; but this method is more particularly applicable to the compound attractions; for example, ſuppoſe a ſolution of the ſalt of Sylvius be added to ſelenite, no decompoſition will take place. This is expreſſed as under:

Salt of Sylvius — Selenite
Vegetable alkali — Vitriolic acid
Marine acid — Lime

The want of horizontal brackets in this ſcheme denotes that the principles preſented to each other do not unite, and conſequently that no decompoſition enſues.

IV. On the contrary, if vitriolated tartar be preſented to the marine ſalt of lime, a mutual decompoſition will enſue; thus,

Salt of Sylvius
Vitriolated tartar — Marine ſalt of lime
Vegetable alkali — Marine acid
Vitriolic acid — Lime
Selenite

In this ſcheme, we ſee that the principles preſented to each other do unite, as is ſhewn by the horizontal brackets, and form the new compounds, ſalt of Sylvius and ſelenite; the former of which remains in ſolution, as is ſhewn by its bracket being turned upwards; while the latter, being nearly inſoluble, falls down, and is accordingly denoted by a bracket whoſe point is turned downwards.

V. By attentively obſerving this laſt ſcheme, it may be ſeen that the attractions exerted between the ſimple ſubſtances which are placed over each other, are the quieſcent affinities, and tend to preſerve the original combinations; whereas the attractions between the ſimple ſubſtances, which ſtand oppoſite to each other, are the divellent affinities, and tend to produce new combinations. If we were in poſſeſſion of complete tables of the numerical expreſſion of ſimple attraction, it is evident that we might foretel every reſult which might be produced by the application of compound ſubſtances to each other; and we ſhall ſee the utility of Mr. Morveau's Table, by applying the numbers to the preceding ſcheme.

Salt of Sylvius

Vitriolated tartar	Vegetable alkali	32	Marine acid.	Marine falt of lime
	62	+	20=82	
	Vitriolic acid	$\frac{54}{86}$	Lime	

Selenite

The attraction between the vegetable alkali and vitriolic acid is expreffed by the number 62; and the attraction between the marine acid and lime is expreffed by the number 20. Thefe are the quiefcent affinities, and their fum 82 expreffes the tendency to preferve the original forms of vitriolated tartar and marine falt of lime. On the other hand, the attraction between the vegetable alkali and marine acid is expreffed by 32, and the attraction between vitriolic acid and lime by 54. The fum of 32 and 54 amounts to 86, and expreffes the divellent affinities which tend to produce new combinations. And as this laft fum exceeds the fum of the quiefcent affinities, it follows that the double decompofition will take place.

VI. In thefe examples we have defignedly taken them the reverfe of each other; but every inftance, fingly exhibited, does in fact point out both the affirmative and the negative propofitions. Thus, from the fact firft exhibited, that magnefia does not decompofe the combination of vegetable alkali and vitriolic acid, it likewife follows, that the vegetable alkali does decompofe the combination of vitriolic acid and magnefia. And accordingly, in the two laft fchemes of double affinity, it is clearly afcertained, from the mutual decompofition of vitriolated tartar and marine falt of lime, that the falt of Sylvius and felenite will not decompofe each other.

The fame horizontal bracket, which in the humid way was ufed to denote folution, is ufed to denote fublimation in experiments by the dry way.

The following fchemes from Bergman will require no explanation, after the inftances we have exhibited.

Schemes of Elective Attractions in the Humid Way.

1. Vitriol. tartar: Vegetable alkali — 62 — Vitriolic acid 65 Ponder. earth; Vitriolated barytes

2. Vitriol. tartar: Vegetable alkali — 62 — Vitriolic acid 54 Lime

3. Comm. falt: Mineral alkali — 28 — Marine acid 32 Vegetable alkali; Salt of Sylvius

4. Marine falt of lime: Lime — 20 — Marine acid 28 Mineral alkali; Common falt

5. Marine falt of lime: Lime — 20 — Marine acid 14 Volatile alkali

6. Epfom falt: Vitriolic acid 62 Vegetable alkali — 50 — Magnefia; Vitriolated tartar

7. Corrof. fublim.: Marine acid 32 Vegetable alkali — Calx of mercury; Salt of Sylvius

8. Martial vitriol: Vitriolic acid 54 Lime — Calx of Iron; Selenite

9. Vitriol. tartar: Vitriolic acid — ☝ — Vegetab. alkali ☞ Nitrous acid; Vitriolated tartar with excefs of acid; Nitre

Vitriol. tartar: Vitriolic acid — ☝ — Vegetable alkali ☞ Acid of tartar; Vitriolated tartar with excefs of acid

11. Salt of Sylvius: Marine acid — ☝ — Vegetable alkali ☞ Acid of tartar

12. Comm. falt: Marine acid — 28 — Mineral alkali Acid of tartar

Schemes of Elective Attractions in the Humid Way.

13\. Borax
Quadrangular nitre
Mineral alkali 50 Nitrous acid
Acid of borax

14\. Selenite
Vitriolic acid
54
Lime — Acid of fugar

15\. Epfom falt
Vitriolic acid
50
Magnefia — Acid of fpar

16\. Nitr. falt of lime
Nitrous acid
44
Lime 54 Vitriolic acid
Selenite

17\. a. White arfenic
Marine acid
Phlogift. — Dephlog. mar. acid
Acid of arfenic

18\. b. White arfenic
Marine acid
Vital air — Vital air
Arfenic
Acrat. marine acid
Acid of arfenic

19\. Liv. of fulphur
Foliated tartar
Veget. alkali 26 Acetous acid
Sulphur

20\. Calcar. hepar
Selenite
Lime 54 Vitriolic acid
Sulphur

21\. Vitriol. tartar
Salt of Sylvius
Veget. alkali 32 Marine acid
62 + 20=82
Vitriol. acid 24
86
Marine f. of lime
Selenite

22\. Vitriol. tartar
Nitre
Veget. alkali 58 Nitrous acid
62
Vitriol. acid — Calx of lead
Nitrous falt of lead
Vitriolic falt of lead

23\. Salt of Sylvius
Veget. alkali 62 Vitriol. acid
32 + 54=86
20
82
Marine acid — Lime
Selenit.

24\. Vitriol. ammo.
Nitrous ammoniac
Volatile alkali 38 Nitrous acid
46
Vitriolic acid — Calx of mercury
Nitrous falt of mercur.
Vitriolic falt of mercury

25\. Comm. Salt
Quadrangular nitre
Mineral alkali — Nitrous acid
Marine acid — Silver
Nitrous falt of filver
Luna cornea

26\. Cream ota r.
Nitre
Veget. alkali — Acid of nitre
Acid of tartar — Calx of mercu.
Nitrous falt of mercur.
Tartareous falt of mercury

27\. Borax
Quadrangular nitre
Mineral alkali — Nitrous acid
Acid of borax — Calx of mercur.
Nitrous falt of mercur.

Schemes of Elective Attractions in the Humid Way.

	Acetous ſalt of magneſia		
28. Marine ſalt of magne.	Magneſia	Acetous acid	Acet. ſalt of ſilver
	Marine acid	Silver	
	Luna cornea		

	Vitriolic ſalt of lead		
29. Vitrio. ſalt of ſilver	Vitriolic acid	Lead	Plumb. corne.
	Silver	Marine acid	
	Luna cornea		

	Nitrous ſalt of copper		
30. Nitrous ſalt of ſilver	Nitrous acid	Copper	Marine ſalt of copper
	Silver	Marine acid	
	Luna cornea		

	Salt of Sylvius		
31. Comm. ſalt	Marine acid	Veget. alkali	Mild veget. alkali
	Mineral alkali	Fixed air	
	Mild mineral alkali		

	Salt of Sylvius		
32. Corroſ. ſublim.	Marine acid	Veget. alkali	Mild veget. alkali
	Calx of mercury	Fixed air	
	Aerated mercury		

	Quadrangular nitre		
33. Nitrous ſalt of lead	Nitrous acid	Mineral alkali	Mild mineral alkali
	Calx of lead	Fixed air	
	Aerated lead		

	Mild magneſia		
34. Epſom ſalt	Magneſia	Fixed air	Mild mineral alkali
	Vitriolic acid	Mineral alkali	
	Glauber's ſalt		

	Sal ammoniac		
35. Marine ſalt of lime	Marine acid	Volatil. alkali	Mild volatile alkali
	Lime	Fixed air	
	Chalk		

36. Tinct. of vege. alkali	Alcohol	Volatile alkali	Mild volatile alkali
	Vegetable alkali	Fixed air	
	Mild vegetable alkali		

	Nitrous ſalt of copper		
37. a Nitrous ſalt of ſilver	Nitrous acid	Calx of copper	Copper
	Calx of ſilver	Phlogiſton	
	Silver		

	Nitrous ſalt of copper	
37. b. Nitrous ſalt of ſilver	Nitrous acid	Copper
	Vital air	
	Silver	

	Martial vitriol		
38. a. Vitrio. ſalt of copper	Vitriolic acid	Calx of iron	Iron
	Calx of copper	Phlogiſton	
	Copper		

	Martial vitriol	
38. b. Vitrio. ſalt of copper	Vitriolic acid	Iron
	Vital air	
	Copper	

39. Liv. of ſulph.	Sulphur	Lead	Sugar of lead
	Fixed alkali	Acetous acid	
	Foliated ſalt		

	Nitre		
40. Solut. of wolf. in vegetable alkali	Veget. alkali	Nitrous acid	Nitrous acid
	Veget. alkali		
	Calx of wolfram	Nitrous acid	
	Compound ſalt, called Acid of tungſten by Scheele		

Schemes of Elective Attractions in the Dry Way.

1\. Vitriol. tartar
Vitriolic acid
Vegetable alkali — Phosph. acid

2\. Comm. salt
Marine acid
Mineral alkali — Nitrous acid
Quadrangular nitre

3\. Comm. salt
Marine acid
Mineral alkali — Acid of arsenic

4\. Sal ammo.
Marine acid
Volatile alkali — Vitriolic acid
Vitriolic ammoniac

5\. a. Marine acid
Dephlo. marine acid
Phlogiston — Calx of manganese

5\. b.
Aerated marine acid
Marine acid — Vital air
Manganese
Calx of manga.

6\. Sal ammo.
Volatile alkali
Marine acid — Lime
Marine salt of lime

7\. Cinnabar.
Mercury
Sulphur — Iron

8\. a. Arsenicated fixed al.
Regulus of arsenic
Arsenical acid — Phlogiston
Fixed alkali

8\. b. Arsenicated fixed al.
Aeriform fluid
Vital air — Combustib. matter
Arsenic (metallic)
Fixed alkali

9\. a. Phosp. volatile alkali
Volatile alkali
Acid of Phosph. — Phlogiston
Phosphorus

9\. b. Phosp. volatile alkali
Volatile alkali
Vital air — Combustible matter
Phosphorus

10\. Marine salt of lime
Marine acid — Volatile alkali
Lime

11\. Fluor spar
Lime
Acid of fluor — Vegetable alkali

12\. Alloy of gold with sil.
Silver — Sulphur
Gold

Schemes of Elective Attractions in the Dry Way.

13. Sulphated lead
Sulphur — Iron
Lead

14. Combination of silver with liver of sulphur
Alkali, Sulphur } Copper
Silver

15. a. Comm. salt
Marine acid — Phlogiston
Mineral alkali — Arsenical acid
} Metall. arsenic

15. b. Comm. salt
Marine acid — Arsenic
Mineral alkali

16. a. Corros. sublim.
Mercury
Calx of mercury — Phlogiston
Marine acid — Calx of antimony
} Antim. (metal)
Butter of antimony

16. b Corros. sublim.
Mercury
Vital air, Marine acid } Antimony
Butter of antimony

17. Vitriolated tartar
Vitriolic ammoniac
Vitriolic acid — Volatile alkali
Vegetable alkali — Acid of arsenic
} Arseni-cated volatile alkali
Neutral arsenical salt

18. Nitre
Nitrous ammoniac
Nitrous acid — Volatile alkali
Vegetable alkali — Vitriolic acid
} Vitriol. ammon.
Vitriolated tartar

19. a. Comm. salt
Corrosive sublimate
Marine acid — Calx of mercury
Mineral alkali — Vitriolic acid
} Vitriol. salt of mercu.
Glauber's salt

19. b. Comm. salt
Corrosive sublimate
Marine acid — { Mercury, Vital air
Mineral alkali — Vitriolic acid
} Vitriol. salt of mercu.
Glauber's salt

20. Sal ammo.
Mild volatile alkali
Volatile alkali — Fixed air
Marine acid — Lime
} Chalk
Marine salt of lime

21. Fluor spar
Acid of fluor — Vegetable alkali
Lime — Fixed air
} Mild vegeta. alkali
Chalk

22. Alloy of gold and copper
Copper — Sulphur
Gold — Antimony
} Crude antimony

We have inserted the whole of Bergman's schemes, excepting those numbered 25, 55, and 56; the former of which includes the acid of sorrel, at present known to be a compound; and the two last relate to experiments with the nitrous acid, which may be considered as doubtful, because a large part of the product assumes the permanently elastic state, and has not been examined. Our chief inducement for inserting all the others is, that the whole together form so considerable a body of chemical knowledge, expressed with so much perspicuity by virtue of this happy arrangement, that their value and effect cannot but greatly tend to promote the researches of experienced chemists, as well as the advancement of the learner. We have also inserted the numbers of Mr. Morveau, which answer as far as they can be applied; and the contemplation of those schemes which contain only partial numbers, will shew what experiments require to be made to extend them farther. For the new names, see the *Table*, CHEMISTRY, p. 474.

ELECTOR, a person who has a right to elect or choose another to an office, honour, &c. See ELECTION. The term *Elector* is particularly, and by way of eminence, applied to those princes of Germany in whom lies the right of electing

the emperor; being all sovereign princes, and the principal members of the empire.

The electoral college, consisting of all the electors of the empire, is the most illustrious and august body in Europe. Bellarmine and Baronius attribute the institution of it to pope Gregory V. and the emperor Otho III. in the tenth century; of which opinion are the generality of historians, and particularly the canonists: however, the number of electors was unsettled, at least, till the 13th century. In 1356 Charles IV. by the golden bull, fixed the number of electors to seven; three ecclesiastics, viz. the archbishops of Mentz, Treves, and Cologne; and four seculars, viz. the king of Bohemia, count Palatine of the Rhine, duke of Saxony, and marquis of Brandenburg. In 1648 this order was changed, the duke of Bavaria being put in the place of the count Palatine, who having accepted the crown of Bohemia was outlawed by the emperor; but being at length restored, an eighth electorate was erected for the duke of Bavaria. In 1692 a ninth electorate was created, by the emperor Leopold, in favour of the duke of Hanover, of the house of Brunswic Lunenburg. There is this difference between the secular and ecclesiastical electors, that the first have an active and passive voice, that is, may choose and be chosen; the last, an active only. The three archbishops are to be 30 years old, before they can be advanced to the dignity; the seculars, 18, before they can perform the office themselves. These last have each their vicars, who officiate in their absence. Besides the power of choosing an emperor, the electors have also that of capitulating with and deposing him; so that, if there be one suffrage wanting, a protest may be entered against the proceedings. By the right of capitulation, they attribute to themselves great privileges, as of making war, coining, and taking care of the public interest and security of the states; and the emperor promises, upon oath, to receive the empire upon these conditions.

The electors have precedence of all other princes of the empire, even of cardinals and kings; and are addressed under the title of *electoral highness*. Their several functions are as follow. The elector of Mentz is chancellor of Germany, convokes the states, and gives his vote before any of the rest. The elector of Cologne is grand chancellor of Italy, and consecrates the emperor. The elector of Treves is chancellor of the Gauls, and confers imposition of hands upon the emperor. The count Palatine of the Rhine is great treasurer of the empire, and presents the emperor with a globe at his coronation. The elector of Bavaria is great master of the imperial palace, and carries the golden apple. The marquis of Brandenburgh is grand chamberlain, and puts the ring on the emperor's finger. The elector of Saxony is grand marshal, and gives the sword to the emperor. The king of Bohemia is grand butler, and puts Charlemagne's crown on the emperor's head. Lastly, the elector of Hanover, now king of Great Britain, is arch-treasurer, though first erected under the title of *standard-bearer* of the empire.

ELECTORATE, a term used as well to signify the dignity of, as the territories belonging to, any of the electors of Germany; such are Bavaria, Saxony, &c. See Elector.

ELECTRIC, derived from ηλεκτρον, "amber," in physics, is a term applied to those substances, in which the electric fluid is capable of being excited, and accumulated without their having the property of transmitting it, and therefore called *non-conductors*. See Electricity.

ELECTRICITY,

THAT part of Natural Philosophy which proposes to investigate the nature of a certain property in bodies popularly called *electrical*.

Sect. I. *History of Electricity.*

THOUGH it is certain that, ever since the creation of the world, the electric fluid has had the same share in all the natural operations that it has at present; yet the discovery of its action, and even of its existence, is, comparatively speaking, of a very late date. Thales the Milesian, who lived about 600 years before Christ, was the first that observed the electrical properties of amber. Of these, indeed, he knew no more than that this substance would attract light bodies when it was rubbed. For 300 years after his time, we hear nothing farther concerning this subject. Theophrastus then tells us, that the *lyncurium* (the same substance now called the *tourmalin)* has the property of attracting light bodies, as well as amber. From this time, there is a chasm in the history of electricity for no less than 1900 years. Indeed, it is scarce to be supposed that during this long interval any person applied himself to the investigation of the subject; as, for the greatest part of it, science of every kind was almost totally extinguished. The electrical properties of jet, however, and, according to Mr. Bose, of the agate, were some way or other discovered during the abovementioned period. But it was not till the beginning of the 17th century that the subject of electricity became properly a distinct science, and the foundation was laid of those discoveries which have since taken place.

The first who can properly be called an *electrician*, was Dr. William Gilbert, who, in the year 1600, wrote a book *de Magnete*, which contains a variety of *electrical* experiments. All these, however, considered only the attractive property of certain substances. Dr. Gilbert's merit consists in his having been at great pains to find out a number of such substances, and thus considerably enlarging the number of electrics.

Till the year 1670 no farther discoveries were made; except some trifling additions to the catalogue of electrics. About this time Mr. Boyle applied himself to the study of electricity. He enlarged the catalogue of electrics, and found that their electric properties were increased by wiping and warming them before they were rubbed. He observed also, that all kinds of bodies were attracted promiscuously; and imagined that they were attracted *in vacuo* as well as in air. In this last position, however, Mr. Beccaria shews that Mr. Boyle must necessarily have been mistaken. He also observed the electric light, though only in the instance of some diamonds.

Otto Guericke, however, who was cotemporary with Mr. Boyle, improved the science much farther. He made use of a sulphur globe, whirled on an axis much in the same way with our present glass globes. Thus he could excite a vastly greater power of electricity than any of his predecessors, and try all their experiments to much more advantage. He discovered electric repulsion; and not only saw the electric light more clearly than Mr. Boyle, but heard the hissing sound with which it is emitted. He also made another remarkable discovery, but which has since been very generally overlooked; namely, that a feather, when repelled by an excited electric, always keeps the same face towards the body which repels it, as the moon does to the earth.

The next discovery of any moment was made by Sir Isaac

Newton; who obferved, that the electric attraction and repulfion penetrated through glafs; and it is much to be regretted that this accurate philofopher did not apply himfelf to the ftudy of electricity with greater affiduity.

In 1709 a treatife was written on electricity by Mr. Hauksbee; who not only far excelled all his predeceffors and cotemporaries, but alfo made fome difcoveries which well deferve the attention of the moft expert electricians at this day. Befides a variety of new experiments made upon electric attraction and repulfion, as well as the light emitted by electric bodies; he found a method of rendering opaque bodies tranfparent by means of electricity. He lined more than half the infide of a glafs globe with fealing-wax; and having exhaufted the globe, he put it in motion; when applying his hand to excite it, he faw the fhape and figure of all the parts of his hand diftinctly and perfectly, on the concave fuperficies of the wax within, juft as if only pure glafs without any wax at all had been interpofed between his eye and his hand. The lining of wax, where it was fpread the thinneft, would but juft allow the fight of a candle through it in the dark; but in fome places the wax was at leaft an eighth part of an inch thick. Yet, even in thefe places, the light and figure of his hand were as diftinguifhable through it as any where elfe. The fealing-wax did not adhere to the glafs in all places; but this made no difference with regard to the tranfparency. Pitch anfwered the purpofe equally well with fealing-wax.

Mr. Hauksbee alfo made a farther improvement, by ufing a glafs globe, which acts much more powerfully than a fulphur one After his death, however, not only the ufe of glafs globes, but even the ftudy of electricity itfelf, feems to have been pretty generally laid afide for fome time. The reafon of this was, that the recent difcoveries of Sir Ifaac Newton engroffed the attention of philofophers to fuch a degree, that they had no leifure for any thing elfe. After the death of that great man, however, the fcience of electricity began to revive; and, in 1729, a capital difcovery was made by Mr. Stephen Grey. This was, the diftinction between conductors and non-conductors of electricity. This difcovery, which was entirely accidental, and attended with feveral curious circumftances, was imparted foon after to Mr. Wheeler, by whofe fuggeftions, they accidentally ftumbled on the difcovery of the non-conducting power of filk. This curious circumftance was followed by a difcovery of the fame power in many other fubftances: and thus, in fact, the foundation of almoft all the fubfequent improvements in electricity was laid. Mr. Grey continued to ftudy electricity as long as he lived; and has given a fet of experiments, of which Dr. Prieftley fays, "It is not eafy to know what to make of them." He imagined that he had difcovered in all electric fubftances a *perpetual attractive power*, which required no kind of excitation either by heating, rubbing, or any kind of attrition. Some other experiments were made by Mr. Grey, with regard to the attraction of electric bodies *in vacuo*; and in this he determined with Mr. Boyle againft the opinion of Mr. Beccaria above mentioned. But the moft remarkable experiments mentioned by Mr. Grey, are his imitations of the planetary motions, which occafioned a great deal of fpeculation, and were faid to have been fuccefsfully repeated by Dr. Mortimer. It is more than probable, however, that both were deceived in a number of particulars; for no motion can be performed by an artificial excitation of the electric fluid, but what is attended with much irregularity.

Soon after Mr. Grey's difcovery of the difference between conductors and non-conductors of electricity, Mr. Du Fay difcovered the difference between pofitive and negative, or, as they were for fome time, and are now again called, the *vitreous* and *refinous* electricities. This difcovery was quite accidental. It was made in confequence of his cafually obferving, that a piece of leaf gold, repelled by an excited glafs tube, and which he meant to chafe about the room with a piece of excited gum copal, inftead of being repelled by it as it was by the glafs tube, was eagerly attracted. The fame was the cafe with fealing-wax, fulphur, rofin, and a number of other fubftances. He difcovered alfo, that it was impoffible to excite a tube in which the air was condenfed.

In the year 1742 the ufe of glafs globes was again introduced by Mr. Bofe, profeffor of philofophy at Wittemberg; though fome attribute this to Chriftian Auguftus Hanfen, profeffor of mathematics at Leipfic. He added alfo a prime conductor, which confifted of a tube of iron or tin. It was at firft fupported by a man ftanding upon cakes of rofin; but afterwards fufpended by filk lines horizontally before the globe. A bundle of thread was put into the end next to the globe, which not only prevented any injury to the glafs, but rendered the electricity ftronger.

The moft remarkable difcovery that hath yet been made in the fcience of electricity, was in the end of the year 1745, and beginning of 1746. This was the method of giving the electric fhock, or the accumulation of the power of electricity in a vial. This had its name of the *Leyden vial*, from Mr. Cunæus, a native of Leyden, who exhibited it as he was repeating fome experiments made by Meffrs. Mufchenbroek and Allamand, profeffors in the univerfity of that city. It is faid, he was not, however, the inventor. The merit of this difcovery (if any merit can arife from a difcovery made by accident) belongs to Mr. Van Kleift, dean of the cathedral at Camin. Soon after this, however, a method of giving the fhock was difcovered in Holland by Mr. Cunæus; and the difcovery of this powerful effect of the electric fluid immediately raifed the attention of all the philofophers in Europe. Many of them greatly exaggerated their accounts; either from a natural timidity, or their love of the marvellous. Mr. Mufchenbroek, who tried the experiment with a very thin glafs bowl, told Mr. Reaumur in a letter written foon after the experiment, That he felt himfelf ftruck in his arms, fhoulder, and breaft, fo that he loft his breath; and was two days before he recovered from the effects of the blow and the terror. He added, that he would not take a fecond fhock for the whole kingdom of France. Mr. Allamand, who made the experiment with a common beer-glafs, faid, that he loft his breath for fome moments; and then felt fuch an intenfe pain all along his right arm, that he was apprehenfive of bad confequences, but it foon after went off without any inconvenience, &c. Other philofophers, on the contrary, fhowed their heroifm and magnanimity, by receiving a number of electric fhocks as ftrong as they could poffibly make them. Mr. Bofe, above mentioned, wifhed that he might die by the electric fhock, in order to furnifh, by his death, an article for the memoirs of the academy of fciences at Paris. "But (adds Dr. Prieftley, from whom this account is taken) it is not given to every electrician to die in fo glorious a manner as the juftly envied Richman."

From the time of this difcovery, electricity became the general fubject of converfation. A number of people all over Europe got their livelihood by going about and fhowing the phenomena of it; and, at the fame time, the paffion for the marvellous ftrongly difcovered itfelf in fome effects of electricity, pretended to be found out in Italy and Germany. Mr. Nollet travelled into Italy, where he vifited all the gentlemen who had publifhed any account of thefe experiments. But though he engaged them to repeat their experiments in his prefence, and upon himfelf; and though he made it his bufinefs to get all the information he could concerning them; he returned fully convinced, that many things alleged of the electrical fluid were totally groundlefs. He was convinced, however, that

by electrification alone, feveral perfons had found confiderable relief in various diforders; particularly, that a paralytic perfon had been cured at Geneva, and that one who was deaf of an ear, another who had a violent pain in his head, and a woman with a diforder in her eyes, had been cured at Bologna; fo that from this time we may date the introduction of electricity into the medical art.

But the *identity* of the electrical matter with *lightning* was a difcovery of more practical ufe to mankind than any other. From almoft the firft difcovery of the electric light, and the crackling with which it is emitted, a fimilarity between it and the phenomena of thunder and lightning had been obferved. This is taken notice of by Dr. Wall, one of the firft who viewed the electric light in any perfect manner. The Abbé Nollet, Mr. Winckler, and others, alfo enumerated many refemblances between the phenomena of electricity and thofe of thunder; but they did not think of any method by which their fufpicions could be brought to the teft of experience. This was firft propofed by Dr. Franklin in 1750. He had before difcovered the effects of pointed bodies in drawing off the electric matter more powerfully than others. This was fuggefted to him by one Mr. Thomas Hopkinfon, who electrified an iron ball of three or four inches diameter with a needle faftened to it, expecting to draw a ftronger fpark from the point of it; but was furprifed to find little or none. Dr. Franklin, improving on this hint, difcovered that pointed rods of iron, fixed in the air when the atmofphere was loaded with lightning, drew from it the matter of the thunder-bolt, without noife or danger, into the body of the earth. Thus a new field was opened for philofophers; but it was foon found, that experiments of this kind were not always to be made without danger. In the fame year, 1752, the Abbé Nollet publifhed fome cautions to thofe who tried experiments on lightning. He had been informed by letters from Florence and Bologna, that fome people there had received violent fhocks while they drew fparks from an iron bar electrified by thunder. One of his correfpondents informed him, that once, as he was endeavouring to faften a fmall chain with a copper ball at one of its extremities to a great chain which communicated with the bar at the top of the building, there came a flafh of lightning which he did not fee, but which affected the chain with a noife like that of wild-fire. The obferver inftantly received fuch a fhock, that the ball fell out of his hands, and he was ftruck backwards four or five paces. The greateft inftance of the danger of thefe experiments, however, was the death of Mr. Richman profeffor at Peterfburgh; which happened on the 6th of Auguft 1753, as he was making experiments on lightning drawn into his own room. Since the difcovery of the identity of lightning and the electric matter, long rods of iron or other metal have been made ufe of with a view to protect buildings from the danger of ftrokes of lightning. A confiderable difpute has been carried on whether thefe rods ought to be pointed or not; but a committee of the royal fociety have, it feems, determined it in favour of the former.

For fome time, the fcience of electricity feems, comparatively fpeaking, to have been at a ftand. Numberlefs improvements indeed have been made upon what was before known; and the recent difcovery of an electric power refiding in the nerves of animals, feems to open a wide field not only of curious, but of ufeful inveftigation.

SECT. II. *Of Electrical Appearances.*

WE have juft now fhewn, that electricity, like moft other articles of fcience, has rifen from very fmall beginnings, and by very flow degrees, to its prefent height. It has been known for ages, that amber, jett, and other bodies, would, when rubbed, attract and repel light bodies, as hairs, feathers, down, duft, &c. and as this property was moft confpicuous in amber, which in the Greek is called *electron*, the peculiar power of that body was termed *electricity*. Upon further enquiry, it was found, that not amber only, but feveral other fubftances had the fame properties in a high degree; that glafs, refinous fubftances, filk, dry wood, &c. have the fame properties; and that any of thefe, when dry, and rubbed for a fhort time, would attract light fubftances very readily. When we rub a ftick of fealing-wax with foft flannel, it attracts any light fubftances, as hairs, feathers, &c. that are brought under it. If we rub a glafs tube with dry filk, it produces the fame effect. On darkening the room, and rubbing the glafs tube again, fparks of fire will follow the hand; prefent your finger to the tube, and thefe fparks will be formed into pencils or brufhes of light, attended with a crackling noife. The friction has, in thefe inftances, manifefted to the fenfes the exiftence of a fubftance that was before imperceptible. The body, that is made by friction to exhibit thefe appearances, is faid to be *excited*; and the appearances are termed figns of electricity.

If a fine downy feather be tied to a filk ftring, and electrified ftrongly, by touching it with the excited glafs tube, it immediately flies from, or is repelled by the glafs tube. If we now prefent an excited ftick of fealing-wax, the feather immediately flies towards it. Thus we fee, that what was attracted by excited wax, is on the other hand repelled by excited glafs. This experiment has given rife to a very important diftinction in electricity, implying a contrariety of agency. One power or agent has been denominated *vitreous*, and the other *refinous* electricity; and further difcoveries have fhown that glafs or wax will, according to the circumftances in which they are fituated, produce either of thefe powers.

From two other experiments we are alfo led to another very important diftinction in this branch of fcience. If we fufpend a brafs ball by a wire from that end of the glafs tube which is oppofite to the hand, and excite the tube as before; as foon as the tube is excited, it will appear, that the ball has acquired all the electric properties of the tube; and will, like it, attract light bodies, and give the fpark. If we now fufpend the ball by a filk ftring, and excite the tube as before; we may may now rub as long as we pleafe, but the ball will exhibit no figns of electricity. Here then we have two fubftances, through one of which, viz. the wire, the electric properties may be conveyed; whereas the other, that is, the filk, prevents their paffing to the ball. The wire is therefore called a *conductor*, and the filk a *non-conductor* of electricity: or, in more general terms, all thofe bodies, through which the electrical fluid is tranfmitted freely, are termed conductors. Thofe bodies, through which it does not pafs at all, or not fo freely, are called non-conductors.

When a body is placed entirely upon non-conductors, it is faid to be *infulated*. Thus, in the laft experiment, the ball was infulated, becaufe it was fufpended by a filk ftring, filk being a non-conductor. Infulation prevents the diffipation of the electrical fluid through the furrounding bodies.

SECT. III. *Principles of Electricity deduced from Experiments on Attraction and Repulfion.*

IT has been already fhewn, that a light body electrified by excited glafs, though repelled thereby, will be attracted by excited wax; and that, on the other hand, if it be electrified by excited wax, it will be repelled thereby, but will be attracted by excited glafs. This obfervation fhould be kept in mind, by all who defire to underftand the operations of electricity; for the greater part of the experiments, and the whole of the reafoning on the fubject, depend on a reference to thefe facts. For the following experiments, it is neceffary to make ufe of light balls formed out of the pith of elder. They

muſt be ſuſpended by fine linen threads from ſmall cylinders of wood, and inſulated upon a common wine glaſs, that is wiped dry and free from duſt.

If we electrify two balls, thus ſuſpended, by excited glaſs, they will repel each other; but we may deſtroy this electricity only by touching them with the finger. If again we electrify them, but with excited wax, they will again repel each other. But bring the balls electrified by wax towards thoſe electrified by glaſs, and they immediately fly towards each other. From theſe experiments we muſt neceſſarily infer, 1. That bodies electrified vitreouſly, repel each other. 2. That bodies electrified reſinouſly, repel each other. 3. That bodies electrified with contrary powers, attract each other.

Seeing that thoſe light ſubſtances which poſſeſs the ſame electric power repel each other, it will always be eaſy for us to diſcover with what power they are electrified. If they are repelled by excited glaſs, they poſſeſs the vitreous electricity; if they are attracted thereby they are reſinouſly electrified; on the contrary, thoſe attracted by excited wax are vitreouſly, and thoſe repelled thereby reſinouſly electrified. In aſcertaining the nature of the electric power, we are to avoid bringing the bodies to be tried ſuddenly near each other; or one ſtrongly electrified too near one that is weakly, ſo as that it may render the experiment doubtful, for reaſons that will ſoon be explained.

It may be proper in this place to point out the leading feature of Mr. Eeles's theory of electricity, which is what the reader will find adopted in the following pages. He conſiders all thoſe electrical operations that are manifeſt to the ſenſes, as occaſioned by two diſtinct, poſitive, and active powers, which equally and ſtrongly attract and condenſe each other; but when by any circumſtance they are rendered unequal to each other, the increaſed power expands into an atmoſphere. Theſe two powers exiſt together iu all bodies; in their natural ſtate they are always conjoined; the electric ſigns, or what we call electricity, are only rendered ſenſible to us by the ſeparation of theſe powers. In other words, though the electric matter is acting the moſt important part among the operations in nature, in its united, and to us latent and inviſible ſtate, yet it becomes no object to our ſenſes, till its powers are ſeparated and rendered unequal.

When the powers are ſeparated and brought into action, the increaſed power expands, and forms what may be termed an electrical atmoſphere. If any body be immerged in this atmoſphere, the powers thereof are ſeparated, and that which is of the ſame kind with the atmoſphere is repelled, while the contrary power is attracted: as long as the body remains immerged therein, the powers remain ſeparated. It is however to be obſerved, that, in exciting electrics, the powers are never entirely ſeparated. The diminiſhed power acts inward to the electric, while the increaſed power acts outward with an extenſive atmoſphere.

If we hold excited glaſs over a cylinder, as at fig. 1. pl. 10. but at a certain diſtance from it (which diſtance will depend upon the power of the glaſs); it will repel the vitreous electricity of the tube into the balls, which will diverge with vitreous electricity, and will of courſe recede from excited glaſs. But if we remove the excited glaſs from over the balls, they cloſe. A temporary ſeparation of the electric matter inherent in the cylinder, is in this inſtance produced by the influence of the excited glaſs; as ſoon as this influence is removed, the powers unite, and the balls come into contact.

If we now place two cylinders, with their ends in contact with each other (fig. 2. plate 10.) and hold the excited tube over the end A; each pair of balls diverge. While they are in this ſtate, ſeparate them one from the other, and you will find the balls of A to be vitreouſly electrified, and thoſe of B reſinouſly ſo; proving that, while the body remained immerged in the atmoſphere, the electric powers thereof were ſeparated, one being at each end. Bring the tubes together again, and the balls immediately cloſe; proving, 1. That the ſeparated powers attract each other. 2. That when united, they condenſe each other, and that all electric ſigns are immediately loſt. 3. The co-exiſtence of the two powers in the cylinders. Again electrify the balls equally, but with the ſame powers; then bring the end of the cylinders together, and the divergence of the balls will not be altered; wh ch ſhews, that equal atmoſpheres of the ſame kind do not act on each other.

If we hold an excited glaſs tube over the cylinder, (as at fig. 4.) and at the ſame time keep a finger in contact with the oppoſite end of the cylinder, removing the glaſs tube and finger together, the balls will diverge with reſinous electricity; for, on trying, we ſhall find them fly towards excited wax, and recede from excited glaſs. The vitreous power is repelled by the excited tube, and paſſes into the finger, which, in exchange, communicates reſinous electricity to the cylinder.

The tendency of an electric atmoſphere to produce the contrary electricity, in the bodies contiguous to it, is pleaſingly illuſtrated by the following experiment: In this, there are four cylinders, A, B, C, D, as at fig. 3. Excited glaſs held over A, repels the vitreous power into B, and draws the reſinous into A; in the ſame manner, B repels the vitreous power of C into D, and draws the reſinous into C; ſeparate B and D from A and C, juſt before the excited glaſs is removed, and A and C will be found poſſeſſing the reſinous, B and D the vitreous electricity; as will be evident on bringing the excited glaſs towards the balls: thoſe at A and C will move towards the glaſs, thoſe at B and D will recede from it.

In a former experiment, where the balls were equally electrified with contrary powers, it appeared, that on bringing the cylinders together, the powers united, and all electrical ſigns vaniſhed. But if one be electrified more than the other, that which is leaſt ſo loſes all its electricity after contact, and the two remain electrified with the exceſs of the electricity of that which was ſtrongeſt. From theſe experiments it appears, that the increaſed power expands itſelf, and acts outwards, and that in proportion to the ſubtraction of the other power; and that it is this ſphere of the expanded power which is called an electric atmoſphere. It further appears, that no ſubſtance ſeems to be electrified, while the powers are equal in or on that body; but in proportion as there is a greater quantity of one power, than there is of the other, then the increaſed power acts outwards from that body, and the body will be electrified with that power, and will repel any other body electrified with the ſame power; but will attract any ſubſtance electrified with the contrary power; and after contact between them, all electrical ſigns vaniſh, if they were equally electrified; but if unequally, both will remain electrified with the exceſs of the ſtrongeſt power. Theſe poſitions will be confirmed by other experiments, in which we ſhall witneſs the contrary directions of the two powers.

Sect. IV. *Of the Electrical Machine, and the proper Manner of working it.*

In proportion as the ſcience of Electricity has improved, ſo have been improved thoſe machines by which the exiſtence and phenomena of the electrical fluid have been demonſtrated. But no invention perhaps can claim ſo juſt a ſuperiority as the electrical machine and apparatus of that late worthy man and excellent philoſopher, Mr. George Adams, of Fleet Street, from whoſe writings we propoſe to draw many important parts of this treatiſe.

It is by turning the handle of the electrical machine, and of courſe the glaſs cylinder which moves with it, that the elec-

trical fluid is produced; and this we ſhall find, as before obſerved, of two kinds, each ſtrongly attractive of the other, though repulſive of a ſimilar kind: when united, the expanſive power they before exerted, is condenſed, and all electric ſigns vaniſh. To render theſe poſitions clear, inſert a wire into the cuſhion, and another into the conductor; each of theſe muſt be furniſhed with a braſs ball at top, and each of them alſo with a ſliding wire with balls on its end, that it may be ſet at any convenient diſtance from the other. On turning the cylinder, you obſerve, 1. That you can obtain an electric ſpark from the balls of either wire on preſenting your knuckle thereto. 2. That a ſtrong ſpark will paſs from one ball to the other. 3. That on holding a cork ball ſuſpended by ſilk, between the two braſs balls, it is alternately attracted and repelled from one to the other. 4. Electrify a pair of inſulated balls by the cuſhion, and you will find them to poſſeſs the reſinous electricity; electrify them by the conductor, and they will poſſeſs the vitreous power. 5. Join the balls together, and all electric ſigns vaniſh.

On the contrary, if you place both wires either on the conductor, or the cuſhion, you will find that no ſpark will paſs between them, that the cork ball remains ſtationary, being neither attracted nor repelled by the balls, and this becauſe they both poſſeſs the ſame kind of electricity. From theſe experiments we infer, that the conductor and the cuſhion are electrified with different powers; that one attracts what the other repels, and that, when they are united, they exhibit no ſigns of electricity; that, on the ſeparation of the powers by excitation, one power attaches itſelf to the excited electric, the other to the rubber.

In fact, the whole variety of electrical experiments appear to be nothing more than different modes of deſtroying or reſtoring an equilibrium. By deſtroying the equilibrium, two poſitive powers are at the ſame time produced. By reſtoring the equilibrium, all things return to their natural ſtate, and every appearance of electricity ceaſes. The two powers are ſo connected, that one can never be exhibited without producing the other. It is probable, that, in the general operations of nature, this fluid always acts in its united form, or that in which it is to our ſenſes latent and inviſible.

On turning the cylinder and ſeparating it from the ſilk, the electric power are ſeparated, the cylinder gives its reſinous power to the cuſhion in exchange for the vitreous; the conductor in like manner exchanges its powers with the cylinder; for as long as the cuſhion communicates with the table by a chain, and you continue turning the cylinder, you will find the conductor ſtrongly electrified with the vitreous power. Take the chain from the cuſhion, aud ſuſpend it from the conductor; on turning the cylinder you will find the cuſhion ſtrongly electrified with the reſinous power. Connect the cuſhion and conductor by a chain, and the powers reunite almoſt as ſoon as they are ſeparated, and the electrical ſigns diſappear.

Hence we ſee why conducting ſubſtances cannot be electrified unleſs they are inſulated. It is becauſe the two powers join inſtantaneouſly in the non-conductor, and can therefore exert no ſenſible action. When the cylinder is turned ſlowly, only a ſmall quantity of the fluid is excited, and it does not fly far in the form of a ſpark; but when we turn ſomewhat faſter, and make the black ſilk adhere to the glaſs, the quantity of excited electricity is conſiderably increaſed. The flaſh or ſpark paſſes through a greater ſpace, and aſſumes a crooked or zig-zag direction, reſembling the flaſhes of lightning. The brilliancy of the ſpark depends much on the preſſure of the atmoſphere; for the ſpark which explodes in air is vivid lightning; but if the ſame be tried in an exhauſted receiver, inſtead of a ſpark and exploſion, only a ſilent, faint diluted ſtream is produced.

But before we proceed to other experiments, it is neceſſary to explain the machine more fully, and ſhew in what way it may be excited moſt powerfully. The parts of the machine, which fall more immediately under our attention, are, 1. The electric, or the glaſs cylinder which is to be excited. 2. The mechanical contrivances by which it is put in motion. 3. The cuſhion and its appendages. 4. The conductor, or conductors. The glaſs cylinder of the machine, repreſented fig. 5, is put in motion by a ſimple winch. This is leſs liable to be out of order, than thoſe that are turned with a multiplying wheel, and alſo enables us to excite the machine more powerfully. The cylinder, F G H I, is ſupported by two ſtrong perpendicular pieces, D E. The axis of one cap of the cylinder moves in a ſmall hole at the upper part of one of the ſupports. The oppoſite axis paſſes through the upper part of the other ſupport. To this axis the winch or handle is fitted. The cuſhion is ſupported and inſulated by a glaſs pillar; the lower part of this pillar is fitted into a wooden ſocket, to which a regulating ſcrew is adapted, to increaſe or diminiſh the preſſure of the cuſhion againſt the cylinder. A piece of ſilk comes from the under edge of the cuſhion, and lies on the cylinder, paſſing between it and the cuſhion, and proceeding till it nearly meets the collecting points of the conductor. The more ſtrongly this ſilk is made to adhere to the cylinder, the ſtronger is the degree of excitation. Before the cylinder, or oppoſite to the cuſhion, is a metallic tube YZ, ſupported by a glaſs pillar L M. This is ſometimes called the prime conductor, often only the conductor. For the more conveniently trying experiments on the two powers, and exhibiting the different ſtates of the cuſhion and conductor, there are two wires to be fixed occaſionally, the one to the conductor, the other to the cuſhion; on the upper part of theſe, are balls furniſhed with ſliding wires, that they may be ſet apart from each other at different diſtances.

It will be neceſſary, before the electrical machine is put in motion, to examine thoſe parts which are liable to wear either from the friction of one ſurface againſt another, or to be injured by the dirt, that may inſinuate itſelf between the rubbing ſurfaces. If any grating or diſagreeable noiſe is heard, the place from whence it proceeds muſt be diſcovered, wiped clean, and rubbed over with a ſmall quantity of tallow; a little of which ſhould alſo be occaſionally applied to the axis of the cylinder itſelf. The ſcrews by which the frame is fixed ſhould alſo be examined, and if they are looſe, they ſhould be tightened.

Having examined the different parts of the machine, and put them in order, the glaſs cylinder, and the pillars which ſupport the cuſhion and conductor, ſhould be well wiped with a dry old ſilk handkerchief, to free them from the moiſture which glaſs attracts from the air, being particularly attentive to leave no moiſture on the ends of the cylinder, as any damp on theſe parts carries off the electric fluid, and leſſens the force of the machine: in very damp weather it will be proper to dry the whole machine, by placing it at ſome little diſtance from the fire.

Care ſhould be taken that no duſt, looſe threads, or filaments, adhere to the cylinder, its frame, the conductors, or their inſulating pillars; becauſe theſe will gradually diſſipate the electric fluid, and prevent the machine from acting powerfully. When you are ſatisfied of this, rub the glaſs cylinder firſt with a clean, coarſe, dry, warm cloth, or a piece of waſh leather, and then with a piece of dry, warm, ſoft ſilk; do the ſame to all the glaſs inſulating pillars of the machine and apparatus; theſe pillars muſt be rubbed more lightly than the cylinder, becauſe, being varniſhed, they may be damaged by too much friction.

It may be proper in ſome caſes to place a hot iron on the

foot of the conductor, in order to evaporate the moisture which would otherwise injure the experiments.

Observe that, 1. To excite the machine, it is requisite to clean the cylinder, and wipe the silk. 2. Grease the cylinder by turning it against a greasy leather, till it is uniformly obscured. The tallow of a candle will answer this purpose. 3. Turn the cylinder till the silk flap has wiped off so much of the grease as to render it semi-transparent. 4. Spread some amalgam on a piece of leather, and apply this against the turning cylinder. By this the friction will immediately increase, and the leather must not be removed until it ceases to become greater. 5. Remove the leather, and then the action of the machine will be very powerful. 6. The pressure of the cushion cannot be too small, when the excitation is well conducted.

The best kind of amalgam is that of Dr. Higgins, composed of zinc and quick-silver; if a little of the latter be added to melted zinc, it renders it easily pulverable, and more quicksilver must be added to the powder, if we want to make a very soft amalgam. It is apt to crystallize by keeping, which seems in some measure to be prevented by triturating it with a small proportion of grease: and it is always of advantage to triturate it before using.

Sect. V. *Of the Momentum of the Electrical Fluid.*

An object well worthy of being investigated is the great strength and velocity displayed by the electrical fluid in all its motions. If it be granted, as we shall endeavour to prove, that the electric matter is the same with the *solar fluid*, then will the *ultimate* cause of its momentum be the power by which the light of the sun is propagated, the pressure of which being equal all round upon all bodies, it can neither move them one way nor the other. But if by means of any other power, this pressure is lessened upon any particular part, the current of matter will set forwards towards that place, with a force proportioned to the diminution of the pressure. Thus, in the common experiments of the air-pump, when the air is exhausted from the receiver, the pressure of the superincumbent atmosphere is directed towards every part of the glass, so that if it be of a flat square shape and not very strong, it will certainly be broken. Now there is reason to suppose, that after the air is exhausted from the receiver, it is full of another subtil fluid of the same nature with the electric. If this could also be extracted from the receiver, the pressure on its sides would be much greater, because not only the atmosphere, but the whole surrounding ether, would press forward towards that place; and it is not probable, that any force whatsoever would be capable of resisting this pressure.

It is plain, therefore, that the momentum of the electrical fluid depends on two causes, the pressure of the atmosphere upon the electric matter, and the pressure of one part of this matter upon another, which is extended throughout the immensity of space. The force and velocity of the fluid depend, therefore, in a great measure, on that which surrounds us. There is a certain state of this fluid, that we violate by our experiments: when this violation is small, the powers of nature operate gently in restoring the disorder we have introduced; but when any considerable deviation is occasioned, the same powers restore the original constitution with great violence and rapidity.

Sect. VI. *Experiments on Electrical Attraction and Repulsion.*

If to the top of a wire we affix three large downy feathers by means of three linen threads, and insert the lower end of the wire into the prime conductor of the machine; upon turning the cylinder, the plumage expands every way, the threads also recede as far as possible from each other. If a finger approaches near to the feathers, all the plumulæ bend towards it; if the finger move this way or that, they all move after it as if alive. If the other hand be put on the conductor, immediately the threads lose their divergence, the plumulæ collapse, and fall close together. Again, on taking the hand away, the threads diverge, and the feathers expand as at first.

On this phenomenon, we can only state those facts which must concur to occasion it. We know that those light bodies which possess the same kind of electricity separate from, or repel each other; the finger communicates to them the contrary power; towards this, therefore, they are impelled by their nature, in order to restore an equilibrium which our operations have destroyed. By putting the hand on the conductor, the powers are immediately exchanged and united, and the electrical effects cease.

Let us place a cork ball, suspended by silk, so that it may be even with the conductor, and at about six inches from it. On turning the machine, the cork remains quiet; touch it with the end of a wire, and the vitreous power of the ball is driven into you, and an equal quantity of the *resinous* is communicated to the ball, which will then therefore fly with great rapidity towards the conductor. Direct the pointed end of the wire towards the ball, and it will keep it fixed to the conductor, by continually supplying it with the resinous power: remove the wire; and the ball, parting with its resinous power to the conductor, in exchange for the vitreous, of which the conductor has the greatest quantity, becomes electrified therewith, and repelled from the conductor.

An experiment analogous to the foregoing, is the following, with a piece of linen thread, which, from the vivacity of its motions, is termed the *animated thread*. For this purpose if you present a fine thread towards the electrified conductor, it will fly backwards and forwards, in a very pleasing manner, according as it conveys the vitreous power to the hand, or the resinous to the conductor, to which it will sometimes be affixed, for the same reason as the ball in the preceding experiment. Let a thread hang from the conductor, and present another towards it, they will attract and join each other: present any non-conducting substance, as a brass ball, near the two threads; the lower one, or that held by the hand, will fly *from* the ball, while that affixed to the conductor flies *towards* it. The vitreous atmosphere of the conductor repels the vitreous power of the ball into the hand, and draws the resinous power into it; the ball being therefore resinously electrified, attracts the upper thread, but repels the lower one, which is in the same state with itself, as acted on by the same causes. In this experiment the afflux and efflux of the two powers are, as it were, visible to the senses. We shall find, that a contrariety of power must always precede, and is absolutely necessary to all electrical attraction, and indeed to every communication of electricity.

Let a small copper plate be suspended from the conductor; and underneath, at a small distance, place a larger copper plate, resting upon a proper stand: on the lower plate put a leaf of gold, and then turn the cylinder. The leaf will rise upon the plate, and expand itself into a perfect plane, with one corner opposite the upper, the other corner opposite the under plate, moving quickly upwards and downwards between both. On lowering the under plate by degrees, the motion of the leaf ceases, and remains suspended in the air between the two plates. Darken the room, and you will find the leaf supported, as it were, by pillars of fire; now, as no substance can be thus supported in equilibrio, but by the joint action of two forces acting in opposite directions, we have a clear proof that there must be two forces acting against each other.

Lay a couple of small paper figures of men or women, on the lower plate, as at *fig.* 7: then turn the cylinder, and you will see the images rise up, moving from one plate to the

other. They generally move in an erect position, sometimes leaping one upon another, and moving in such a variety of postures, as to afford much entertainment. It has already been observed, that there are *two powers* in electricity; now the heads of the puppets are electrified with one power, and the feet with the other; they are therefore repelled at both ends, and never come in contact, unless the lower part of one touch the higher part of the other, and then they strongly embrace each other.

If you would further illustrate the affluence and effluence of the two powers, dry the head of one of the images, and the power thrown out from the conductor cannot enter that puppet so freely, as the contrary power from the lower plate enters the feet, which are not so dry; the image will therefore ascend to the upper plate, and remain there: reverse the experiment, by drying the feet and wetting the head, and the image will remain fixed to the lower plate. These as well as many other experiments prove, that it is not the mere component parts of the body that are acted on, in electrical experiments; but that it is the different states of the electrical powers inherent or adhesive to the body, which occasion the effects; and that, strictly speaking, it is the opposite powers only that attract each other, and that no substance is ever attracted until it has acquired a contrary kind of electricity.

Let us now consider a small apparatus, consisting of three bells with two clappers between them, as represented at fig. 6. in the plate. They are suspended from a straight piece of brass, the two outer ones by small brass chains; the middle bell and the clappers are suspended on silk; from the middle bell there is a chain which goes down to the table. If we turn the machine, the clappers fly from bell to bell, and afford a pleasing sort of musical peal by electricity. The power from the conductor is conveyed down the chains to the exterior bells; by means of the chain, the exterior bells repel the same power with which they are electrified from the ball or clapper, which, on the powers being thus separated, are driven to the outer bell by the contrary power which flows in from the table, &c. through the middle bell: the ball becoming electrified with the same power as the middle bell, is driven back, and will continue going from one to the other, as long as the outside bells are kept in an electrified state by the machine's motion. But if any one takes hold of the silk cord which is tied to the lower end of the chain that comes from the middle bell, and thereby raises that chain from the table, the ringing will immediately stop; for silk, being a non conductor, prevents the afflux and efflux of the fluids.

The tumbler and pith balls furnish another curious experiment. Put a pointed wire into one of the holes which are at the end of the conductor, hold a glass tumbler over the point, then electrify the conductor, and turn the tumbler round, that the whole interior surface may receive the fluid from the point; place a few pith balls on the table, and cover them with this glass tumbler, the balls will immediately begin to leap up and down, as if they were animated, and will continue to move for a long time.

We shall now proceed to describe a few more of those leading experiments, which have been so advantageous to the science of which we are treating.

Sect. VII. *Of the Methods of imitating the Planetary Motions.*

The machine called Rackstrow's Orrery consists of small glass balls blown exceedingly thin. These are placed on a wooden board, and environed with circles of brass wire insulated with sealing-wax, or glass, of such a height that the centre of the balls may be nearly parallel to the wire circles. One of these circles may represent the orbit of Saturn, another that of Jupiter, &c. The circles being connected with the conductor of the machine by a wire, and a glass sphere placed between each, the spheres will perform their revolutions round their orbits, and at the same time acquire a rotation on their axes. When the electrical machine is set in motion, the balls will be first attracted to the brass circles, by which means the point that touches the brass circle will become electrified, and be immediately repelled; other parts will in the same manner be attracted and repelled, by which means the glass ball acquires a kind of spinning motion on its axis, at the same time it must have a progressive motion round the circle.

Let us provide a ball of cork about three quarters of an inch in diameter, hollowed out in the internal part by cutting it in two hemispheres, scooping out the insides, and then joining them together with paste. Having attached this to a silk thread, between three and four feet in length, suspend it in such a manner that it may just touch the knob of an electric jar, the outside of which communicates with the ground. On the first contact it will be repelled to a considerable distance, and, after making several vibrations, will remain stationary; but if a candle be placed at some distance behind it, so that the ball may be between it and the bottle, the ball will instantly begin to move, and will turn round the knob of the jar, moving in a kind of ellipsis, as long as there is any electricity in the bottle. This experiment is very striking, though the motions are far from being regular; but it is remarkable, that they always affect the elliptical rather than the circular figure.

Let a piece of India paper be cut in the shape of an isosceles triangle, whose sides are about two inches long and two-tenths of an inch in breadth; then erect a brass ball of two or three inches diameter on a brass wire one-sixth of an inch in thickness, and two feet six inches long, on the prime conductor: electrify the conductor, and then bring the obtuse end of the piece of paper within the atmosphere of the ball; let it go, and it will revolve round the ball, turning often at the same time round its own axis.

Sect. VIII. *Of the universal Dissemination and continual Action of the Electrical Fluid.*

It has been long a received opinion among philosophers, that the electrical fluid is universally disseminated, and in continual action. To prove this to others, various instruments have been contrived to detect the smallest variations, and discover the minutest signs of its existence. These instruments have been generally named electrometers; of which that described by the Rev. Mr. Bennet of Wirksworth, fig. 1. plate 11. stands the foremost, as being by far the most sensible.

The foot of this electrometer is made of metal, and about three inches high, that it may be handled without touching the glass. The cylindrical glass, in which the gold leaf is suspended, is about five inches high, and one in diameter. The cap is made of metal, and flat on the top, that the various substances whose electricity is to be examined may be conveniently placed thereon. The diameter of the cap is larger than that of the glass, and its rim is about an inch deep, hanging parallel to the glass, in order to keep it clean and dry; within this is another circular rim that goes over the glass, and is lined with a soft substance to make it fit close, within this rim; at the centre of the cap a tube is fixed, wherein the peg is placed to which the two slips of gold leaf or silver are fixed. Were it not for the glass, the gold leaf would be so agitated by the least motion of the air, that it would be entirely useless. To prevent the gold leaf from being attracted and torn by flying to the glass, two pieces of tin-foil are fastened with varnish on the opposite sides of the glass, where it may be expected to strike these slips, and carry off the superfluous electricity, and increase the sensibility of the instrument.

From the experiments made with this instrument, it is not

only evident that the electrical fluid is univerfally diffeminated, but that the fmalleft motions in nature difturb its natural equilibrium, and feparate the two powers, and thus manifeft it to our fenfes. That this fluid is the etherial medium, or element of fire, connected with fome material fubftance, can fcarce now be doubted: if fo, all the ofcillations in nature put it in action, or, what is more probable, it is the caufe of thofe ofcillations. Mr. Bennet's electrometer will fufficiently prove that all folution of continuity excites electricity; and there is fcarce any inftance perhaps where its action is manifefted, but what may be traced to this fource. In other words, every thing that will increafe one power, or leffen the other, produces electric appearances. The following are fome of Mr. Bennet's experiments. 1. Powdered chalk was put into a pair of bellows, and blown upon the cap of the electrometer; the ftream of chalk produced vitreous electricity, when the nozzle of the bellows was only fix inches diftant from the cap; but the fame ftream electrified it with the refinous power, when at the diftance of three feet. In this experiment the quality of the electricity feems to be changed by difperfing or widening the ftream, and making it pafs through a longer tract of air: it is alfo changed by paffing the ftream through a bunch of fine wires, filks, or feathers, placed in the bellows; it is refinous when blown from a pair of bellows, the iron pipe being taken off to enlarge the ftream. This laft experiment feems to anfwer beft in damp weather. The vitreous electricity generally remains; but in the refinous, the leaf gold collapfes as foon as the cloud of chalk is paffed. 2. A piece of chalk drawn over a brufh, or powdered chalk put into a brufh, and projected on the cover, gave refinous electricity. The electricity was not permanent. 3. Powdered chalk blown from a plate placed upon the cover, gave a permanent vitreous electricity. If a brufh be placed upon the cover, and a piece of chalk is drawn over it; when the hand is withdrawn, the leaf gold gradually expands with vitreous electricity, as the cloud of chalk is diffipated.

SECT. IX. *Of the Electric Spark, and the Influence of Points.*

IF the knuckle or any fmall joint of the hand be brought near the conductor, fo that a fpark with the appearance of fire paffes between that and the conductor, we feel a fenfation fomewhat refembling a ftroke from the end of a fmall wire. Remove the knuckle further from the conductor, and the fpark becomes longer, and forms feveral curves in its paffage, having the exact appearance of a flafh of lightning. In this experiment as much of one power paffes from the finger to the conductor, as of the other from the conductor to the finger. No fpark will pafs unlefs there can be this interchange of power; and the fpark is always from thofe parts where the exchange can be moft readily brought about.

Whenever the two powers can be eafily changed, which is the cafe with pointed metallic bodies, the equilibrium is reftored filently, and the conductor is of courfe gradually divefted of its electric appearances: but where the furface is large, and a contrary ftate not fo eafily produced, the electricities are as it were compreffed, and do not efcape till they have acquired power to overcome the intervening fpace of air, when it explodes, and a vivid fpark like lightning takes place.

On prefenting a needle, or any other fine pointed fubftance, to an electrified body, the electric fluid rufhes to it with great velocity, and the electricity is faid to be drawn off. This drawing off, however, does not extend to any great diftance, not even all round the electrified body, if you keep turning the machine at the fame time that you prefent the point. To prove this, place the wire, to the end of which a number of fine threads are faftened, in one of the holes on the top of the conductor; turn the machine, the threads on the wire diverge, and fpread out like rays proceeding from a centre; now prefent a point towards one fide of the conductor, but at fome diftance from it, and the threads on one fide will lofe their divergence and hang down, while thofe on the other fide continue to diverge. In fact, a point never acts beyond the electric atmofphere; nor does it act upon that any further than it is immerged therein, and then only fo far as it can draw the refinous power through them, and part with fo much of the vitreous to them. Sufpend a piece of down, or a fmall ball, by a filk ftring, fo that it may hang againft the fide of the conductor. When you turn the machine, it will be electrified, and fly to the extreme part of the conductor's atmofphere: ceafe turning, and bring a point towards the outfide of the down, and inftead of the down being driven in towards the conductor, it will fly to the point, till it has exchanged powers with the point; then it will fly to the conductor, and be electrified, and again repelled; when it comes to a certain diftance from the point, it will fly towards it, and be electrified thereby, and fo on, as long as the conductor remains in an electrified ftate. When the down is on the verge of the electric atmofphere, immerge your point in the atmofphere, and you will fee the down approach the conductor in proportion to the immerfion of the point, and this as often as you move the point forward to the conductor, but no further; fo that the point acts only while it is in contact with the electrical atmofphere.

So, as long as the machine is turning, and the point immerged in the electric atmofphere, there will be a ftrong ftream of the refinous power flowing in from the point to the conductor, and that in proportion to the vitreous power carried off by the point. If this ftream meets an electrified cork ball, or piece of down, it will change their powers, and electrify them with the refinous power, by which means they are attracted to the conductor, and will be fixed there by the continual ftream of the refinous power; draw back your hand to leffen the refinous ftream, and you will fee the down move from the conductor by degrees, and remain between the two powers, without being forced to the conductor, or able to fly far therefrom. The foregoing experiments are moft decifive when the electricity is feeble. You may render it ftill more evident that the fpark of the electrical fluid, from the prime conductor to any conducting fubftance, depends upon the greater or lefs degree of difficulty in producing the contrary current, by the expedient of placing a point at the end of a piece of fealing-wax, and at a fmall diftance from that part of the metal in contact with the fealing-wax, pafting a fmall round bit of tinfoil, and at a little diftance from this, another bit, &c. Having done this, put your finger upon one of the pieces of tinfoil, that is furtheft from the metallic point, and prefent the point towards the conductor, and you will find that it does not act near fo powerfully, nor at fo great a diftance as in the former cafe; and if you approach it fufficiently near the conductor, a fpark will pafs between it and the conductor. Connect your finger immediately with the metal, and you will not be able to obtain a fpark, and the electric appearances of the conductor will be fooner deftroyed by the quicker interchange of the oppofite electricities.

We fee the fpark, which explodes, and is bright in the air, become filent, faint, and diluted in vacuo: fo, on the other hand, the electricity, that would pafs imperceptibly in air, may be made to explode, and become bright, by paffing it through mediums more refifting than air.

If a metallic veffel, nearly filled with common oil, be placed on the conductor, and a point therein immerged, from which, in the open air, fcarcely any vifible appearance can be obferved; yet, even under thefe circumftances, ftrong fparks pafs between the point and the bottom of the veffel; and the

oil is thrown into a violent ebullition, by the afflux and efflux of the two electrical fluids. From a pointed wire fuſpended vertically from the conductor, the point being downwards, no ſpark can be drawn though the machine is acting powerfully. But immerge it in a ſmall bottle of oil, and put your thumb oppoſite the point; and the ſpark becomes loud, the oil is curiouſly agitated, and, if you examine the bottle, you will find it perforated by the electrical fluid.

Fig. 2, plate 2, repreſents a glaſs tube, round which, at ſmall but equal diſtances from each other, pieces of tinfoil are paſted in a ſpiral form, from end to end; this tube is encloſed in a larger one, fitted with braſs caps at each end, which are connected with the tinfoil of the inner tube. Hold one end in the hand, and apply the other near enough to the prime conductor to take ſparks from it · a beautiful and lucid ſpot will then be ſeen at each ſeparation of the tinfoil; theſe multiply, as it were, the ſpark taken from the conductor; for, if there was no break in the tinfoil, the electric fire would paſs off unperceived.

Figure 4 repreſents ſeveral ſpiral tubes, placed round a board. A glaſs pillar is fixed to the centre of the board, and on the top of this pillar is a braſs cap, carrying a fine ſteel point, to ſupport a wire furniſhed at each end with a braſs ball, and nicely balanced. Place this under a ball proceeding from the conductor, ſo that a continued ſpark from this ball to the centre of the ſuſpended wire ſhall give this wire a rotatory motion, and the balls in their revolution will give a ſpark to each ſpiral tube, which, in its paſſage from one ſpot to the other, forms a ſpecies of illumination exceedingly brilliant.

We might proceed to illuſtrate this ſubject by a variety of experiments equally beautiful and deciſive; but as it would carry us beyond our proper limits, we refer the reader to Mr. Adams's excellent Eſſay on Electricity.

In order to ſet fire to ſpirits of wine, it is beſt to heat the metallic ladle a little, into which the ſpirits are to be poured, or elſe juſt to fire the ſpirits, and blow them out, a few ſeconds before they are electrified. This experiment may be performed two ways: 1. By placing the ladle with the ſpirits on the conductor, and then taking a ſpark through the ſpirits, which will ſet them on fire. Or, 2. If a perſon ſtands on the inſulated ſtool, and holds in his hand a ſpoon with the ſpirits of wine, and another perſon on the floor brings his knuckle, or a braſs ball, quickly to the ſurface of the ſpirits, they will be inſtantly in a flame. You may vary this experiment thus: 3. Let the electrified perſon on the ſtool hold the ſpirits as before, while another perſon, ſtanding alſo on an inſulated ſtool, holds in his hand an iron poker, one end of which is made red-hot; he may then apply the hot end to the ſpirits, and even immerge it in them, without firing them; but he may ſet the ſpirits on fire, with either the hot or cold end, provided the hot end be not worn to too ſharp a point. The ſpirits could not be kindled while the perſon was inſulated, becauſe the electric powers could not in that caſe be ſeparated; and hot iron, immerſed in ſpirits, will very ſeldom or never ſet them in a blaze.

From what has been ſaid, it cannot but be evident to the reader, that when the quantity of electricity is ſmall, it is incapable of ſtriking at a conſiderable diſtance, and the ſpark appears ſtraight; but when it is ſtrong, and capable of ſtriking at a greater diſtance, it aſſumes a crooked zig-zag direction. In every electrified conductor, the electricity always eſcapes from that part of the ſurface where the powers are moſt ſeparated. The ſpark is of a different colour according to the denſity; when it is rare, it appears of a blueiſh colour; when more denſe, it is purple; when highly condenſed, it is clear and white like the light of the ſun. The middle part of an electric ſpark, when the two powers meet, often appears diluted, and of a red or violet colour; the ends are more vivid and white: when very ſtrong, it will ſhoot out and divide into many different branches.

SECT. X. *Of the Motions produced by an Electric Stream.*

IN all caſes where there is an efflux of one power of electricity, there is alſo an afflux of the other power, provided any conducting ſubſtance be placed ſo near and in ſuch circumſtances, as that it can be acted upon.

If a braſs croſs, fig. 5. be raiſed on a point like a compaſs needle, with each of its points bent the ſame way; and the whole placed upon the conductor: upon working the machine, it will turn with great rapidity, but always from the points, becauſe the electric fire flying off from the points, acts forcibly on the air, and is conſequently re-acted upon; which occaſions the motion. Take the fly and its point, and hold it in your hand under the conductor, and it will turn in the ſame manner, by a ſtream of electricity of a contrary power to that thrown off from the conductor, which is drawn in from you and delivered from the points of the fly to the conductor. Now inſulate the fly, and place it at the ſame diſtance from the conductor, and it will not move, becauſe no electricity can be drawn through it; but hold a pin near it, and the fly will immediately begin to turn, as it draws through the pin a ſufficient quantity of electricity from your body.

It is upon this principle that thoſe who would blend entertainment with philoſophy may contrive a variety of curious machines, whoſe motions may be produced by the electrified ſtream, which will afford much entertainment to thoſe who can reliſh an innocent domeſtic amuſement: and by theſe, ſcience will be benefited; for to render any ſcience familiar is to render it prevalent; and the more it prevails in practice, the more likely it is to be improved.

SECT. XI. *Of the Effect of Electricity on Fluids.*

THE Abbé Nollet's experiments plainly ſhow, that electricity augments the natural evaporation of moſt fluids, particularly of thoſe which have the greateſt tendency to evaporate; that it, in this reſpect, acts moſt powerfully upon the fluids when they are contained in metal veſſels; but it never makes any fluids evaporate through the pores either of metal or glaſs. When fluids, that are paſſing through capillary tubes, are electrified, the ſtream is ſubdivided; and if the tube be leſs than $\frac{1}{10}$ of an inch in diameter, their motion is generally very much quickened.

Let a metal phial, to the bottom of which a capillary tube is adapted, be ſuſpended to the conductor. Before the cylinder is turned, the tube carries off the water only by interrupted drops; but on working the machine and electrifying the water, the dropping from the tube is changed into a continued ſtream. On applying a finger to the conductor, the electricity is interrupted, and the water again only deſcends in drops: the finger taken away, the water runs in a diverging ſtream: darken the room, and a fiery ſtream deſcends from the tube. The term of the electrical *jet de feu* has been given to this experiment.

If you inſulate two pails with capillary tubes, connecting one with the cuſhion, the other with the conductor, and turn the machine; the water, which is diſperſed into very minute particles, when they are near enough, is brought together by the effort of the two powers to join each other; the drops coaleſce and come down like rain in a heavy ſhower.

Again, place a drop of water on the conductor, and turn the machine. On preſenting the knuckle towards this drop, long zig-zag ſparks are obtained from the drop of water; the

drop taking a conical ſhape, the knuckle is wetted. The ſpark is conſiderably longer than could be obtained from the conductor without the water being applied.

To the ball at the end of the conductor, faſten a bit of ſealing-wax in ſuch a manner that it may be eaſily ſet on fire by a taper: ſet it on fire, whilſt at the ſame time you turn the machine. You will ſee the wax become pointed, and ſhoot out an almoſt inviſible thread to a conſiderable diſtance. If you receive the filaments on a ſheet of paper, the paper will be covered in a very curious manner by the electrified wax threads; the wax flying to thoſe places where it can unite with the contrary kind of electricity.

Sect. XII. *Of the Properties of the Leyden Phial.*

We now proceed to conſider the way in which a common glaſs jar, after a little preparation, becomes capable of giving a perſon ſuch a violent ſenſation, as nothing elſe in nature can give. But before we enter into the theory of charged glaſs, it is neceſſary to ſhew in what manner it is charged and diſcharged. This jar is coated on the outſide and lined on the inſide with tinfoil, to about two inches ſhort of the top, which is ſtopped with a piece of wood. A wire paſſes through the wooden top, and is connected underneath with two other wires, which are bent ſo as to touch the inſide coating of the jar; a ſmooth ball is fixed on the top of the wire. To enable us to diſcharge the jar without receiving what is called the ſhock, two inſtruments have been contrived, one called the common diſcharging rod, fig. 8, pl. 10. which is nothing more than a ſemicircular braſs wire, furniſhed with two braſs balls, one at the end of each wire. The other, which is of very extenſive uſe in electrical experiments, is called the jointed diſcharging rod, fig. 9. It is furniſhed with a glaſs handle; the legs are moveable, and may be ſet to any diſtance that may be convenient.

Having placed the jar on the table, ſo that the ball on the top of its wire may be about one-eighth of an inch from the ball of the prime conductor, turn the machine, and ſparks will fly from the ball of the conductor to the ball of the jar. Continue turning as long as you perceive the fire paſs between the conductor and ball of the jar; but when it ceaſes, you may leave off turning, and conſider the jar as charged. This done, take hold of the diſcharger by the middle, and apply one knob to the outſide coating near the bottom, and keeping it there, put the other to the ball of the jar, and it will be diſcharged of its fire with a loud ſnap; but the perſon who holds the diſcharger feels nothing from the diſcharge, becauſe the handle of the diſcharger does not conduct.

If you charge the jar again, and touch the outſide coating with one hand, and then bring the other to the ball of the jar, you will act the part of the wire diſcharger, and receive a ſhock through your arms and breaſt, and the phial will be diſcharged. If a ſingle perſon receive a ſhock, the company is diverted at his ſole expence; but all contribute their ſhare to the entertainment, and all partake of it alike, when the whole company form a circle by joining their hands, the perſon at one extremity of the circle touching the outſide coating, while he, who is at the other extremity touches the ball of the jar. All the perſons who form this circle are ſtruck at the ſame time, and with the ſame degree of force.

It is ſometimes very material, to know the ſtate of a jar with reſpect to the charge; Mr. Henly's quadrant electrometer is the beſt inſtrument yet known for that purpoſe. It conſiſts (fig. 17, pl. 10.) of a perpendicular ſtem formed at top like a ball, and furniſhed at its lower end with a braſs ferril and pin, by which it may be fixed in one of the holes of the conductor, or at the top of a Leyden bottle. To the upper part of the ſtem, a graduated ivory ſemicircle is fixed, about the middle of which is a braſs arm or cock, to ſupport the axis of the index. The index conſiſts of a very ſlender ſtick, which reaches from the centre of the graduated arch to the braſs ferril; and to its lower extremity is faſtened a ſmall pith ball nicely turned in the lathe. When this electrometer is in a perpendicular poſition, and not electrified, the index hangs parallel to the pillar; but when it is electrified, the index recedes more or leſs according to the quantity of electricity.

In explaining the theory of the Leyden phial, it will be rendered evident, that the electric powers, when in equilibrio, do really condenſe each other; and that one power always expands in proportion as the action of the other is withdrawn, or in proportion to the increaſe of one power, and the diminution of the other; and that when the bottle is charged, it is equally electrified on both ſides, but with different powers of electricity; and when a communication is made by a conductor, the increaſed power on the outſide flies in, and the increaſed power within flies out, to make the powers equal on both ſurfaces.

If you place a Leyden bottle upon the inſulated ſtand, forming a communication between it and the conductor, and give the machine a few turns, both ſides of the bottle will be electrified with the vitreous power, as you may eaſily prove by touching them with down or a ſmall ball ſuſpended by ſilk; for when this is electrified by touching the outſide, it will be alſo repelled by the ball which communicates with the inner ſurface.

Having placed an inſulated bottle ſo that the ball may communicate with the conductor; let a wire alſo be connected with the coating, ſo as to form a communication with the table. Next turn the machine, and, 1. On applying a cork ball, you will not find any ſigns of electricity in the coating, but you will find the ball (or inſide) electrified with the vitreous power. 2. Remove the wire communicating with the table, and you will find the coating alſo electrified with the vitreous power; and this as often as you remove the wire, till the bottle is full charged. 3. When the bottle is full charged, remove its communication both with the conductor and table, touch the coating, and the cork ball will remain ſuſpended by it, without any ſign of being electrified; then touch the knob of the bottle with your hand, the cork ball will be ſtrongly repelled from the coating, and be electrified with the reſinous power. 4. Take another cork ball ſuſpended by ſilk, and touch the knob of the bottle therewith, and the cork ball will be electrified with the vitreous power, and be repelled. 5. Now touch the coating with your finger, and the cork ball will be repelled much further by the ball; but that which was repelled from the coating, now flies towards it, and remains at reſt, till you touch the knob of the bottle with your finger; it will then be electrified as at firſt, and be violently repelled; the ball which was electrified by the knob of the bottle will now fly towards it. This change in the extent of the atmoſphere of the different powers takes place almoſt inſtantaneouſly as often as the ball or coating are touched.

Or the knob of the bottle may be made to connect with the conductor by a wire, ſuſpending a cork ball ſo as to touch the conductor; then, on touching the coating, the ball will be repelled from the conductor, while that next the coating is attracted; touch the knob of the bottle, and the ball will be repelled from the coating, and attracted by the conductor, and ſo on, as often as you pleaſe.

We may conclude from hence, 1. That the bottle is electrified with the vitreous power on the inſide, and the reſinous on the outſide. 2. That when the equilibrium of theſe powers is deſtroyed by leſſening the quantity of one, the ex-

treme part of the other expands itſelf into an extenſive atmoſphere; but the atmoſphere of the leſſened power is condenſed, as appears by the cork balls falling cloſe to the conductor and coating. 3. It remains to be ſhewn, how theſe powers came to be thus ſituated on the inſide and outſide of the bottle, or why they do not mix through the glaſs where they ſeem to have the greateſt tendency to unite. Here it will be neceſſary to conſider the ſeparation of theſe powers between the globe and the cuſhion; for all the other phenomena are only a conſequence of the ſeparation that takes place between theſe. Now the cylinder parts with its reſinous power to the cuſhion, in exchange for the vitreous; the conductor in like manner to the globe, and the inſide of the bottle to the conductor; and ſo the exchange would go on with the next conducting ſubſtance, but that the bottle gives ſome obſtruction to the paſſage of the electrical powers; by which means the vitreous power, which paſſes through the glaſs to the conducting ſubſtance upon the outſide of the bottle, is carried off, together with the vitreous power of the coating, along the wire which communicates with the table, in exchange for an equal quantity of the reſinous power brought back by the wire to the coating of the bottle; till at length the reſinous power on the outſide is able to counterbalance the vitreous power on the inſide, and thus affords an opportunity for drawing off the reſinous power on the inſide of the bottle, to the conductor; ſo that the bottle remains a partition between the two powers, and they cannot change place through the peculiarly conſtructed pores of the glaſs, while their ſurfaces are ſo powerfully oppoſed. For when the junction is made in the open air, or when their ſurfaces are oppoſed in any quantity, it is not done without violence; occaſioning a loud noiſe and a flaſh of fire, while burſting through to meet each other; for wherever the different powers unite in any quantity, they are condenſed very much.

The cauſe of the violent convulſion felt through the body by completing a circle with the hands, ariſes only from the different powers paſſing in oppoſition through the ſame nerves. For if one perſon touches the coating, and another the top of the bottle, the bottle will be diſcharged without giving either of them the ſhock. Now it is very clear, that as much fire paſſed through either of them, as if each had ſingly diſcharged the bottle. But in this caſe the fire is diffuſed through all parts of the body; and the fire brought in, is drawn from all parts of the body, and conſequently the nerve cannot be ſo much ſhocked as in the former caſe, when all the fire paſſes in oppoſition through the nerves of the ſame part.

Sect. XIII. *The Theory of the Leyden Phial illuſtrated by Experiments.*

In the firſt place, charge an inſulated bottle, take it from the conductor, and let a cork ball ſuſpended by ſilk hang againſt the outſide of the bottle: touch the outſide or coating with your finger, the ball will not be affected; but touch the knob of the bottle, and the ball immediately flies off, ſtrongly electrified with the reſinous power; and thus you may go on for a conſiderable time, altering the balance of the powers within and without-ſide the bottle, by alternately touching the top and the bottom of the bottle. The defenders of Franklin's ſyſtem will hardly ſay, it is the return of the poſitive electricity which electrifies the ball negatively. The fact is, that when you touch the top, you take a ſpark of the vitreous power from the inſide, and in exchange give as much of the reſinous power thereto. By this means, the force of the vitreous power within the bottle is leſſened, which leaves the reſinous power on the outſide in greater quantity, than the vitreous within-ſide, and conſequently at liberty to exchange with any non-electric in contact with it, and thus the ball becomes charged with the reſinous electricity.

If you charge a bottle fully, and remove the wire from the table, and make the coating communicate with the conductor inſtead of the knob, and then turn the machine, the reſinous power with which the coating is electrified becomes covered with the vitreous power, and you may take as many ſparks from it as you pleaſe, without making any change in the charge of the bottle; for when you ceaſe turning, and remove the communication with the conductor, and touch the outſide of the coating with the finger, all ſigns of the vitreous power diſappear; and when the circle is completed, the bottle is diſcharged with as loud a report as it would have done before you applied the conductor to the coating; for the vitreous power within the bottle, being undiſturbed, kept an equal quantity of the reſinous power firmly fixed to the outſide of the Leyden phial.

But this is by no means the caſe when you give the vitreous power from the inſide an opportunity to eſcape. Thus, when the bottle is full charged as before, remove the wire that communicates with the table, and bring the coating in connection with the conductor; after a turn or two of the cylinder, take a ſpark from the ball of the bottle, and you will find that it will fly to a conſiderable diſtance, often double the diſtance you can draw a ſpark from the conductor; becauſe the vitreous power, covering the reſinous power on the coating, leſſens the action on the vitreous power within the bottle, and therefore leaves that power greater freedom to fly off: but as you go on taking ſparks, they gradually leſſen, becauſe, after a few, the vitreous power in the bottle is leſſened, and the reſinous power within increaſed by the quantity received in exchange on every ſpark; and thus by a few ſparks, the bottle is diſcharged. But if you go on to take more ſparks, the bottle will be re-charged with the reſinous power withinſide, inſtead of the vitreous, which before was in poſſeſſion of it.

If fifty turns of the cylinder will charge your bottle, turn only twenty-five, and then remove the communication between the coating and the table, and as you turn on (whether you continue the communication from the conductor to the top of the bottle, or ſhift it to the coating), you will find the bottle electrified on both ſides with the vitreous power; remove the bottle from the conductor, and then diſcharge it with an inſulated diſcharger, and you will find the bottle ſtill electrified, both within and without, with the vitreous power; but this electricity will diſappear, if either the ball or coating be touched.

But in order to illuſtrate further the reciprocal exchange of the electric powers, take an inſulated bottle with a wire proceeding from the bottom, at right angles to which is a wire for receiving a needle with reverſed points. Make the top of the bottle communicate with the conductor; and, all the time the bottle is charging, the needle will turn; but when the bottle is charged, the needle ſtops. Then touch the top of the bottle with your finger, or any conductor, and the needle will turn till the bottle is diſcharged. Now while the bottle is charging, if you touch the needle with a piece of bog-down, or a cork ball, ſuſpended by ſilk, you will find it electrified by the vitreous power, which flies off in exchange for the reſinous power drawn in from the air to the outſide of the bottle; and while the bottle is diſcharging, if you apply the down or ball in the ſame manner to the needle, you will find them electrified with the reſinous power, which flies off from the outſide of the bottle in exchange for the vitreous power drawn in through the points from the air; while the vitreous power from the inſide of the bottle makes the ſame exchange for the reſinous power through your finger, to make theſe different powers equal to each other, within and without the phial.

Let two coated bottles be put on an electric ſtand, with their coatings in contact; and while you charge one from the conductor, let a perſon on the floor touch the top of the other bottle with his finger. You will find the firſt bottle charged with the vitreous power inſide, and the ſecond with the reſinous power inſide. Now the exchange here is evident; for while the reſinous power from the inſide of the firſt bottle changes place with the vitreous thrown in from the conductor, the vitreous, from the coating, changes place for ſo much of the reſinous from the coating of the ſecond bottle; and the vitreous in that bottle changes place for ſo much of the reſinous power drawn in through the body of the man.

Charge a Leyden bottle, and ſet it aſide to be in readineſs to aſcertain the ſtate of another bottle. Next take the bottle with the projecting wires, fig. 10, pl. 10, unſcrewing the ball from the wire at the coating, and ſuſpending a pair of pith balls therefrom. This done, bring the knob of the bottle to the conductor; work the machine, and the phial will charge ſlowly, and the balls will repel each other; while you are turning and the bottle charging, bring the knob of the firſt bottle towards the balls, and they will be repelled. This plainly proves, that the outſide of the bottle is electrified vitreouſly while it is charging, that is, with the ſame electricity as the inſide is charged with.

If we diſcharge the bottle with the projecting wires, and charge it again as before, we ſhall ſtill find, that whilſt it is charging, the balls will fly from the knob of the firſt bottle; if we ceaſe turning, the balls ceaſe to repel each other; they now touch each other, and again recede, but with a contrary electricity, for they are now attracted by the knob of the firſt bottle. This ſhews that the difference between the two ſides cannot appear, while they are charging, or while vitreous electricity is forced through the bottle.

It is neceſſary now to diſcharge both bottles, in order to try another experiment, to determine the ſtate of the outſide during the charge. Firſt put the ball on the end of the wire of the bottle with the projecting wires, and bring the knob thereof to the conductor, holding the knob of the firſt bottle againſt the coating of that with the projecting wires; by working the machine, both will be charged. As ſoon as they are pretty well charged, and while the machine is working, remove the firſt bottle from the other; after this is removed, ceaſe working the machine as ſoon as poſſible. Now connect, by a wire, the two outſide coatings, and bring the balls to each other. If, while the bottles were charging, the outſide of that with projecting wires had been reſinouſly electrified, the inſide of the ſecond would have been ſo alſo; and on their being thus brought together, both bottles would be diſcharged; but this is not the caſe, for the inſides of both are charged with the vitreous electricity, the coating having exchanged powers with the bottle charged thereby. This experiment ſhews, that to conſider one ſide of a phial to be poſitive, and the other negative, at the time they are charging, is erroneous, although it has long been a received opinion.

The deciſive criterion of the reſinous and vitreous electricity, as determined by the light on metallic points, gives full evidence in favour of Eeles's theory, while it is directly oppoſed to that of Franklin. For you will here find, that during the time that the bottle is charging, the outſide exhibits the ſign of vitreous electricity. To prove this, place a pointed wire at the end of the conductor, and place the apparatus, with the ſliding wires, fig. 11, plate 10, on one of the inſulated ſtands, firſt removing the bottle from it. Then unſcrew the balls from the projecting wires of the remaining inſulated bottle, and alſo from the ſliding wire, which leaves the points, that were under the bottle, expoſed and ready for the experiment.

Having thus prepared matters, place the inſulated bottle, ſo that the point, from the inſide, may be about half an inch diſtant from that in the conductor; and let one of the points of the ſliding wire be at the ſame diſtance from, and oppoſite to, the point projecting from the outſide of the inſulated bottle. Now turn the machine, and as ſoon as the charge begins, the ſigns of the electricities are viſible, illuminating the points of the interrupted circuit. The point on the prime conductor gives the bruſh or ſign of vitreous electricity; the ſign on the point oppoſed to it on the knob of the bottle is reſinous. The light from the wire, that projects from the coating of the bottle, is the bruſh or vitreous ramified light; but that of the point oppoſed thereto is the ſtar, or ſign of reſinous electricity, as they ought to be according to Mr. Eeles's theory; not "contrary to the kind or ſource of electricity from whence they proceed," which is the caſe, on the principles of Dr. Franklin's theory. See Read's Summary View of Spontaneous Electricity, p. 81 and 82.

Sect. XIV. *Experiments relative to the Diſcharge of the Leyden Jar.*

Of theſe experiments, which are calculated to ſhew that the two electricities ruſh into union from oppoſite directions, the three firſt were made by Mr. Atwood of Cambridge, and are deſcribed by him in his Analyſis of a Courſe of Lectures. He charged the ſurfaces of an electric inſulated plate ſlightly, and diſcharged it through an interruped circuit (formed of needles placed in a groove of wax, the diſtance between each needle was very ſmall); the two powers were viſible, on the diſcharge illuminating the points of the interrupted circuit, each power extending further from the ſurface contiguous thereto, in proportion to the ſtrength of the charge; but when this was ſufficiently ſtrong to make the illuminations proceeding from each ſide meet, there was an exploſion of the whole charge. Twelve feet was the length of the interrupted circuit made by this gentleman.

A cylindrical plate of air was charged under the receiver of an air-pump; and it was found, that the more the air was exhauſted from between the ſurfaces, the more readily and eaſily the powers came into union.

Mr. Atwood made an exhauſted receiver part of the electric circuit; and on uſing ſuch charges as were not ſufficient to form an exploſion, he found the electric light proceeding in oppoſite directions from the parts communicating with the vitreous and reſinous ſurfaces.

Suppoſing a Leyden bottle is charged but ſlightly, if you touch the coating with a finger of one hand, and at the ſame time bring a finger of the other to the knob of the jar, you will receive a ſmart blow upon the tip of each finger, but the ſenſation reaches no higher. Charge the jar a degree higher, and you will feel a ſtronger blow, reaching to the wriſts, but no further. When it is charged ſomewhat higher, a ſevere blow will be received, but which will not reach beyond the elbows. Laſtly, when the jar is ſtrongly charged, the ſhock will be perceived at the wriſts and elbows; but the principal blow is felt at the breaſt, as if a blow from each ſide met there. This plain and ſimple experiment of Mr. Symmers obviouſly ſuggeſts the exiſtence of two currents proceeding in contrary directions, accords with thoſe of Atwood and Volta, and is in direct contradiction to the Franklinian doctrine, "that the ſame quantity of electric matter, which is thrown upon one of the ſurfaces of glaſs in charging, is driven from the other, and that in the diſcharge this accumulated quantity is reſtored to the deficient ſurface."

When we charge a jar very highly, the electricities will often, in their endeavours to unite, force a hole through the jar, and puſh out the coating on both ſides, ſometimes melting

it; the burr of tinfoil protruded from the middle of the glafs ftrongly indicates, that the two electricities meet at the middle of the fubftance of the glafs.

It is afferted by Mr. Read, that when the charge for melting of fine wire is of a proper intenfity to melt it into fine globules, he has obferved the wire to be of a paler red heat in the middle than at the extremities, and the melting to begin at the middle; leaving a portion unmelted at each end. At other times (though lefs frequent) the wire was obferved to be of a more glowing heat in two parts, and thefe were generally near the middle. Thefe effects clearly fhew, that the vitreous and refinous electricities of the charged jar met in great force near the middle of the wire, which is directly contrary to the leading notions of the Franklinians.

This eager difpofition in the divided fluids to unite, is often perceived in a full charged Leyden bottle, at the upper edge of the outfide coating, and at the edge of the cork on the neck of the bottle; rays of light darting from each, and foliciting, as it were, an union, and fometimes performing an actual explofion.

Sect. XV. *The foregoing Principles confirmed by the Phenomena of the Electric Spark.*

The colours of the electric fpark appear to differ according to its denfity. When it is rare, it appears of a blueifh colour; when more denfe, it is purple; when highly condenfed, it is clear and white, like the folar light. An electric fpark often appears diluted at its middle part, and of a red or violet colour, while the ends are vivid and white: this appearance cannot be accounted for by the theory of a fingle fluid moving in one direction, but is a proof of two currents moving in oppofite directions; the electric figns growing weaker where the two powers unite. Mr. Read has well obferved, that the place of re-union is much lefs luminous, and in fome cafes quite dark; and that this is the natural effect of the union of the two electricities: at that point the diftinctions of vitreous and refinous ceafe, and there the electric light vanifhes. Thefe appearances are beft obferved, by viewing in the dark a ftrong electric fpark paffing between two bodies electrified in contrary ways.

Notwithftanding the appearances of the electric light on a point and ball, as well as of the electric fpark, are fubject to many variations, yet are there certain figns generally peculiar to each kind of electricity. For inftance, if the refinous part of a fpark be fmall, or what has been ufually termed the luminous globule, then the middle part is generally of a purplifh colour. When ramified rays iffue from the vitreous part, then the refinous is more extended, ftretching out towards the vitreous. When the vitreous and refinous electricities ftrike into each other in denfe light, in various parts of the intermediate fpace, then their exact place of union is generally obfervable by a dark fpot. Mr. Read, with propriety, confiders the lofs of light in any part of an electric fpark, whether total or partial, as the immediate effect, and conftant fign of the reunion of the two vitreous and refinous electricities.

He further obferves, that whether the refinous light affume the figure of an oblong flame, or of a luminous globule, in either cafe the vitreous light is feen to approach, and unite with it in all poffible directions. The effect of a vitreous furface appears to extend farther than the effect of a refinous one.

Sect. XVI. *Of the Appearances of the Electric Light in Vacuo.*

Notwithstanding we have already pointed out fome experiments in vacuo, that illuftrate this point, yet thofe of Mr. Read are fo decifive, that not to mention them here would be unpardonable. In conducting them a glafs tube was ufed, 3 feet 7 inches long, furnifhed at each end with brafs caps, one of the caps fitted to the plate of the air-pump; from each cap a brafs wire, on which was a brafs ball, projected within the tube: when this tube is fufficiently rarefied, the charge of a Leyden phial will readily pafs through the rarefied air.

The Leyden jar, in thefe experiments, muft only have a flight charge; for, if the charge be ftrong enough to force the whole contents fwiftly through the rarefied air, the motion of the fluid will be too rapid, and the light too refplendent to permit an exact obfervation of the appearances.

The difcharge being made in the dark, you will perceive, the moment the circuit is formed for that purpofe, a light within the tube, but chiefly at each end. Thefe lights are of the contrary kinds of electricity, and accord with the fide of the bottle to which they are connected. You may fometimes perceive the two lights to have a manifeft tendency to meet near the middle of the refifting medium. Mr. Read has obferved the light within the tube to be confiderably diminifhed in fplendour, where the two powers unite: and fo it ought to be; for when the two electricities unite, and regain their natural ftate, they lofe their light; for it is only in a divided ftate that the electrical matter is luminous. The fame appearances are produced in the tube by the fimple fpark; that is, the contrary electricities are difcovered at each extremity.

As a decifive experiment, Mr. Read fufpended his exhaufted tube in an horizontal direction, by filk lines from the ceiling. It is more convenient, however, to infulate the glafs tube, or luminous conductor, by means of glafs pillars, as at fig. 13. plate 10. One end of the tube was placed fo as to receive an electric fpark from the conductor of his machine, at half an inch from the other end: there was a metallic communication with the floor.

When the machine was worked, the tube became filled with electric light, and it continued fo long as the action of the machine continued. Mr. Read obferves, that the inftant the fupply ceafes, the light divides near the middle of the tube, and flies back to the ends; fully evincing the truth of Mr. Eeles's theory, by fhewing that the light within the tube is not all of one kind of electricity: the tube includes both electricities in one appearance of light: the moment the action of the machine is difcontinued, the afflux and efflux ceafe, and each electricity returns to its own fituation, where the feparation firft took place.

Indeed, with a view of afcertaining beyond difpute, that the light within this kind of exhaufted tube confifted of vitreous and refinous light, he made the following experiment: The glafs tube was fufpended as before, and two Leyden phials in an horizontal pofition, but lying on glafs ftands, were placed one at each end of the tube, with their metallic knobs nearly in contact with the metallic caps of the glafs tube. In this difpofition of the apparatus, the coating of one bottle is to receive a fpark from the prime conductor, and the coating of the other a fpark from the metallic communication with the floor.

When the cylinder was in motion, fparks were perceived to pafs in the four intervals of air, and at the fame time a luminous appearance within the glafs tube. On removing the bottles, and examining their charges, they were found to correfpond with the lights within the tube, to which they were oppofed. One bottle was vitreoufly electrified, and the other refinoufly. It is clearly fhown by thefe experiments, that there is at the fame time one power acting from within, towards the outfide of a charged Leyden phial, and another power acting from the outfide towards the infide of the phial; and thefe concur with other experiments in fhewing, that electricity confifts of two diftinct pofitive powers acting towards each other and in oppofite directions. Thofe who are difpofed to make the trial may

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do it by means of a coated flask from which the air has been exhausted: see fig. 14.

The properties of the Leyden phial may be illustrated in a variety of entertaining ways, with which every electrician is acquainted. We will therefore prolong this section no farther than to notice two; one of them, the *spotted bottle*, so called, because it is only coated with small pieces of tinfoil, placed at a little distance from each other. See fig. 18. in the plate. Charge this bottle in the usual manner, and you will see strong sparks of electricity fly from one spot of tinfoil to the other, making the passage of the fluid on the outside very visible. Discharge this bottle, by bringing a pointed wire gradually near the knob, and the uncoated part of the glass between the spots will be pleasingly illuminated, and the noise will resemble that of small fired crackers. If the jar is discharged suddenly, the outside surface appears illuminated. To produce these appearances, the glass must be very free from moisture. If a phial uncoated on the outside be held in the hand, and its knob presented towards an electrified conductor; the fire, while it is charging, will pass from the outside to the hand, in a pleasing manner; on the discharge, beautiful ramifications will be seen upon the uncoated part of the bottle.

This subject may be still farther pursued by suspending two sets of bells from a Leyden bottle; one set connected with the inside, the other with the outside, as represented by fig. 16. Hook up the chain from the bells communicating with the inside, that they may have no connection with the table; charge the bottle in the usual manner; during the charge, the set suspended from the outside will continue to ring. After the bottle is charged, unhook the wire of the bells suspended from the inside. Touch now the wire A, and the bells will cease ringing, but the other set will begin to act; take the finger from A, and apply it to B, and the bells at B will be quiet, while those at A will be set in motion, and so on alternately, till the bottle is discharged of the electrical fluid.

Sect. XVII. *Of the Electrical Battery.*

There is nothing so formidable amongst an electrical apparatus as the electrical battery, which consists of a number of Leyden jars connected together in a box. The bottom of the box is covered with tinfoil: from these a hook projects on the outside of the box, by which any substance may be connected with the outside of the jars; their insides are all connected by wire or some metallic communication. By means of this, you may perform a great number of very surprising and interesting experiments; and though, if very large, it be a formidable appendage to an electrical machine, and ought always to be used with caution, yet it cannot be said that the apparatus of an electrician is complete without it. Its effects in rending various bodies, in firing gunpowder, in melting wires, and in imitating all the effects of lightning, are highly curious and interesting.

It must be confessed, there is much caution necessary in the use and management of a battery, and you should be careful never to make part of the circuit, as well as to prevent those that are seeing the experiments touching the battery, or approaching too near to any part of the apparatus. The quadrant electrometer should be always used with it; it is best to place it upon the ball, which unites the internal wires, but it should always be elevated two or three feet above the ball. A battery cannot be charged so high in proportion as a single jar; the quadrant electrometer, therefore, never rises so high as 90 degrees, seldom higher than to 60 or 70 degrees, more or less, in proportion to the size of the battery, and the force with which the machine acts.

A very curious experiment on the perforation of paper by the electrical fluid, which also proves with great clearness the existence and action of the two electric powers, has been made by Mr. Atwood, who suspended a quire of paper by a line, in the manner of a pendulum, from a convenient altitude, so that its plain might be vertical. The largest charge from a battery was then passed through it, while quiescent in an horizontal direction perpendicular to the plane, the rods of communication not touching the paper: the phenomena were, first, the aperture in the leaves, being protruded both ways from the middle: second, not the smallest motion was communicated to the paper from the force with which the battery was discharged.

In this experiment, the thickest and strongest paper was made use of, and the height from which it was suspended was sixteen feet. It is an extraordinary appearance on the hypothesis of a single electric fluid, that a force sufficient to penetrate a solid substance of great tenacity and cohesive force, should not communicate the smallest motion to the paper, when a breath of air would cause some sensible vibration in it. But the other phenomenon, i. e. the opposite direction in which the leaves are protruded, tends very much to strengthen the opinion of two opposite currents: indeed, when the two facts are taken together, it is scarcely possible to reconcile the hypothesis of a single power with the appearances exhibited.

We are informed by Mr. Symmer, that he placed in the middle of a paper book, of the thickness of a quire, a slip of tinfoil: in another of the same thickness he put two slips of tinfoil, including the two middle leaves between them; and upon passing the electric stroke through them, he found the following effects. In the first, the leaves on the side of the foil were pierced, while the foil itself remained unpierced; but at the same time he could perceive that an impression had been made on each of its surfaces, at a small distance from each other: such impressions were still more visible on the paper, and might be traced as pointing different ways. In the second, all the leaves of the book were pierced, excepting the two holes that were between the slips of foil; and in these two, instead of holes, the two impressions in contrary directions were extremely evident.

If a quire of paper, without having any thing between the leaves, be pierced by the electrical stroke, the two powers will keep in the same track, and make but one hole in their passage through the paper; not but that the power from above, or that from below, sometimes darts into the paper at two or more different points, making so many holes; but these generally unite before they go through the paper. They seem to pass each other about the middle of the quire, for there the edges are most visibly bent different ways; whereas, on the leaves near the outside, the holes very often carry more the appearance of a power issuing out, than of one darting into the quire.

If any thin leaf of metal, such as gold leaf, or tinfoil, be put between the leaves of the paper, and the whole is struck; the counteracting powers deviate from the direct track, and make their way in different lines to the metallic body, and strike it in two different points distant from one another about $\frac{1}{4}$ of an inch, more or less; the distance appearing to be generally less when the power is greatest; and whether they pierce, or only make impressions upon it, they leave evident marks of motion from two different parts, and in a direction contrary to each other. When two slips of tinfoil are put into the middle of a quire of paper, including two or more leaves between them, if the electricity be but weak, the counteracting powers only strike against the slips, but leave an impression: if the shock be stronger, one of the slips is pierced, but seldom both; and it appeared in general to Mr. Symmer, that the power which issued from the outside acted with greater force than that which passed from the inside.

To reduce thick pieces of glass to powder. Place a thick piece of glafs on the ivory plate of the univerfal difcharger, fig. 15. plate 10. and a thick piece of ivory on the glafs, on which a weight from one to feven pounds is to be placed; take off the balls a, b, bring the points of the wires againft the edge of the glafs, and pafs the difcharge through the wires, by connecting one of the wires with the hook of the battery, and forming a communication, when the battery is charged, from the other wire to the ball. By this operation the glafs will be broken, and fome part of it fhivered to an impalpable powder. When the piece of glafs is ftrong enough to refift the fhock, the glafs is often marked by the explofion with the moft lively and beautiful colours that can be imagined.

Fix fome very dry white wood between the balls of the univerfal difcharger, the fibres of the wood running in the fame direction with the wires: then pafs the fhock through them, and the wood will be torn to pieces; or run the points into the wood, and then pafs the fhock, which will anfwer as well.

In attempting to melt wires by the electrical fluid, you ought to have a battery containing at leaft 30 fquare feet of coated furface; you may then connect the outfide coating with a wire of about $\frac{1}{50}$th of an inch in diameter, and from 12 to 24 inches in length; faften the other end of the wire to one of the balls of the difcharging rod. On making the difcharge, the wire will become red-hot, then melt, and fall upon the floor or table in glowing globules. Sometimes the fparks are thrown to a confiderable diftance: if the force of the battery be very great, they will be entirely difperfed by the explofion. To thofe who are defirous of carrying to a greater extent the experiments with an electrical battery, we would recommend the perufal of Adams's Effay on Electricity.

Sect. XVIII. *Of Lightning.*

No tranfition can be more natural than to pafs from the electrical battery to the fubject of lightning itfelf: for the former feems to be more than an imitation; it is nature invefted with her own attire. The light and found accompanying thefe phenomena, when exhibited on the great fcale of nature, are indeed fo awfully fublime, that we can fcarcely blame the weaknefs of thofe, who, in ages lefs informed, fuppofed it to be the immediate minifter of vengeance from an angry Deity. They are now more rationally confidered, as the means of reftoring a neceffary equilibrium; and no doubt anfwer very important purpofes in the economy of nature.

When it happens that lightning is accompanied with thunder, it is well defined, and has generally a zig-zag form; fometimes it only makes one angle like the letter V, fometimes it appears like the arch of a circle. But the moft formidable and deftructive form which lightning is ever known to affume, is that of balls of fire. The motion of thefe is very often perceptible to the eye; but wherever they fall, much mifchief is the refult of their explofion. The next to this, in its deftructive effects, is the zig-zag kind; for that fpecies, whofe flafhes are indiftinct, and whofe form cannot eafily be obferved, is feldom known to do much hurt. The colour of lightning is alfo an indication of its power to do mifchief, the paleft and brigheft flafhes being moft deftructive in their effects.

The zig-zag kind of lightning, when near, is remarkable for a kind of omniprefent property. If two perfons are ftanding in a room, looking different ways, and a loud clap of thunder happens, accompanied with the zig-zag lightning, they will both diftinctly fee the flafh, not only by that indiftinct kind of illumination of the atmofphere, which is occafioned by fire of any kind, but the very form of the lightning itfelf, and every angle it makes in its courfe will be as diftinctly perceptible, as though they had looked directly at the cloud from whence it proceeded. If a perfon happened at that time to be reading, he would diftinctly fee the form of the lightning between himfelf and the book.

Lightning ufually confines its effects to a fmall fpace; feldom refembling thofe phenomena which accompany explofions of gunpowder, or of inflammable air in mines. Inftances, however, have occurred; and the following is perhaps one of the moft remarkable: "Auguft 2, 1763, about fix in the evening, there arofe at Anderlight, about a league from Bruffels, a conflict of feveral winds borne upon a thick fog. This conflict lafted four or five minutes, and was attended with a frightful hiffing noife, which could be compared to nothing but the yellings of an infinite number of wild beafts. The cloud then opening, difcovered a kind of very bright lightning, and in an inftant the roofs of one fide of the houfes were carried off and difperfed at a diftance; above 1000 large trees were broke off, fome near the ground, others near the top, fome torn up by the roots; and many both of the branches and tops carried to the diftance of 60, 100 or 120 paces." Whole coppices were laid down, as corn is by ordinary winds; and the glafs of the windows, fituated near the fpot, was fhivered to atoms.

It is not unufual for thunder-ftorms to produce moft violent whirlwinds, fuch as are by fome philofophers attributed to electricity; nay, even to occafion an agitation of the waters of the ocean itfelf: and all this too after the thunder and lightning has ceafed. Of this the following inftances happened at Great Malvern, October 16, 1761: At a quarter paft four in the afternoon, the people were furprifed with a moft fhocking and difmal noife; 100 forges, all at work at once, could fcarce equal it. Upon the fide of the hill, about 400 yards to the fouth-weft, there appeared a prodigious fmoke, attended with the fame violent noife, as if a volcano had burft out of the hill; it foon defcended, and paffed on within about 100 yards of the fouth end of the houfe; it feemed to rife again in the meadow juft below it, and continued its progrefs to the eaft, rifing in the fame manner for four different times, attended with the fame difmal noife as at firft; the air being filled with a naufeous and fulphureous fmell. It gradually decreafed till it was quite extinguifhed in a turnip field, about a quarter of a mile below the houfe; the turnip leaves, with leaves of trees, dirt, fticks, &c. filled the air, and flew higher than any of the hills. The thunder ceafed before this happened, and the air foon afterwards became calm and ferene."

What electricity is in our hands, fuch is lightning in the hands of nature. The wonders that philofophers exhibit at pleafure are little imitations of thofe great effects which aftonifh and alarm us; neverthelefs, they feem to depend on the fame mechanifm. The fame properties, the zig-zag fparks, their fimilar action on conducting fubftances, the power of rending, inflaming, and difperfing in every direction the fubftances on which lightning acts with power, the giving polarity to ferruginous matter, &c all concur to fhew their identity. But independent of thefe fimilarities, the thing is proved by the plaineft and cleareft evidence; when the atmofphere is charged with thunder clouds, we can by an electrical kite draw from it the matter of lightning, and with this matter perform every electrical experiment with which we are acquainted.

It has already been fhown, that the electric powers never become fenfible to us, except when they are feparated, and then chiefly in their paffage from one body to another in oppofite directions; and that an equal quantity of a different power muft be conducted from the earth to the cloud to produce lightning. For this purpofe, there muft in like manner be the fame reciprocal exchange of powers between two clouds. Thefe, when highly electrified with the different powers, coming near together, approach with an increafing force till

they flaſh in exchanging their powers. But as clouds are formed of diſtinct particles, and every particle has its ſhare of both the electric powers, according to the equality or inequality of quantity of each power; in each particle, it is more or leſs electrified; and on the various combinations of theſe powers will ariſe the mode in which the clouds approach each other, and in which they exchange their different powers.

If the electrified particles happen ſo to approach each other that their atmoſpheres are preſſed off together to a great diſtance from the cloud, they then act nearly the ſame as if the cloud was one continuous body: but after the flaſh, thoſe particles which have exchanged powers, and in which the two electricities are united, being no longer buoyed up by theſe agents, deſcend in ſhowers of hail or rain.

That this in fact takes place, and that theſe atmoſpheres are extended to a great diſtance from the cloud, appears from all experiments made both here and in other countries; for it is plain, that an atmoſphere goes up from the earth, of the power which is contrary to that of the cloud, which would not take place if the atmoſphere of the cloud did not reach the earth. As ſoon as one of theſe highly electrified clouds approaches ſo near to the earth as to exchange powers with it, then is the damage done to thoſe things through which the exchange is made.

A variety of circumſtances ſhew, that the atmoſpheres of the clouds are condenſed at the time of their joining by a flaſh, and that the contrary electricity is then as it were drawn up from the earth. Thus in Mr. Ludolf's account, Phil. Tranſ. vol. 47, at every clap of thunder the electricity ſeemed extinct, and did not return till after the ſpace of about 30 ſeconds; the threads, which by their divergence indicated the electricity, approached each other ſuddenly, as if they had been puſhed together with force. The Abbé Nollet and many others have obſerved ſimilar appearances. In an obſervation of Abbé Nollet, the clap of thunder put a ſtop for ſome time to the force of the electricity. All this may be eaſily illuſtrated by our electrical apparatus. If two cork balls ſuſpended by linen threads are brought from the end of a wire within the atmoſphere of an electrified conductor, they will be electrified with a power contrary to that which electrifies the conductor; receding from each other, but flying towards the conductor. On taking a ſpark from the conductor, they will immediately collapſe; the electricity drawn into them from the earth returning to it again.

We have already obſerved, that clouds electrified with the contrary powers are often driven together, and the particles coming into contact, the powers are exchanged without that violent flaſh which uſually accompanies a thunder ſtorm. In this caſe, the particles generally deſcend in heavy ſhowers of rain; but the exchange of powers is moſt complete in the middle of the united clouds, and it is generally from the middle of the cloud that the heavieſt part of the ſhower proceeds.

One obſervation, out of many that might be produced, will confirm this. It was made by Mr. Eeles in October 1760; when the clouds were very diſtinct, and the ſhowers heavy. In three different clouds he found the ſhowers from the beginning electrified with the vitreous power; the ſhowers from the middle of each cloud ſhewed no ſign of electricity, and the end of each cloud was reſinouſly electrified, the wind N. W. There was no appearance of electricity in the middle of the ſhowers, becauſe the electric powers are there united to each other in every drop; their atmoſpheres and actions were therefore incapable of activity.

It is not uncommon for rain, hail, and ſnow, to exhibit ſigns of being electrified, for the clouds are ſeldom ſo equally electrified with the different powers of electricity, as upon meeting to render them equal in each deſcending drop. In large flakes of ſnow, the electricity is often very evident; for when they come near a non-electric body, they are driven towards, and cling about it like a feather or any ſimilar electrified ſubſtance.

It has been obſerved, that, if two electric plates or jars be charged, and a communication made from the vitreous ſide of one, to the reſinous ſide of the other, no diſcharge will follow, unleſs a communication is formed between the other two ſurfaces at the ſame inſtant. It is in this manner that the natural electricity in the atmoſphere is frequently diſcharged. Two clouds being electrified with oppoſite powers, the ſurfaces of the earth immediately under them are likewiſe electrified with powers contrary to thoſe in the clouds above them; and the moiſture of the earth forming a communication between the two contiguous charged ſurfaces, whenever the two clouds meet, there will follow a diſcharge, both of the clouds and ſurfaces on the earth oppoſed to them. If the earth ſhould be dry, and conſequently afford a reſiſtance to the union of the two electricities accumulated on or under its ſurface, there will follow an exploſion in the earth as well as in the atmoſphere, which will produce concuſſions and other phenomena which have frequently been obſerved to happen in dry ſeaſons, particularly in thoſe climates where thunder and lightning are moſt common.

All the phenomena of lightning are very eaſily accounted for, upon Mr. Eeles's theory of a double current, and the efforts in nature to reſtore the electrical fluid to a latent ſtate, whenever by any means the powers thereof have been ſeparated. Thus, in great thunder ſtorms, there is a portion of the earth under the cloud which is electrified thereby with the contrary electricity; thoſe objects therefore, which form the moſt perfect conductors between the clouds and that portion of the earth, will moſt probably be ſtruck, as being the readieſt way by which the two oppoſite powers can unite, and reſtore the electrical equilibrium both in the cloud and the earth, one part of the flaſh aſcending from the earth, the other deſcending from the cloud to the earth.

We will ſuppoſe a cloud, vitreouſly electrified, to be formed over a certain part of the earth's ſurface. The electric power of the cloud firſt ſeparates that of the atmoſphere; and while it is thus operating, the atmoſphere is reſinouſly electrified. In a little time the air becomes vitreouſly electrified, and then both that and the cloud act as one body. The ſurface of the earth then begins to be electrified, and the powers therein to be ſeparated, and a continual effort is made by the contrary electricities to unite between the earth and the cloud. If thoſe cauſes which firſt produced the electricity ſtill act, the power becomes inconceivably great, and the flaſhes in uniting will tear every thing to pieces that ſtands in their way.

It has been juſtly obſerved by Mr. Read, that a portion of the earth may be highly electrified, and yet we may be inſenſible of it, becauſe we are involved in it; for where all things are equally involved in an electrical atmoſphere, there can be no viſible ſigns of the preſence of the electric matter. Thus if two or more perſons be electrified, while ſtanding on the ſame inſulation, they ſhew no ſigns to each other of being electrified. Whatever be a perſon's ſituation, whether in the houſe or open field, he is liable to be involved in an electric charge, whether it be ſtationary, or moving with the clouds. Mr. Read found himſelf ſo involved once in Hyde Park; the atmoſphere had a menacing appearance, with a heavy black cloud at no great diſtance; on taking his pocket electrometer out of its caſe, and holding it in his hand, it inſtantly diverged near one inch. It is not probable, that the reſtoration of the equilibrium, or returning ſtroke, as it is often called, will hurt any one, unleſs the party be placed directly in the way.

It is probable, as has been already obſerved, that the ope-

tions of the electrical matter are most universal and important in its latent and united state; and that whenever by separation it becomes visible, there is then a general stress throughout the greater part of our system, to restore the equilibrium. It is probable also, that this stress is greater in proportion to the quantity separated; that this separation in many instances is spontaneous; and that, as this fluid is universally disseminated, there is no occasion to consider the appearance of electricity in vapour, &c. as the means by which this fluid is communicated to the clouds.

From the remarks of Mr. de Luc, it would hence appear, that lightning often arises from sudden production of a great quantity of the electrical fluid; that which is then manifested not being apparent as electricity, but just before we perceive its effects. This is further confirmed by his observations when on mountains, where he had often opportunities of viewing these phenomena. Thus in a storm on the Buet (one of the Alps), while the air was perfectly transparent and dry (the last circumstance being determined by the hygrometer), clouds began to form in different parts; these, when thickened and united, embraced the summit of the Buet, and supported themselves against Mount Blanc, and the summits of the neighbouring mountains. Mr. de Luc and his companions were overwhelmed with rain; there was also a vast deal of lightning; which was often violent, and lasted for a considerable time. Mr. de Saussure has also cited instances where the clouds formed a conducting communication with the ground, and yet the lightning continued as at first.

From these phenomena, air perfectly transparent and dry, containing neither the vapours of which the cloud is formed, nor the electric fluid, but only the ingredients proper to create them, he infers, that by some unknown cause, clouds of a certain kind are formed spontaneously, and during the progress of their formation the electricity is produced in great abundance, exploding every time it is thus formed; and that before this, the electric fluid no more existed in that state, than the aerial fluids, which are disengaged from gun-powder, existed as such before the gun-powder was exploded. Mr. Eeles's theory is confirmed by this account of Mr. de Luc very satisfactorily.

Some idea may be formed of the prodigious quantity of the electric fluid, that is sometimes manifested, and passing between the clouds and the earth, by an instance or two with which we are furnished by Mr. de Luc. Thus a cloud was observed at the top of the mountains of Turin: it was formed of a mass, whose obscurity rendered it terrific, producing, in those places over which it was situated, night at noon day; this mass was ploughed as it were by lightning, which was soon after followed by a grumbling kind of thunder: there fell so prodigious a quantity of water and ice from this cloud, that the country was ravaged by the torrents, the hedges were beat down, and the ditches half filled with hail. Erfurt, a small city in Germany, was struck in one night in forty-two different places; seven persons were killed, three houses were set on fire, but quenched by the rain, which came down in torrents. Now it is impossible that we can find, on the vapour theory, known humidity enough in any strata of transparent air, to explain the formation of such clouds, and the torrents of rain which fell from them.

SECT. XIX. *Of Metallic Conducting Rods for Buildings.*

WE now proceed to consider the advantages arising from the use of conducting rods. It has been already said, that the electrical fluid is always impelled to those places where an exchange of powers can be most easily made, or where the union of the two powers is least resisted. If, then, there happens in any of the preceding instances to be a house furnished with a conducting rod, directly between that part of the cloud and that part of the earth where there is the greatest effort for restoring the equilibrium, the conductor will be struck, and will probably prevent the building from receiving any injury. If there be no conductor, the lightning will for the foregoing reasons pass at the same place, but the building will probably be damaged, because the passage of the electrical powers will be opposed by the non-conducting properties of some of the materials.

Among electricians there has long existed a difference of opinion concerning the termination of conducting rods for preserving buildings from lightning; some warmly contending that they should be terminated by knobs or balls; others as strenuously contending, that they should be pointed at the extremity.

The identity of electricity and lightning having been satisfactorily proved, conductors of some kind or other have been generally allowed to be necessary for the safety of buildings in thunder storms, as they afford a ready passage for the union of the contrary electricities. Electricians seem to have forgot that neither lightning nor electricity ever strikes a body, merely for the sake of the body, but because that body is a means of restoring the equilibrium which before was disturbed.

When a quantity of the electrical fluid is excited by means of an electrical machine, a body communicating with the earth will receive a strong spark from the prime conductor; it receives this spark, not because it is capable of containing all the electricity of the cylinder and conductor, but because the natural situation of the fluid being disturbed by the motion of the machine, the natural powers make an effort to restore the equilibrium. No sooner, then, is a conducting body, communicating with the earth, presented to the prime conductor, than the whole effort of the electricity is directed against that body; not merely because it is a conductor, but because it affords a place by which the natural powers can more readily unite, and which they would do by other means, though that body were not to be presented. That this is the case, we may easily see, by presenting the same conducting substance in an insulated state to the prime conductor of the machine, when we shall find only a small spark will be produced. In like manner, when lightning strikes a tree, a house, or a conducting rod, it is not because these objects are high, but because they are situated in that place, where, from a variety of causes, the impetus of the two powers can be lessened by their union.

Hence we may perceive the fallacy of that kind of reasoning which is generally employed on this subject. Because a point presented to an electrified body in our common experiments draws off the electricity in a silent manner, Franklin and his followers have concluded, that a pointed conductor will do the same thing to a thunder cloud, and thus prevent any kind of mischief. For this very reason, however, Mr. Wilson and his followers have determined, that the use of pointed conductors is utterly unsafe; they justly consider the Franklinian idea of exhausting the clouds of their electricity, to be not less absurd, than it would be to clear away an inundation with a shovel, or exhaust the atmosphere with an air-pump. They bring many instances, where a point will receive a full stroke, and assert that it solicits a discharge, and that being often unable to conduct the whole electricity of the atmosphere, it is impossible for us to know whether the discharge they solicit, may not be too great for our conductor to bear, and consequently all the mischiefs arising from thunder storms may be expected, with this mortifying circumstance, that this very conductor has probably been the sole cause.

It should here further be observed, that the Franklinians granting them all they ask, still make their pointed conductor

of too much consequence; for it is now well known, that points have no influence at all, unless they are immerged in the electrified atmosphere. If a pointed body does not communicate with the earth, but the communication is interrupted by a short interval, it will receive a full spark. It will also receive a full spark, if it be suddenly brought sufficiently near a strongly electrified body; this case applies strongly against pointed conducting rods for shipping. It will also receive a full spark at a considerable distance, if surrounded with non-conducting substances. The circumstances on which an explosion depends are too many to be here enumerated; in general it may be said, that, with respect to a point, it will depend on the suddenness of the discharge, on the proximity of the cloud, on the velocity in its motion, on the quantity of electricity contained in it, and on the contrary electricity opposed to it. If a small cloud hangs suspended under a large cloud loaded with electric matter, pointed conductors on a building underneath will receive the discharge by explosion, in preference to those terminated by balls; the small cloud will form an interruption, which allows only an instant of time for the discharge. If a single electric cloud be driven with considerable velocity near to a pointed conductor, the charge may be caused to explode upon it by the motion of the body so charged.

A conductor that is pointed has not the power of attracting the lightning even a few feet out of the direction it would choose itself. Of this we have a most decisive instance in what happened to the magazine at Purfleet, in Essex. That house was furnished with a conductor, raised above the highest part of the building; nevertheless, a flash of lightning struck an iron cramp in the corner of the wall of the building, considerably lower than the top of the conductor, and only forty-six feet in a sloping line distant from its pointed extremity. This, with all its supposed power of drawing off the electric matter, was neither able to prevent the flash, nor to turn it forty-six feet out of its way. The fact is, that the lightning was determined to enter the earth at the place where the Board-house stands, or near it; the conductor, fixed on the house, offered the easiest communication, but forty-six feet of air intervening between the point of the conductor and the place of the explosion, the resistance was less through the blunt cramp of iron, and a few bricks moistened with the rain, to the side of the metalline conductor, than through the forty-six feet of air to its point, for the former was the way in which the lightning actually took its course.

But the propriety of using conductors of either kind may also have been rendered doubtful from the accident which happened to the poor-house at Heckingham, Norfolk, which was struck by lightning, though furnished with eight pointed conductors, and which, it has been confidently said, were uninterrupted, continuous, and at the time of the stroke perfectly connected with the common stock. Hence it is evident, that the good effect of conductors, in general, is by no means so certain as has been imagined.

Fig. 3. plate 11. is the thunder house, as it is usually called; an apparatus principally used to illustrate the Franklinian method of preserving houses from damage by lightning. It consists of a mahogany board, shaped like the gable end of a house. It is fixed upright on an horizontal board as a stand; a square hole is made in the gable board, into which is fitted, so as to go in and out easily, a square piece of wood: a wire is fixed in the one diagonal of this board, and wires are also fixed in the gable board, one from the upper part, the lower end of which comes to one corner of the square hole; the upper end of the other wire coincides with the opposite corner, and goes down to the bottom of the gable board. The upper wire has a brass ball on the top; this may occasionally be taken off, which leaves a point exposed. At the bottom of the lower wire there is a hook: connect the hook at the bottom with the outer coating of a jar, place the square piece in the hole, so that the metallic wire shall not coincide with the other two; when the jar is charged, bring the discharging rod from the knob thereof to the ball of the house; an explosion will ensue, and the square piece will be driven out to a good distance from the thunder house.

If the square piece be put into the hole, in such a manner that the ends of the diagonal may not coincide with the ends of the wire of the gable board, the discharge being made as before, while the metallic circuit is complete, the square board will remain unmoved.

Next, take off the ball, and the point will prevent an explosion, and its accumulating therein in such a quantity as to do any injury.

In these experiments, the prime conductor is supposed to be a thunder cloud discharging its contents on some metal projection at the top of a building; and this is considered as receiving no damage when the conductor is perfect; but when the connection is interrupted, the fluid in passing from one part to the other injures the building.

Sect. XX. *On the Nature of Electricity.*

Having pointed out the principal phenomena of electricity, and exhibited many of the experiments in this branch of natural philosophy; we shall now endeavour to trace out its connection with the great agents in the operations of nature, in order that the reader may form some idea of what electricity is, and of its use in the great system of things. Whatever it may be, it is certain, and that without any exaggeration, that whether we look to the heaven above, or the earth beneath, we can scarcely perceive any thing that is not acted upon, and in a manner perfectly subjected to the operations of this wonderful agent.

That the electric fluid is real matter, and not a mere property, is evident from a variety of circumstances. When it passes between bodies, it divides the air, and puts it into those undulations which give us the idea of sound. It emits the rays of light in every direction, and those rays are variously refrangible and colorific, as other light is: and, if light is acknowledged to be matter, it is contrary to reason and experience to suppose that the thing which emits it should not likewise be material. Neither are the other senses unaffected at its presence: its smell is strongly phosphoric or sulphurous. The sense of feeling evinces its presence, not only from the sparks which, when received from the conductor of a powerful machine, are pungent, and will pass through two or three persons standing on the ground, but also from the shock. A stream of electric matter has also evidently a subacid taste when applied to the tongue.

If we contemplate the system of nature, we clearly perceive three kinds of fluids of extreme subtility, and very much resembling one another; these three are fire, light, and electricity. Their resemblance is so great, that it is not surprising to find it the general conception of all uninformed minds, that they are ultimately the same.

If the supposition be true, that natural effects are not to be ascribed to many different means or agents where one will suffice, these three should be considered as different modifications or states of the same fluid. Light or solar fire will burn in fuel, and act in solid matter with greater effect than the most violent fire of a furnace. Common fire, like that of the sun, will promote vegetation and ripen fruits. The electric fire will light a candle, and fire gunpowder, like the common fire; will afford a spectrum of the 7 primordial colours in common with light; and will throw metals into fusion with a violent

ſcorching heat. But, to enter more into particulars; theſe three fluids all agree in one property, that of exciting heat in certain circumſtances, and not doing ſo in others. Fire, in the common acceptation of the word, always excites heat; but in its latent ſtate, it lays aſide this property; and in vapour, for inſtance, is cold to the touch. Light, when collected into a focus by a burning glaſs, i. e. when its rays converge to a centre, and diverge or attempt to diverge from one, produces heat.

Electricity, when its force is concentrated and converged, produces heat, as we ſhall preſently ſhew by its effects on a thermometer. This does away the objection formerly made to thoſe who aſſerted, that electricity was that elementary fire which pervaded all ſubſtances: the objection was, that though the electric matter emitted light, and had the appearance of fire, it wanted its eſſential characteriſtic of burning; and where great quantities of the fluid were forced through ſubſtances, they inſinuated, that it might be occaſioned by the internal commotion to which their ſmall particles were expoſed.

It is needleſs to inſiſt on the weakneſs and fallacy of the objection, as it is completely removed by many facts. 1. The effect of electricity upon the thermometer. 2. By the experiment that was made at the Pantheon by Mr. Wilſon, with the immenſe apparatus that was conſtructed for making experiments on the preferable utility of pointed or knobbed conductors for preſerving buildings from lightning. The electric aura from this machine fired gunpowder in the moſt unfavourable circumſtances that can be imagined, namely, when it was drawn off by a ſharp point, in which caſe it has generally the leaſt force. Upon a ſtaff of baked wood, a ſtem of braſs was fixed, which terminated at the top in a wooden point; this point was put into the end of a ſmall tube of Indian paper, made ſomewhat in form of a cartridge, about an inch and quarter long, and $\frac{2}{15}$ths of an inch in diameter. When the cartridge was filled with common gunpowder unbruiſed, a wire communicating with the earth was faſtened to the bottom of the braſs ſtem. The charge in the large conductor being kept up by the motion of the cylinder, the top of the cartridge was brought near to the conductor, ſo as even frequently to touch the tinfoil with which it was covered. In this ſituation a ſmall faint luminous ſtream was frequently obſerved between the top of the cartridge and the metal. Sometimes this ſtream would ſet fire to the gunpowder the moment it was applied; at others it would require half a minute, or more, before it would take effect. The difference in time was ſuppoſed to ariſe from ſome moiſture in the gunpowder. Tinder was fired with much more eaſe.

Thus the electric fluid moving through bodies, either in ſmall quantities, or with rapidity, or in very great quantities, will produce heat, and ſet them on fire: it ſeems therefore ſcarcely diſputable, that this fluid is the ſame with the element of fire. But theſe are not to be ſuppoſed the only inſtances of their identity; for fire is brought into action by friction, as well as electricity. Fire dilates all bodies: the electric fluid has alſo a dilating power, which is evident from its action on a thermometer, though, in general, the dilating power of electricity is leſs than the force with which bodies cohere. Fire promotes and accelerates vegetation as well as germination. Electricity does the ſame. Electricity, as well as fire, accelerates evaporation. The experiments made by Mr. Achard on the eggs of a hen, and by others on the eggs of moths, prove that electricity, as well as heat, favours the development of thoſe animals. The electic fluid, in common with fire, will reduce metals into a ſtate of fuſion.

If bodies unequally heated touch each other, the heat is diffuſed uniformly between them. In the ſame manner, if two bodies with unequal degrees, or different kinds, of electricity touch each other, the ſame thing will happen. If ſubſtances of different kinds, and of equal degrees of heat, be placed in a medium of a different temperature, they will all acquire, at the end of a certain time, the ſame degree of heat. There is a conſiderable difference, however, in the ſpace of time in which they acquire the temperature of the medium, *e. g.* metals take leſs time than is required for glaſs.

It will be found, on an attentive examination, that the bodies which receive and loſe their heat ſooneſt, when they are placed in mediums of different temperature, are the ſame which ſooneſt receive and loſe the electric ſigns. Metals, which become warm or grow cool the quickeſt, are the ſubſtances in which the electric powers unite moſt readily. Wood, which requires more time to be heated or cooled, receives and loſes electricity ſlower than metals. Laſtly, glaſs and reſinous ſubſtances, which receive and loſe ſlowly the electric fluid, acquire with difficulty the temperature of the ſurrounding medium.

If an iron rod be heated red-hot at one end, the other extremity, though the bar be ſeveral feet long, will become ſo warm in a little time that the hand cannot hold it; becauſe the iron conducts fire readily: but a tube of glaſs, only a few inches long, may be held in the hand, even while the other end is melting. The electic fluid, in the ſame manner, paſſes with great velocity from one end of a rod of iron to the other; but it is a conſiderable time before a tube of glaſs, at one end of which an excited electric is held, will give electric ſigns at the other.

From theſe obſervations we may juſtly conclude, that ſeveral bodies that receive and loſe with difficulty their actual degree of heat, receive and loſe alſo with difficulty their electricity. Among other properties of electricity it is to be obſerved, that *the electric powers may be put in action by heat and cold.* Mr. Canton procured ſome thin glaſs balls, of about an inch and a half diameter, with ſtems or tubes about eight or nine inches in length, and electrified them, ſome vitreouſly on the inſide, others reſinouſly, and then ſealed them hermetically Soon after he applied the naked balls to his electrometer, and could not obſerve the leaſt ſign of their being electrical: but holding them to the fire, at the diſtance of five or ſix inches, they became ſtrongly electrical in a ſhort time, and more ſo when they were cooling. Theſe balls would, every time they were heated, give the electric power to, or take it from, other bodies, according to the vitreous or reſinous ſtate of it within them. Heating them frequently diminiſhed their power, but keeping one of them under water a week did not in the leaſt impair it. The balls retained their virtue for more than ſix years.

Many of the precious ſtones are alſo known to acquire electricity by heat: the tourmalin eſpecially, which has always, at the ſame time, a vitreous and reſinous electricity; one ſide of it being in one ſtate, the other in the oppoſite. Sometimes one ſide will at the ſame time poſſeſs both electricities. Theſe powers may be excited by friction and by heat; nay, even by plunging it in boiling water alone.

A variety of facts prove, that electricity is produced by liquefaction. Thus, where chocolate is manufactured in large quantities, a vivid light is frequently ſeen flaſhing upon its ſurface after melting, and it will alſo attract light ſubſtances, ſeparate pith balls, &c. When it had loſt this property, Mr. Henly found it might be reſtored by melting it together with a ſmall quantity of olive-oil. If ſulphur be melted in a glaſs veſſel, and taken out when cool, both it and the glaſs will be found in a ſtrongly electrified ſtate.

It has been already ſhewn, that electricity is produced by the evaporation of water. The following is Mr. Read's mode of performing this experiment. He inſulates a large hollow tin cone, containing about four ſheets of tin plates, with many

yards of ſmall wires coiled up within it; one end of the wire is extended from the cone, to a very ſenſible electrometer. The cone and wire collect and condenſe the aſcending electrified vapour, as it quits the inſulated veſſel containing the fluid. The electrometer connected with the cone is vitreouſly electrified; that connected with the veſſel from whence the vapour aroſe, is in a reſinous ſtate. The ſame ingenious writer has alſo ſhown by burning different ſubſtances in inſulated veſſels, under his tin cone, that bodies, in paſſing from a ſolid to a fluid ſtate, produce the two electricities: the quantity obſerved is in general very ſmall, on account of the intimate affinity between flame and electricity.

Sect. XXI. *Of the Action of Electricity on the Thermometer.*

If a ſenſible mercurial thermometer be inſulated, and the bulb placed between two balls of wood, one affixed to the conductor, the other communicating with the ground, the electric fluid, in paſſing between the two balls, will raiſe the mercury in the thermometer conſiderably. With a cylinder of about ſeven inches and a half in diameter, the fluid paſſing from a ball of lignum vitæ to a ball of beech, and thence to the ground, elevated the quickſilver in the thermometer from 68° to 110°, repeatedly to 105°. The thermometer was raiſed from 68° to 85°, by the fluid paſſing from a point of box to a point of lignum vitæ; from 67° to 100°, from a point of box to a ball of box; from 66° to 100°, from a ball of box to a braſs point; from 69° to 100°, from ball to ball; the bulb of the thermometer being covered with a piece of flannel. *If then theſe fluids, fire, light, and electricity, which thus mutually, and in all reſpects, aſſume each other's properties, are not the ſame; experiment is a thing not to be depended upon, and the moſt obvious rules of philoſophiſing, adopted and approved by all parties, are no better than ſpecious deluſions.*

To ſay more indeed to any obſerver of nature muſt be ſuperfluous; but it is neceſſary to accumulate proof, in order to leſſen the prejudices of modern philoſophers, who have altogether neglected to ſtudy and trace the great agents of nature. For theſe it may be neceſſary to point out other links, in which they may ſee the connection between fire, light, and electricity. Thus, as heat is diminiſhed, electricity ſucceeds in its place. All electric bodies, by heat, are rendered conductors, and can no longer be excited; but as ſoon as the heat is removed, their electric property is reſtored. Water, which is a conductor, on being frozen has its conducting powers leſſened; when cooled down to twenty degrees below o of Fahrenheit's ſcale, it becomes an electric, and will emit ſparks by friction, like glaſs. The atmoſphere is a natural electric; but by a certain degree of heat it loſes in a degree this property, and becomes a conductor; nor is there any doubt that its electric properties are increaſed in proportion to the degree of cold to which it is brought.

Some facts are mentioned by Mr. Æpinus in a letter to Dr. Guthrie, which will illuſtrate this ſubject; they relate to phenomena that are known to take place in Ruſſia, when a great cold has continued for ſeveral weeks. Mr. Æpinus was ſent for, to ſee an uncommon phenomenon. On going into the apartment of Prince Orloff, he found him at his toilet, and that, at every time his valet drew his comb through his hair, a pretty ſtrong crackling noiſe was heard; and on darkening the room, the ſparks were ſeen following the comb in great abundance, while the Prince was ſo completely electrified that ſtrong ſparks could be drawn from his hands and face; nay, he was even electrified by the puff employed in powdering him.

On another occaſion, the Great Duke of Ruſſia ſent for Mr. Æpinus one evening in the twilight, and told him, that having briſkly drawn a flannel cover off a green damaſk chair in his bed-chamber, he was aſtoniſhed at the appearance of a ſtrong bright flame that followed; but conſidering it as an electrical appearance, he had tried to produce a ſimilar illumination on different pieces of furniture, and could then ſhew him a beautiful and ſurpriſing experiment. He then threw himſelf on his bed, which was covered with a damaſk quilt, laced with gold; and rubbing it with his hands in all directions, he appeared to be ſwimming in fire, as at every ſtroke flames aroſe all around him, darted to the gold laced border, ran along it, and up to the top of the bed.

While this experiment was proceeding, Prince Orloff came into the room, with a ſable muff in his hand, and ſhewed, that by only whirling it five or ſix times round his head in the air, he could electrify himſelf ſo ſtrongly, as to ſend out ſparks from all the uncovered parts of his body; for the inlaid floors had become ſo dry, as to inſulate him completely. We may therefore, in the winter ſeaſon, conſider the frozen ſurface of the earth, the water, and atmoſphere, as forming one electrical machine of enormous magnitude; for the natural cold of thoſe countries is often ſuch as to cool water to more than 20 degrees below o, and thus render it an electric. That ſomething of this kind is real, appears from the exceſſive bright aurora borealis, and other electric appearances far exceeding any-thing in this country. In the ſummer time theſe appearances are not remarkable, but an exceſſive heat prevails from the long continuance of the ſun above the horizon. *The quantity of heat in ſummer being ſucceeded by a proportionable quantity of electricity in winter*, one can ſcarce avoid concluding, *that the heat in ſummer, or diſengaged fire, becomes electric fluid in winter, which going off through the celeſtial expanſe returns again to the grand ſource of light and heat; thus making room for the ſucceeding quantities which, during the next ſeaſon, are to enliven the earth.*

If we admit the identity of light, fire, and electricity, the ſource from whence the electric fluid is derived into the earth and atmoſphere muſt be very evident: it can be no other than the ſun, or ſource of light. The vaſt quantity of light continually proceeding from the ſun to the earth, muſt in a great meaſure be abſorbed thereby; but from other operations in nature, it is prevented from remaining there; it is therefore in continual circulation, to make room for the new quantities continually coming from the ſun. It muſt however be obſerved, that as this fluid is variouſly combined, it cannot appear in its natural form of fire or light, till it is diſengaged, and capable of receiving a motion ſimilar to what it had when proceeding from the ſource of light.

Mr. Jones conſiders this change of matter into a different form, with the ſubſequent regeneration of it into its primitive form, as one of the great ſecrets of nature, whereby the world is kept from decaying either with reſpect to its matter or its motion. By means of a circulation in matter, the laſting motions of nature are maintained, and its ſtores unimpaired.

Sect. XXII. *Luminous Experiments.*

We now proceed to deſcribe a ſeries of experiments that do in the ſtrongeſt manner prove the identity of the electric fluid and light, and that both are tranſmitted through electric as well as other ſubſtances; and farther, that it is on the motion of this fluid that tranſparency depends; that when this medium is at reſt, the body is opake; when ſet in motion, the contrary.

If we take a ſtrong ſpark through the centre of an ivory ball, it will be illuminated throughout its whole ſubſtance. If we take a ſpark through a ball of box-wood, it will appear of a beautiful crimſon, or rather a fine ſcarlet colour: or if the ſhock be paſſed through pieces of wood of different thickneſſes and denſity, a very ample field for obſervation and experiment will be afforded. To make a bottle of water luminous, connect one end of a chain with the outſide of a charged jar, let the other

end lie on the table, place the end of another piece of chain at about one quarter of an inch diſtance from the former, then ſet a decanter of water on theſe ſeparated ends, and, on making the diſcharge through the chain, the water will appear beautifully luminous and bright. In fact, there is ſcarcely any ſubſtance, fluid or ſolid, but what may be rendered luminous, by paſſing the electric fluid through it, and thereby ſeparating the electric powers inherent in the body. In water, ſpirit, oil, animal fluids of all kinds, the diſcharge of a Leyden phial, of almoſt any ſize, will appear very ſplendid, provided they are carefully placed in the circuit, ſo that the fluid may not paſs through too great a quantity of them at once.

In order to perform this ſucceſsfully, place the fluid, on which the experiment is to be made, in a tube three quarters of an inch in diameter, and four inches long; ſtop up the orifices of the tube with two corks, through which puſh two pointed wires, ſo that the points may approach within one-eighth of an inch to each other; the fluid, in paſſing through the interval which ſeparates the wires, is always luminous, if a force be uſed ſufficiently ſtrong; the glaſs tube, if not very thick, always breaks when this experiment ſucceeds. To make the paſſage of the fluid luminous in the acids, they muſt be placed in capillary tubes, and two wires introduced, as in the preceding experiment, whoſe points ſhall be very near each other. It is a well-known fact, that the diſcharge of a ſmall Leyden phial, in paſſing over a ſtrip of gold, ſilver, or Dutch metal leaf, will appear very luminous. By conveying the contents of a jar, meaſuring two gallons, over a ſtrip of gold leaf, one-eighth of an inch in diameter, and a yard long, it will frequently give the whole a dazzling brightneſs. We may give this experiment a curious diverſity, by laying the gold or ſilver leaf on a piece of glaſs, and then placing the glaſs in water; for the whole gold leaf will appear moſt brilliantly luminous in the water, by expoſing it, thus circumſtanced, to the exploſion of an electrical battery.

Another thing to be obſerved is, that *the difficulty of making any quantity of the electrical fluid luminous in any body, increaſes as the conducting power of that body increaſes;* becauſe the two powers unite ſooner in proportion to the conducting power, and conſequently all electric ſigns are at an end. To make the contents of a jar luminous in boiling water, a much higher charge is neceſſary, than would be ſufficient to make it luminous in cold water, which is univerſally allowed to be a conductor of the worſt kind.

Acids, for various reaſons, have been reckoned very good conductors: if, therefore, into a tube filled with water, and circumſtanced as has been already deſcribed, a few drops of either of the mineral acids are poured; it will be almoſt impoſſible to make the fluid luminous in its paſſage through the tube, as the two powers immediately unite with each other.

The eaſe with which the electrical fluid is rendered luminous in any particular body, is increaſed by increaſing the rarity of the body. The appearance of a ſpark, or of the diſcharge of a Leyden phial, in rarefied air, is well known. But as ſimilar phenomena attend the rarefaction of ether, of ſpirits of wine, and of water, we need not reſt the truth of the obſervation on the ſeveral varieties of this fact.

The effects of the electric ſpark in rarefied water, ſpirits of wine, ether, and acids, are ſhewn in the following experiment by Mr. Morgan. Into the orifice of a tube, 48 inches long, and two-thirds of an inch in diameter, he cemented an iron ball, ſo as to bear the weight which preſſes upon it when the tube is filled with quickſilver, leaving only an interval at the open end, that contains a few drops of water. Having inverted the tube, and plunged the open end of it into a baſon of mercury, the mercury in the tube ſtood nearly half an inch lower than it did in a barometer at the ſame inſtant, owing to the vapour which was formed by the water. But through this rarefied water the electrical ſpark paſſed as luminouſly as it does through air in an equally rarefied ſtate.

If there are placed, inſtead of water, a few drops of ſpirits of wine on the ſurface of the quickſilver, phenomena ſimilar to thoſe of the preceding experiment will be diſcovered, with this difference only, that as the vapour in this caſe is more denſe, the electrical ſpark, in its paſſage through it, is not quite ſo luminous as it is in the aqueous vapour. If good ether be ſubſtituted in the room of the ſpirits of wine, it will preſs the mercury down ſo low as the height of 16 or 17 inches. The electrical fluid, in paſſing through this vapour (unleſs the force be very great indeed) is ſcarcely luminous; but if the preſſure on the ſurface of the mercury in the baſon be gradually leſſened by the aid of an air-pump, the vapour will become more and more rare, and the electric ſpark, in paſſing through it, will increaſe in brilliancy.

The brightneſs and ſplendor of the electric ſpark is always increaſed when it is compreſſed into a ſmaller compaſs. That is, a ſpark, or the diſcharge of a battery, which we might ſuppoſe equal to a ſphere one quarter of an inch in diameter, will appear much more brilliant, if the ſame quantity of fluid is compreſſed into a ſphere one-eighth of an inch in diameter. This obſervation is the obvious conſequence of many known facts. If the machine be large enough to afford a ſpark, whoſe length is nine or ten inches; this ſpark may be ſeen ſometimes forming itſelf into a bruſh, in which ſtate it occupies more room, but appears very faintly luminous; at other times, the ſame ſpark may be ſeen dividing itſelf into a variety of ramifications, which ſhoot into the ſurrounding air. In this caſe, likewiſe, the fluid is diffuſed over a large ſurface, and in proportion to the diffuſion, ſo is the faintneſs of the appearance. A ſpark, which in the open air cannot exceed one quarter of an inch in diameter, will appear to fill the whole of an exhauſted receiver, four inches wide and eight inches long: but in the former caſe it is brilliant, and in the latter it grows fainter and fainter, as the ſize of the receiver increaſes. This obſervation is further proved by introducing two pointed wires into the vacuum, ſo that the fluid may eaſily paſs from the point of the one to the point of the other; when the diſtance between them is not more than the one-tenth of an inch, in this caſe we ſhall find a brilliancy as great as when open to the atmoſphere.

Convey as much air into a Torricellian vacuum, 36 inches long, as will fill two inches only of the exhauſted tube if it were inverted in water; this quantity of air will afford reſiſtance enough to condenſe the fluid as it paſſes through the tube into a ſpark, 38 inches long. The brilliance of the ſpark in condenſed air, in water, and in all ſubſtances through which it paſſes with difficulty, depends on principles ſimilar to thoſe which account for the foregoing reſults.

In electrical appearances, as well as in thoſe of burning bodies, there are caſes in which all the rays of light do not eſcape; and the moſt refrangible rays are thoſe which firſt or moſt eaſily eſcape. The electrical bruſh is always of a purple or blueiſh hue. If a ſpark be paſſed through a Torricellian vacuum, made without boiling the quickſilver in the tube, the bruſh will diſplay the indigo-coloured rays.

To a metal ball, four inches in diameter and inſulated, fix a wire a foot and a half long; this wire ſhould terminate in four ramifications, each of which muſt be fixed to a metallic ball half an inch in diameter, and placed at an equal diſtance from a metallic plate, which muſt be communicated by metallic conductors with the ground. A powerful ſpark, after falling on the large ball at one extremity of the wire, will be divided in its paſſage from the four ſmall balls to the metallic plate. When the diviſion of the fluid is examined in a dark room,

ſome little ramifications are ſeen, which will yield the indigo rays only: indeed at the edges of all weak ſparks the ſame purple appearance may be diſcovered. You may likewiſe obſerve, that the nearer you approach the centre of the ſpark, the more brilliant its colour is.

A fact which will help us to account for ſome very extraordinary appearances is, that *the influence of different media on electrical light is analogous to their influence on ſolar light.* Thus, let a pointed wire, having a metallic ball fixed to one end of its extremities, be forced obliquely into a piece of wood, ſo as to make a ſmall angle with the ſurface of the wood, and to make the point lie about one-eighth of an inch below the ſurface. Let another pointed wire, which communicates with the ground, be forced in the ſame manner into the ſame wood, ſo that its point likewiſe may lie about one-eighth of an inch below the ſurface, and about two inches diſtant from the point of the firſt wire. Let the wood be inſulated, and a ſtrong ſpark, which ſtrikes on the metallic ball, will force its paſſage through the interval of wood which lies between the points, and appear as red as blood. To prove that this appearance depends on the wood's abſorption of all the rays but the red; when theſe points were deepeſt below the ſurface, the red only came to the eye through a priſm; when they were raiſed a little nearer the ſurface, the red and orange appeared; when nearer ſtill, the yellow; and ſo on, till, by making the ſpark paſs through the wood very near its ſurface, all the rays at length become viſible.

"Previous to the diſcoveries that have been made in modern times, relative to the chemical effects of light, ſome mathematical philoſophers diſputed its exiſtence as a particular fluid, and even that of fire itſelf; they crudely imagined, that the phenomena of light and heat were only particular modifications of the ſubſtances in which they appeared; a kind of vibration of their particles, tranſmitted by means of a medium, as in the caſe of ſounds.

"They applied the mathematics to this hypotheſis, in order to explain ſome particular phenomena; and as every thing that appears to be deduced from mathematical theorems, eaſily ſeduces thoſe who do not apply themſelves to examine data, this theory, which effectually barred the road to the moſt important phyſical reſearches, met with many partiſans: but chemiſtry and meteorology have now come in to terminate the controverſy; and there are at preſent very few philoſophers who do not agree, that lucidity and heat are the effects of two fluids, namely, light and fire, which produce thoſe particular phenomena whenever they are at liberty; but which at the ſame time may be ſo combined with other ſubſtances, as to lie hidden in them without producing theſe effects, till again ſet at liberty. By an attention to theſe great agents, the ſtudy of nature has proceeded with rapidity, and the preſent æra will probably on this account be as much celebrated in the hiſtory of ſcience, as thoſe in which Paſcal demonſtrated the preſſure of the air on bodies, and in which Newton diſcovered the principle of gravity.

"Our progreſs in the knowledge of the origin of bodies has been much advanced in this age, ſince chemiſts and philoſophers have begun to examine their volatile products, in other words, the elaſtic fluids; but this would have been doing but little, had not the advances in other branches of natural knowledge led them to diſcover, that the phenomena of heat proceeded from a particular ſubſtance ſuſceptible of chemical affinities, namely, fire, the immediate cauſe of heat. Here then is a ſubſtance of the higheſt importance in the compoſition of bodies, which nevertheleſs eſcaped the attention of philoſophers, while they only eſtimated and expreſſed the amount of their products by their weights. Is it poſſible for any one to ſuppoſe, that we have hereby diſcovered all the imponderable ſubſtances that enter into the compoſition of natural bodies?"

We ought by no means to neglect the phenomena of lucidity, while every thing announces to us that light is a chemical ſubſtance. This neglect is ſcarcely now to be apprehended, as philoſophers are aware that great chemical effects may be produced by imponderable ſubſtances. The phoſphoric phenomena of certain mineral ſubſtances indicate clearly that light enters as an ingredient in their compoſition. Wilſon and Beccaria have ſhewn, that every ſubſtance in nature is more or leſs phoſphorical; and we have juſt ſeen, that there is ſcarce any ſubſtance which may not be rendered luminous by ſeparating its electric properties.

The ſort of relation between theſe two imponderable ſubſtances, whoſe exiſtence is now eſtabliſhed beyond a doubt, is ſuch as in many other inſtances is found to ſubſiſt between ſuch ſubſtances as enter into the compoſition the one of the other. Light frequently does not ſenſibly act otherwiſe than as the cauſe of lucidity, or of luminous phenomena; and fire in the ſame manner, only as the cauſe of heat: but at other times, fire, in producing heat, produces alſo in the end its luminous effects; and in ſome circumſtances light, in making viſible the objects, by its reflection contributes to produce heat. Theſe phenomena clearly indicate, that one of theſe ſubſtances contains the other, but that under certain circumſtances it may be ſo decompoſed, as to permit either of them to exerciſe the properties peculiar to the other.

That great chemiſt Boerhaave, in his analyſis of fire, has ſo clearly eſtabliſhed the univerſality and importance of this element, and ſo ſtripped it of the myſtic dreſs in which it was enveloped before his time, that one would have imagined it ſcarce poſſible for philoſophers to have referred ſo many of its ſubtil effects to occult or fanciful properties; yet that ſuch has been the caſe, is evident from the ſlighteſt inſpection of modern theories. Again, though the moſt obvious phenomena in nature, and numerous experiments, tend to aſcertain beyond all doubt, that the matter of common light or fire pervades all nature, and fills all things; yet, as has before been obſerved, the whole has been overlooked as an accidental filtration that implied no conſequences, nor interfered with the various unintelligible properties of bodies, notwithſtanding it pervaded their innermoſt penetralia.

Nothing can be more evident, than that the natural omnipotence of light depends on the ſun; by him, in a natural ſenſe, the matter of fire, as his iſſue, is omnipreſent, and all-ſufficient. If the life of all things depends on the activity he communicates to them, is it not probable that it is the influence of the ſolar fluid that generates and maintains that life, in all its ſpecific characters, in every being according to its kind? And that life, whether it be vegetable or animal, is ſuch as it is according to the ſtate of the fire in it; and that every dead thing is only ſo, becauſe its fire is quenched? The ancient philoſophers affirmed, that the light of the ſun, which gave life and motion to all things, muſt exiſt in all things; they therefore conceived all things to be replete with it. May we not then conſider it highly probable, that this terraqueous globe is only an accumulation of materials introduced into the boundleſs ocean of ſolar fluid for a theatre on which, under the direction and guidance of the ALMIGHTY, it may diſplay its inexhauſtible energy and powers; the terreſtrial maſs being ſo diſpoſed and arranged by its DIVINE AUTHOR, as to become a ſeminal bed of materials, where light and fire may pierce, animate, and diſplay an endleſs variety and ſucceſſion of beings?

We cannot form any clear or diſtinct idea of the agency of the ſolar fluid in the air, in animals, in vegetables, &c. without conſidering it firſt more in general; nor can we properly take a view of the univerſal agency of the element productive of fire, light, and electricity, and its importance to the animal

frame, unless we take an enlarged prospect of its action. Besides, knowledge often makes more rapid advances, by reasoning upon known facts, than by discovering new ones, which by their novelty too often lead to hasty and undigested theories. In the disquisition upon these fluids, we have always kept an eye upon the doctrine of electricity; and the preceding as well as following experiments all concur in shewing the analogy that runs through nature; and it will be evident, that electricity, though not in name, has been the doctrine of all ages. Let us therefore continue to treat of these wonderful fluids. Of all that are known in the universe, the mobility of the matter of light is the greatest. There is not the smallest speck of colour in the beams of the sun, that does not obediently receive perpetual impressions from him in all lineal directions, by night as well as by day. The sun, as the fountain of motion, is also continually agitating this fluid either radially, or obliquely, by the lateral shocks and friction of the radii upon those parts of the fluid that lie out of the line of the sun's irradiation; these, together with the constant vicissitudes of day and night, preserve, in all its internal parts, a continued motion.

It must be owned, however, that even this is not adequate to convey a just idea of the constant, positive, intense energy, from the activity of the matter of light; of which a better idea may be formed, by examining the mode of its action in the interior parts of the most rigid and solid bodies. For in the most secret recesses of the most solid and passive substances, the matter of light is so far from existing in an indolent quiescent state, that it is impossible to form an adequate idea of its incessant and active energy, under these circumstances. Yet this state of bodies is but little thought of by philosophers in their researches into its properties, either common or special, which we shall illustrate, by considering the circumstances of sonorous bodies, and the phenomenon of hammering cold iron till it becomes of a red heat.

Were this fluid resident within bodies, in an indolent and passive state, it could exert no reluctation on any mechanical force disturbing its passive occupation within bodies; whereas, in fact, its natural state is never disturbed without an active irritation being excited in the fluid, to recover and repossess its organical and interstitial inherency, greater than that by which it was expelled; it returns with a force not barely sufficient to recover the dimensions it occupied within bodies, but with a violence capable of expanding them as much beyond their natural size as the external blow or concussion tended to compress them within it: hence a vibratory colluctation takes place between that action which preserves bodies in their natural crasis, and the rapid returns of the fluid to its natural state. These vibrations continue for a time, and imperceptibly diminish till they cease entirely.

The violent agitation, thus excited by the collision of bodies, is not confined to their points of contact, but pervades their whole substance, and oscillates in every part; as is demonstrated to the eye and ear, when a musical chord is struck. We have specimens also of it, in all elastic sonorous bodies. When a bell is struck, the sound continues labouring in the ear for a considerable time afterwards; nor is the tumult subsided, when our sense of it fails; it passes through a gradual decay not perceptible to our senses. If an iron poker be suspended from the head, by holding it between the teeth; though iron discovers no great degree of any sonorous quality, yet if it be struck, you will have a very striking sensation of the vibratory motion its whole substance conceives from the stroke, by the teeth's transmitting these effects to the ear.

We hear much from physiologists of the irritability of our nervous system, as a very mysterious phenomenon; but there are more striking examples of this irritability in the most rigid inanimate substances, such as glass, bell metal, &c. which though so rigid that few instruments will make an impression on them, are yet capable of being agitated through every atom of their substance; nay, so as in some cases to be burst in pieces by the impression of certain sounds. A wine glass will burst in pieces by the action excited through its substance by certain tones of voice. Columns of marble or porphyry are tremulous to thunder explosions, and to certain tones which an organ is capable of producing.

And this excessive mobility of parts throughout the whole substance of the most rigid bodies, clearly implies a great turgency of their substance with some very active fluid, so that a small increase of its action is ready to burst them in pieces. A slight resistance to the internal agitation of a bell, will, upon this principle, cause it to crack.

It is not easy to conceive, that such a tremulous motion as this should be produced through the whole continuity of such hard bodies, unless they contained in themselves some inconceivably active element, exerting a constant nisus to force their parts to as great a distance from each other as possible, and barely counteracted by the power that maintains their cohesion. The indications of this restless activity within solid bodies, are not confined to such as are commonly called elastic. Thus iron yields more striking proofs of this latent active principle than any substance of greater elasticity than itself, and thus discloses to our sensible conviction, precisely what that principle or restless element is, that exerts its energy so powerfully within all terrestrial substances. For the power within bodies, that sustains and preserves their form, is not a passive power. It is a positive re-action to the approach of the parts of the body. The law of re-action being equal to action, resides ultimately in the constitution of this powerful fluid medium. Whenever the spaces it occupies within the surface of bodies are pressed nearer one another by any sudden shock or collision, and consequently this medium is for an instantdriven out, the next instant it returns with violence, not merely enough to regain its place in the body, but equal to that with which it was ejected; and therefore, in returning, it dilates its spaces as much beyond their size, as they were compressed below their natural standard by their collision; by which means a temporary oscillation is excited between the efforts of that power, which circumscribes bodies, and binds them to their natural dimensions, and the internal medium which was irritated by the stroke to act with a degree of force equal thereto.

But should the strokes, which dispossess this fluid of the spaces it naturally obtains within bodies, be quickly and successively renewed, before the colluctations raised by the former ones have subsided; the internal agitation may thereby soon be raised to such a height, as to break forth and become manifest in the form of actual fire.

We may in fact consider every material being, through all the forms of nature, as a composition of this celestial fluid and terrestrial matter; and that the distribution of material substances into these two classes is the true key to all natural knowledge. It not only distinguishes this globe from the celestial fluid in which it swims, but is to be applied to every individual terrestrial substance; which must be considered, if we would comprehend the phenomena of nature, as an intimate composition of these two elements: the latter being the organ or case to the energy of the former, and the modifier of its incessant activities; while the former is the medium used by mind to impress those characters on the latter, which are known as the distinguishing properties of different substances.

Agreeably to the variety of these phenomena by which its energy has been discovered to us, this fluid has been named, under different circumstances, *light*, *fire*, *electricity*, *materia subtilis*, *materia media*, &c. At other times it has been divested of its materiality, and been considered merely as a principle

annexed to or inherent in matter, under the terms of *occult quality*, *nifus*, *attraction*, *electric attraction*, *elasticity*, *irritability*, *vital principle*, *life*, *sympathy*, *stimulus*, &c.

The invifible agent which is thus varioufly defcribed, is ever ready to exert and fhew itfelf in its effects, cherifhing, heating, fermenting, diffolving, fhining, and operating in various manners, according to the fubjects which employ and determine its force. It is prefent in all parts of the earth and firmament, though in moft cafes latent and unobferved, till fome occafion produces it in act, and renders its effects vifible; it exifts in our conftitution, and indeed in every form in nature, in two modes, interftitially and organically. If the pores of gold (the denfeft of all known fubftances) exceed its folid or earthly parts, how much greater muft the proportion of folar fluid be in our frame than in that of gold! The element of water furnifhes an illuftration of this.

In confequence of its tranfparency, water certifies to our fenfes, that light has free accefs into and through its fubftance; and the latter probably fills up its interftices, as water does a fpunge when foaked in it. But we know further by the fluidity and the volatilifation of water, that the matter of light or fire has not only accefs to its interftices, but penetrates and occupies its fimilar elementary particles; for thefe particles could not be rendered volatile, but by internal dilatation; nor could they be dilated, but by fomething that their internal parts were capable of receiving. Thefe particles then are the organical parts of water, which have their individuality as feparable elementary parts, as well as their fimilarity of character, preferved by that etherial principle with which they are endued.

Having fettled thefe points, we fhall now have an obvious folution of the difficulties which have attended the queftion, What is the principle of natural life? Modern phyfiology has indeed bewildered the conception of its pupils, by not diftinguifhing between the term life, ufed metaphyfically for our fyftem of confcioufnefs, or as the refult of our whole compofition, explicable only by the creator, and the fame term life, ufed phyfically, to denote the natural power that prefides in reciprocally regulating, and being regulated by, the mechanifm and difpofition of the whole, and of every part and particle of the animal machine.

The unremitting and reciprocal corrufcations of this vital principle in the fluids and folids, according to the different qualities and confiftencies they affume in different parts of our conftitution, difplay and fuftain the whole fyftem of life in every individual. Light is not more inftantaneoufly difpatched by reflection from a mirror, or by that power which every point of the air has of reflecting lightning, than that with which the fame fluid, under the character and modification of the vital principle, acts from place to place in our bodies. For the moment of willing, and of moving any member, is, to us, undiftinguifhably the fame; fo likewife the moment of being touched, and the touch being felt. But thefe inftantaneous tranfmiffions in our frame are not confined to fuch as we have a confcious perception of: they are inceffantly tranfacting; the remoteft vibrating artery correfponding with the heart, does not more immediately and conftantly feel its power, than the material principle of vitality, through its whole form in our ftructure, feels the permanent influence of its own power concentred in and irradiating from the brain, the nerves being the directors of the various intended energy of the powers of natural life. This vivifying plenum, occupying and organifing every particle and interftice in our compofition, can difcharge its whole nifus according to the pathic intimation and direction of any nerve or nerves, as inftantly as electricity does through the fubftance of the body that receives the electrical ftroke.

When it is confidered that the rarefying and expanfive force of this element is fufficient, in an inftant of time, to produce the greateft and moft ftupendous effects, we have a full proof not only of the power of fire, but alfo of the wifdom with which it is managed, and withheld from burfting forth to the utter ravage and deftruction of all things; and it is very remarkable, that this fame element, fo fierce and deftructive, fhould yet be fo varioufly applied by Providence, as to prove the genial and cherifhing flame of every thing that exifts on the earth.

Upon a due confideration of what has been faid, it will be found that our arguments concur in proving, what all nature bears teftimony of, "that the fluid etherial matter of the heavens acts by impulfe on the folid matter of the earth; is inftrumental in every one of its productions, and neceffary to all the ftated phenomena of nature. The elements may then be divided into active and paffive; not that they are fuch by any inherent or effential difference, but that, according to the order eftablifhed by the Divine Architect, they are obferved to fubfift under fuch relations.

Sect. XXIII. *Of Animal Electricity.*

Having proceeded thus far in the fubject of Electricity in general, we next come to fpeak of the reafons and experiments which induced Dr. Shebbeare, in 1755, to adopt electricity as the principle of vital heat and motion. We fhall alfo fhew how far his opinion has been confirmed by fubfequent difcoveries.

When we put a mufcle into motion by the will, we are able neverthelefs to actuate it by a farther extenfion of volition, as from walking to running. By this operation of the mind, there is more of the vital fire determined to the mufcles employed in thofe actions; mufcles are alfo brought into action, by the fire from the electrical machine, and palfied limbs have been rendered plump by the fame means, and a power of motion and action reftored to thofe whofe palfies have not been of a long ftanding, and which had not their fource from an injury of the fpinal marrow. This offers a convincing proof, that vital fire is the caufe of mufcular motion, and that this vital fire is of the fame kind with that produced by the common means of electricity.

After our having difcovered in the electrical fluid fo many phenomena, which are always to be diftinguifhed from thofe of fire, it will fcarce be any longer difputed, that they are the fame in their own nature. Nor, after the fire put in action in electrical experiments has been perceived by all our fenfes, can we fuppofe, that there can be lefs reality in it, than in earth, air, water, or fire, whofe reality with refpect to mankind depends on the evidences of thofe very fenfes. Electricity communicates ideas to every fenfe; it is light to the eye, odour to the nofe, ftroke to the touch, and fub-acid to the organs of tafte.

If heat be communicated, either by means of water, or any other method, to the heart of a viper or of an eel taken from the body of thofe animals, it will again begin to vibrate. Now heat is fire in action, and thus the fame effect is produced as in the cafe of a palfied limb.

The hearts of vipers, eels, and fuch-like animals are put into motion by a power of the fame nature, though in a lefs degree than that which moves the hearts of larger animals, becaufe they are extremely cold by nature, and therefore, in them, a lefs degree of fire ftimulates the heart than in the larger animals. It is not improbable, that the fame degree of heat which is neceffary to keep a fowl alive, would deftroy a frog or viper. After the heart of a viper has ceafed to beat with the application of any certain degree of heat, it will vibrate again on the application of a ftill greater degree of heat.

Again, the heart of an animal, which in the open air has ceafed to move with a certain degree of heat, will vibrate again in vacuo with the fame degree; for, the preffure of the atmo-

ſphere being removed, a leſs power is required to diſtend the ventricles.

The heart of an eel, which had been ſome time dead, was placed by Dr. Shebbeare on a card, and put on the conductor. The firſt motion perceived, was its ſwelling, or the diaſtole of the ventricles, which not being immediately followed by the contraction or ſyſtole, he took the electrical ſpark from the heart, on which it contracted. It then dilated again, and upon the application of his finger again contracted; and thus having repeated it ſeveral times, the heart continued to perform its diaſtole and ſyſtole, without being touched; and when it was removed it ceaſed, but began again upon being placed on the conductor.

From lord Bacon we have a very remarkable inſtance of the effect of fire upon the human heart. He ſays, "that upon the embowelling of a criminal, he had ſeen the heart of a man, after it was thrown into the fire, leap up for ſeveral times together, at firſt to the height of a foot and a half, and then gradually lower, to the beſt of his memory, for the ſpace of ſeven or eight minutes."

If we trace vital heat and motion from their ſource, we ſhall find theſe phenomena ſtill more clearly illuſtrated. An egg, though it include all the parts neceſſary for the formation of an animal, will never produce a chicken, unleſs it is kept in a certain degree of heat for a certain time; which heat, regularly conducted, is all that is neceſſary to the production of a young animal. There is no other vital principle transfuſed from the hen to the embryo, than from a common fire. Thus is fire plainly proved to be the firſt mover in the animal machine, and is the only active material or natural principle during its exiſtence; and it is a principle abſolutely neceſſary for the preſervation of health. If fire then be allowed to poſſeſs the power of exciting the vital motion in the womb, or egg, we cannot reaſonably refuſe it the power of continuing it after the animal is produced.

Now, a variety of reaſons, which will be ſeen as we proceed, render it apparent, that the fluid of fire paſſes by the nerves to the brain and ſpinal marrow, and from thence to the heart for the ſupplying the cauſe of involuntary motion; and that a ſufficient quantity is always detained there to go to the muſcles at particular times to enable them to perform the voluntary actions. This fire is lodged in the brain, medulla ſpinalis, ganglions, and nerves, and thence operates on all the different parts of the body; and what is loſt of it is continually ſupplied from the ſurrounding bodies.

By the nerves which are deſtined to the ſenſe of feeling, this fire is conveyed to the brain; while thoſe which are deſtined to motion, are the conductors by which it is conveyed to the muſcles. For a particular explanation of the manner in which it acts, Dr. Shebbeare's writings on this ſubject muſt be conſulted.

It is not the exiſtence of the fluid of fire alone, that conſtitutes and preſerves the vital heat and vital motion; but it muſt for this purpoſe be brought into a certain ſtate or degree of action, which, in a healthy man, amounts to 98 of Fahrenheit's thermometer; and according to the degrees of heat originally deſtined to each animal, and the exceſs or decreaſe of it, will be the ſtate of its activity and vigour. Neither is this confined to animals; ſomething of the ſame kind ſeems to take place in vegetables. The heat which produces an apple to perfection, would never bring forth a pine apple; and the firs which thrive and look green on the bleak and ſnowy hills of Norway, would periſh in the burning ſands of Barca; whilſt the ſpicy vegetables of the eaſt would languiſh and expire in that cold clime which perfects the oak.

In like manner that degree of heat which hatches the chicken from an egg, would deſtroy the whole race of fiſhes if applied to their ſpawn; and thus the very ſame element, which makes an animal complete in one degree, and in one ſpecies, deſtroys its exiſtence in another ſpecies with the ſame degree. A degree of heat which would injure the life of a frog, would not be ſufficient to keep the heart of a ſheep in action. Health depends on a degree of heat which is natural to each animal, and happily we are furniſhed by nature with powers to keep up this degree, and counteract and throw off what is ſuperfluous.

In what we have here ſaid of vital heat and motion, there is nothing new ſuppoſed; no new property aſſigned either to fire or electricity; no new formation given to any part of the human fabric. Thus we require no more of the nerves than that they exiſt, and that they are conductors of the electric fluid; which experiment proves. Vital heat and vital motion are here as they are in nature, beginning together, and continuing ſo through life. Solar fire and the electric fluid are one and the ſame vivifying principle, actuating all the different orders of material beings: they are ſo radically the ſame, that in various inſtances you find that what was one becomes the other; and thus facts and philoſophy are united; and the cauſe of natural life and motion is diſcovered by reaſon and experience to be the ſame with what our ſenſes inform us to be intuitively the true one. Generally ſpeaking, whenever the explanation of the cauſe of any phenomena in nature is contradictory to the obvious apprehenſion of a plain underſtanding, there is reaſon to ſuſpect its truth. That to the agency of fire all animal motion and animal heat are owing, is obvious to the meaneſt capacity; and if this element ceaſe to act, or if it be diſunited from the body, death is the certain conſequence. Every part of nature affords facts to ſupport this opinion. Every ray of the great luminary which enlightens the univerſe is fraught with fire, which it is ready to manifeſt on meeting with a proper recipient. Without their genial warmth, both animal and vegetable life muſt ceaſe, and all nature become one lifeleſs and torpid maſs.

In a word, all nature teſtifies the exiſtence of this etherial fluid, and demonſtrates its inceſſant and active energy. To us, indeed, it often remains latent; and peculiar circumſtances are neceſſary to excite thoſe ſigns which render its effects moſt viſible to our ſenſes. The ancients, viewing nature as ſhe is, often attained more accurate notions of her operations, than modern philoſophers. Theſe, by multiplying experiments without firſt attaining a correct idea of the facts continually preſented for obſervation in the great laboratory of nature, have often waſted their time and talents; and in the end have bewildered themſelves in an inexplicable labyrinth, or, at beſt, have only ſupplied the place of one ſpecies of ignorance by ſubſtituting another.

The diſciples of Plato and Pythagoras maintained, that fire was the great inſtrumental cauſe in the univerſe, ſubordinate to the infinite creative mind; and that it actuated the macrocoſm, and animated the microcoſm. The ancient naturaliſts have univerſally maintained the exiſtence of fire in all bodies; and however indiſtinctly they were able to write on it, what they wrote was true. Theophraſtus has ſpoken of fire in terms that beſpeak a conſiderable knowledge of the ſubject. Far from ſuppoſing motion to be the cauſe, much further from ſuppoſing it to be the eſſence of fire, he aſſerts, that fire is a very diſtinct thing from the matter in which we ſee it lodged, and from the motions which we ſee excite it; and that it is, in its pure natural ſtate, fine, etherial, imperceptible, and at perfect reſt. He hints, that this fire was the breath which the creator diffuſed in all matter, which, paſſing over the waters, made out of them metals, ſtones, and earth; and aſſerts, that it is the inſtrument which he employs to give all things vitality and action.

The ancients in general conſidered earth and water, air and fire, as the component elements of all viſible and known corporeal beings, and that life was conveyed to them through the

elements of air and fire; that this fire was continually operating to apply and adjoin to these bodies the newly arrived matter, converting this matter into a substance of the same nature or form with that part to which it was applied, and thus fitting it for the growth or increase, as well as the aliment of the part. But then they also considered natural life as only possessed of these powers, because it was the immediate agent of mind: for mind is evidently the cause of form to all things formed by man; and the cause of union or conjunction, to all things united or conjoined by the assistance of art.

Not to agree at least in some respects with these ancient sages is impossible: for when we contemplate the universe with attention, we find that, in fact, there is no effect either beautiful, great, marvellous, or terrible, but what proceeds from the operation of fire. We cannot therefore be surprised, that after the discovery of electricity it was considered as the physical cause of motion, irritability, &c. notwithstanding which, medical men have shewn a blameable degree of reluctance towards the investigation of this subject, though there can be no doubt of the importance of its application in medicine.

Though the agency of this fluid, and its existence in animated nature, have been so fully proved, that there can be very little doubt that it is essentially connected with, and continually exerting its influence on, the human frame, we shall nevertheless mention in this place some further instances to corroborate what has been already advanced. By means of a small condensing plate, Mr. Cavallo obtained very sensible signs of electricity from various parts of his own body, and the head of almost any other person. The strong electricity obtained in frosty weather from silk stockings, &c. on being pulled off, as well as that obtained by combing the hair, have been long known. Among others, Mr. Brydone mentions a lady, who, on combing her hair in frosty weather in the dark, had observed sparks of fire to issue. This made him think of trying to collect the electrical fire from human hair alone. To this end, he desired a young lady to stand on wax, and comb her sister's hair, who was sitting in a chair before her; soon after she had begun to comb, the young lady on the wax was surprised to find her whole body electrified, and darting out sparks of fire against every object that approached her. Her hair was strongly electrical, and affected an electrometer at a considerable distance. He charged a metallic conductor from it, and in the space of a few minutes collected a sufficient quantity of fire to kindle common spirits, and, by means of a small jar, gave many smart strokes to those that were present.

Mr. Brydone observes, that when the discoveries in electricity are further advanced, we may find, that what we call sensibility of nerves, and many other diseases, which are known only by name, are owing to the body's being possessed of too large or too small a quantity of this subtil fluid, which is perhaps the vehicle of all our feelings. It is known, that in damp and hazy weather, when this fire is blunted and absorbed by the humidity, its activity is lessened, and what is collected is soon dissipated; then our spirits are more languid, and our sensibility is less acute. And in the *sirocc* wind at Naples, when the air seems totally deprived of it, the whole system is unstrung, and the nerves seem to lose both their tension and elasticity, till the north west wind awakens the activity of the animating power, which soon restores the tone, and enlivens all nature, which seemed to droop and languish in its absence; nor can this appear surprising, if it be from the different state of this fire in the human body, that the strictum and laxum proceed, and not from any alteration in the fibres themselves, or their being more or less braced up (among which bracers cold has been reckoned one), though the muscular parts of an animal are more braced when they are hot, and relaxed when they are in a contrary state.

The perpetual electricity of the atmosphere, which is now no longer a problem, seems to furnish a very just inference, that it must exert a certain power over all the beings on the earth, and principally on organized bodies, among which the human frame claims the first place.

There is, however, no necessity for deductions from a general view of nature, for we are now in possession of facts, which prove, that it is a principal agent in promoting the functions of animated beings; as in the gymnotus electricus, torpedo, and silurus electricus. For the similitude established between the electrical fluid of these animals, and that of nature at large, is such, that in a physical sense they may be deemed perfectly analogous.

Sect. XXIV. *Of the later Experiments made to ascertain the Nature of Animal Electricity.*

When the extraordinary sensations produced by the torpedo, &c. were attributed by Mr. Walsh to electricity, his opinions, and the inferences deduced from his experiments, were vehemently opposed by many of the best electricians of the day: the conceptions of these men being limited to the minutiæ of experiments, they were incapable of grasping a more extensive subject, or one that was not in all respects conformable to the appearances they were accustomed to. Whereas a just view of things should have prepared them to expect various anomalies, while they were investigating the nature of an invisible and subtil agent, subject to a variety of modifications from the substance through which it passes, or with which it may be combined. Hence, in the pursuit of animal electricity, every electric sign is not to be expected, as, from the very nature of its connection with animated beings, it will certainly acquire new and distinct properties.

Before we proceed to describe the experiments of Valli and others, it is necessary to enlarge a little on those principles which may seem to throw a light on the subject of animal electricity, and by which they may be reconciled to the general agency of nature. It is evident, from a great variety of experiments, that electricity is always first rendered sensible by a solution of continuity. There is also every reason to suppose, that the electric matter is carrying on its most important functions, when we are unable to perceive any signs of electricity. It has been shewn, that the electric matter, and what we term electricity, are not inseparable beings; that the one may subsist, when the other ceases to appear. As the air may occupy a space without producing sound, so the electric matter may reside in a body without exhibiting any electric signs. We know also, by universal observation, as well as partial experiments, that there is a principle in all bodies, which is continually endeavouring to extend their form, but whose energies are continually counteracted by an exterior force. Now it must be evident, that every solution of continuity will give an opportunity for this expansive, dilating substance to escape, when it puts on new and unexpected appearances. Now, as we know this expanding substance is fire, and have a proof, that on its escape it exhibits electric signs; we have a further confirmation of the identity of fire and the electrical fluid.

Perhaps this view of the subject is in itself a sufficient refutation of Dr. Munro's attempt to prove, in his Experiments on the Nervous System, that the nervous fluid or energy is not the same with the electrical; though many other arguments may be adduced to answer that intention. The doctor's difficulty, in conceiving how the electrical fluid can be accumulated within our nervous system, is not greater than that of conceiving how it is accumulated amidst a conducting fluid in the torpedo, &c. nor indeed than of its being accumulated in the Leyden phial, as glass is now known to be permeable to it. But the difficulty with respect to animals vanishes, when we consider

that *electrical appearances are occasioned by a state of the fluid altogether different from that under which it exists in the animal frame.* When it is in the latter its powers are united, and its operations imperceptible: when it appears as electricity, its powers are divided, and some of their effects rendered obvious to the senses.

So far as mechanical stimuli have any relation to fire, so far they will be in some degree similar to the electrical fluid, and act in the same manner; for stimulants act only as they are the vehicles of fire. Munro's second objection therefore falls to the ground. The same reasoning applies to his sixth objection. His fourth argument, so far from proving that the nervous and electrical fluids are not the same, may be considered as a clear proof of their identity, for the two electrical powers always act in opposite directions. On the same principle, the nervous energy, i. e. the electrical fluid in its united state, cannot pass readily up or down a nerve that has been tied or cut, for the tying or cutting the nerve changes the state of the fluid itself.

Previous to our account of the experiments relating to animal electricity, it will not be improper to notice some remarks of the Rev. Mr. William Jones, inserted in his Essay on the First Principles of Natural Philosophy, and which are intimately connected with our present subject. "As the force of the electrical fluid (says he) is principally exerted on the nerves and tendons of the body, there is reason to believe that this fluid is the same with that something which many physicians have discoursed upon under the name of *animal spirits.* The nerves do not appear as if they were designed to admit any animal fluid or liquor, unless it be an indolent lymph necessary to keep them moist: but their pellucidity indicates that they are properly adapted to give a direct passage to the fluid light; for they are transparent, and that not transversely, but longitudinally, or in the direction of their fibres. This Mr. Jones observed accidentally, as some eyes of sheep and oxen, which he had procured for dissection, lay on the table; one of these eyes shone in the day-time, much in the same manner as the eyes of some animals do in the dark. On examining into this circumstance, he found that if his hand were interposed between the nearest window, and the extremity of the optic nerve (a part of which, nearly an inch in length, remained with the eye, and was accidentally pointed towards the window) the light immediately disappeared."

From these particulars he was led to consider, whether the light that appears in the eyes of some animals in the night time, is really a reflection of light from the eye, as is commonly supposed; or whether it does not rather pass into the eye, through the optic nerve, from the body of the animal. It is not easy to conceive how this shining can be occasioned by a reflection of light from the choroides in the bottom of the eye, when the light to be reflected (as in dark night) is not visible before its entrance into the eye. If a candle be held before the eyes of a dog, and you place yourself in the line of reflection, the light will be visibly reflected from his eyes, because the illumination is sufficiently strong: but when there is no visible illumination at all, how should it account for the like effect? Whence it is more reasonable, that this appearance should be owing to a light from within the body of the animal, which being weaker than the light of the day, but stronger than the light of the night, is visible in the night, but not in the day. The light of other bodies which shine in the dark is inherent in those bodies, as in putrefying veal, fish, rotten wood, phosphorus, the glow-worm, &c. Concerning the last of these, the eminent anatomist and philosopher, T. Bartholine, has the following observation: "If a glow-worm be examined, it will appear to have a lucid liquor in the hinder part of its body, where the heart is placed, by which the heart is moved and illuminated; and this fluid retains its light so long as the heart of the insect lives, and possesses the power of motion."

In his "Heads of Lectures on a Course of Experimental Philosophy," Dr. Priestley has given a most excellent and compendious view of the principal experiments that have been made by Valli and others, engaged in the same enquiry, to determine the electricity of animals. For a circumstantial detail of these we refer to the work: one alone we reserve, which will suffice to give an idea of the nature of these operations. The abdomen of a frog was opened, in order to lay bare the spine of the back, and discover the crural nerves which issue from it. A few lines above this point Mr. Valli cut the animal in two, and passing his scissars immediately under the origin of these nerves, removed the remaining portion of the vertebral column, so as only to leave the vertebra which united the bundle of nerves. This portion of the vertebræ was enveloped with a piece of sheet-lead; the coated part was touched with one end of a metallic conductor, and with the other the surface of the thighs, which were previously stripped of their skins. The movements produced thereby were violent, and continued for a considerable time. See a representation of the prepared frog in pl. 11.

This being the manner in which the animal is prepared for these experiments, we shall now speak of the principal results, as Dr. Priestley has stated them.

1. The nerve of the limb being laid bare, and surrounded with a piece of sheet-lead, or of tinfoil, if a communication be formed between the nerve thus armed, and any of the neighbouring muscles, by means of a piece of zinc, strong contractions will be produced in the muscles of the limb.

2. If a portion of the nerve, which has been laid bare, be armed as above, contractions will be produced as powerfully, by forming the communication between the armed and bare part of the nerve, as between the armed part and a muscle.

3. A similar effect is produced by arming a nerve, and simply touching the armed part of the nerve with the metallic conductor.

4. Contractions will take place if a muscle be armed, and a communication be formed by means of the conductor between it and a neighbouring nerve. The same effect will be produced if the communication be formed between the armed muscle and another muscle which is contiguous to it.

5. Contractions may be produced in the limb of an animal, by bringing the pieces of metal into contact with each other, at some distance from the limb; provided the latter make part of a line of communication between the two metallic conductors. The method taken to prove this, is the following: The amputated limb being placed upon a table, let the operator hold with one hand the principal nerve, previously laid bare; and in the other let him hold a piece of zinc: let a small plate of lead or silver be then laid upon the table at some distance from the limb, and a communication be formed by means of water between the limb and the part of the table where the metal is lying. If the operator touch the piece of silver with the zinc, contractions will be produced in the limb the moment that the metals come into contact with each other. The same effect will be produced, if the two pieces of metal be previously placed in contact, and the operator touch one of them with his hand.

6. Muscular contractions can be produced in the amputated leg of a frog, by putting it into water, and bringing the two metals into contact with each other, at a small distance from the limb.

7. The electric influence which has passed through, and excited contractions in one limb, may be made to pass through, and excite contractions in another limb. In performing this experiment, it is necessary to attend to the following circumstances: Let two amputated limbs of a frog be taken; let one of them be laid upon a table, and its foot be folded in a piece of silver; let

a perſon lift up the nerve of this limb with a ſilver probe, and another perſon hold in his hand a piece of zinc, with which he is to touch the ſilver including the foot. Let the perſon holding the zinc in one hand, catch with the other the nerve of the ſecond limb; and he who touches the nerve of the firſt limb, is to hold in his other hand the foot of the ſecond: let the zinc now be applied to the ſilver including the foot of the firſt limb, and contractions will immediately be excited in both the limbs.

8. There is no involuntary muſcle, except the heart, in which contractions cannot be excited by theſe experiments: contractions are produced more ſtrongly, the farther the coating is placed from the origin of the nerve.

9. The bodies of animals almoſt dead have been conſiderably revived by exciting this influence. When theſe experiments are repeated upon an animal that has been killed by opium, or by the electric ſhock, very ſlight contractions are produced; and no contractions whatever will take place in an animal that has been killed by muriated quickſilver, or that has been ſtarved to death. Zinc appears to be the beſt exciter when applied to gold, ſilver, molybdena, ſteel, or copper; the latter metals, however, excite but feeble contractions when applied to each other; next to zinc, in contact with theſe metals, tin and lead appear to be the moſt powerful exciters.

10. If a plate of zinc be applied to the upper part of the point of the tongue, and a plate of ſilver to its under part; on bringing the two metals into contact with each other, a pungent diſagreeable feeling, which it is difficult to deſcribe, is produced in the point of the tongue. And if a plate of zinc is placed between the upper lip and the gums, and a plate of gold applied to the upper or under part of the tongue; on bringing theſe two metals into contact with each other, the perſon imagines that he ſees a flaſh of lightning, which, however, a by-ſtander in a dark room does not perceive; and the perſon performing the experiment perceives the flaſh, though light is completely excluded.

Dr. Munro, after performing this experiment repeatedly, conſtantly felt a pain in his upper jaw, at the place to which the zinc had been applied, which continued for an hour or more; and in one experiment, after he had applied a blunt probe of zinc to the ſeptum narium, and repeatedly touched with a crown piece of ſilver applied to the tongue, and thereby produced the appearance of a flaſh, ſeveral drops of blood fell from that noſtril; and Dr. Fowler, after making a like experiment on his ears, experienced ſimilar effects.

SECT. XXV. *Of the Reſemblance of the Fluid put in Motion by the foregoing Experiment, to the Electrical Fluid.*

ON this ſubject it is obſervable, that the fluid ſet in motion by the application of the metals to each other, and to animal bodies, or to water, agrees with or reſembles the electrical fluid in the following reſpects: 1. Like the electrical fluid, it communicates the ſenſe of pungency to the tongue. 2. Like the electrical fluid, it is conveyed readily by water, blood, the bodies of animals, the metals; and is arreſted in its courſe by glaſs, ſealing-wax, &c. 3. It paſſes with ſimilar rapidity through the bodies of animals. 4. Like the electrical fluid, it excites the activity of the veſſels of a living animal; as the pain it gives, and hemorrhage it produces, ſeem to prove. Hence, perhaps, it might be employed with advantage in amenorrhœa. It excites convulſions of the muſcles in the ſame manner, and with the ſame effects, as electricity. 5. When the metals and animal are kept ſteadily in contact with each other, the convulſions ceaſe, or an equilibrium ſeems to be produced, as after diſcharging the Leyden bottle.

Notwithſtanding theſe remarkable diſcoveries relative to the peculiar operation of electricity when produced from an animal body; it muſt be confeſſed, we have advanced but a very ſhort way towards a complete development of the phenomenon of nervous influence. Enough indeed has been diſcovered, to ſhew clearly, that there exiſts a ſtrong and immediate connection between that and the electricity afforded by inanimate ſubſtances. It is to be hoped, that future attempts will be attended with ſtill farther advantages to this ſublime branch of natural philoſophy; and that the obſcurities with which, it muſt be owned, the ſubject is ſtill involved, will, ere long, be removed by the diligent and well-directed exertions of the philoſophers and phyſiologiſts of our own times.

ELECTRIDES, anciently iſlands in the Adriatic ſea, which received their name from the quantity of amber (*electrum*) which they produced. They were at the mouth of the Po, according to Apollonius of Rhodes; but ſome hiſtorians doubt of their exiſtence.

ELECTROMETER, an inſtrument which ſhews the quantity of electrical fluid preſent. See ELECTRICITY, p. 245.

ELECTRUM, in natural hiſtory. See AMBER.

ELECTUARY, in pharmacy, a form of medicine compoſed of powders and other ingredients, incorporated with ſome conſerve, honey, or ſyrup. Voſſius obſerves, that all the remedies preſcribed for the ſick, as well as the confections taken by way of regale, were called by the Greeks εκλειγματα, and εκλεικτα, of the verb λειχω, "I lick;" whence, ſays he, was formed the Latin *electarium*, and afterwards *electuarium*. This conjecture he ſupports from the laws of Sicily, where it is ordained, that *electuaries*, ſyrups, and other remedies, be prepared after the legal manner. The Bollandiſts, who relate this etymology, ſeem to confirm it. For the compoſition of electuaries, ſee PHARMACY.

ELEEMOSYNA *Carucarum*, or *pro Aratris*, or *Aratri*, in our ancient cuſtoms, a penny which king Ethelred ordered to be paid for every plough in England towards the ſupport of the poor. Sometimes it is alſo called *eleemoſyna regis*, becauſe firſt appointed by the king.

ELEEMOSYNARIUS, in our old writers, is uſed for the almoner or peculiar officer who received the eleemoſynary rents and gifts, and diſtributed them to pious and charitable uſes. There was ſuch an officer in all religious houſes. The biſhops alſo uſed to have their almoners, as now the king has.

ELEGANCE, from *eligo* "I chooſe," denotes a manner of doing or ſaying things politely, agreeably, and with grace. With grace, ſo as to riſe above the common manners; politely, ſo as to ſtrike people of delicate taſte; and agreeably, ſo as to diffuſe a reliſh which gratifies every body.

ELEGANCE, in oratory and compoſition, an ornament of politeneſs and agreeableneſs ſhown in any diſcourſe, with ſuch a choice of rich and happy expreſſions, as to riſe ſuperior to the common manners, and to ſtrike people of a delicate taſte. It is obſerved, that elegance, though irregular, is preferable to regularity without elegance: that is, by being ſo ſcrupulous of grammatical conſtruction, we loſe certain licences wherein the elegance of language conſiſts.

ELEGIAC, in ancient poetry, any thing belonging to elegy. See ELEGY.

ELEGIT, in law, a writ of execution, which lies for a perſon who has recovered debt or damages; or upon a recognizance in any court, againſt a defendant that is not able to ſatisfy the ſame in his goods.

ELEGY, a mournful and plaintive kind of poem. See the article POETRY.

ELEMENTS, in phyſics, the firſt principles of which all bodies in the ſyſtem of nature are compoſed. Theſe are ſuppoſed to be few in number, unchangeable, and by their combinations to produce that extenſive variety of objects to be met with in the works of nature. That there is in reality ſome foundation for this doctrine of elementary bodies is plain; for there are ſome principles evidently exempted from every change or decay, and which can be mixed or changed into different forms of matter. A perſon who ſurveys the works of nature in an inattentive manner, may perhaps form a contrary opinion, when he conſiders the numerous tribes of foſſils, plants, and animals, with the wonderful variety that appears among them in almoſt every inſtance. He may from thence be induced to conclude, that nature employs a vaſt variety of materials in producing ſuch prodigious diverſity. But let him inquire into the origin of this apparent diverſity, and he will find that thoſe bodies which ſeem the moſt different from each other are at bottom nearly the ſame. Thus the blood, chyle, milk, urine, &c. as well as the various ſolid parts of animals, are all compoſed of one particular ſubſtance; of graſs, for inſtance, with the aſſiſtance of air and water, and even ſometimes of very inſipid kinds of graſs. The ſame ſimplicity preſents itſelf in the original compoſition of the nouriſhment of vegetables, notwithſtanding the variety among them with reſpect to hardneſs, ſoftneſs, elaſticity, taſte, odour, and medical qualities. They chiefly depend, for theſe, upon water and the light of the ſun; and the ſame ſimplicity muſt take place in animals that are fed on vegetables. The analyſis of animal ſubſtances confirms this hypotheſis; for they can all be reduced into a few principles, which are the ſame in all, and only differ with regard to the proportions in which they are combined. With regard to animals, the caſe appears to be the ſame: and the more we are acquainted with them, the more reaſon we have to believe that the variety in their origin is very ſmall.

Notwithſtanding the infinite variety of natural productions, therefore, it appears, that the materials employed in their production are but few; that theſe are uniformly and certainly the ſame; totally exempted from any change or decay; and that the conſtant and gradual change of one body into another is produced by the various ſeparations and combinations of the original and elementary parts, which is plain from the regularity and uniformity of nature at all times. There is a change of forms and combinations through which it paſſes, and this has been the caſe from the earlieſt accounts of time; the productions of nature have always been of the ſame kind, and ſucceeded one another in the ſame order. If we examine an oak, for inſtance, we find it compoſed of the ſame matter with that of any other that has exiſted from the earlieſt ages. This regularity and uniformity in the courſe of nature ſhows that the elementary parts of bodies are permanent and unchangeable; for if theſe elementary particles which conſtituted an oak ſome thouſand years ago, had been undergoing any gradual decay, the oaks of the preſent times would have been found conſiderably different from thoſe that exiſted long ago; but as no difference has been obſerved, it would ſeem that the ultimate elements of bodies have always continued the ſame.

Reflections of this kind have ſuggeſted an idea of ſeveral principal elements of which all other bodies are compoſed, which by their various combinations furniſhed all the variety of natural bodies. Democritus, and other great philoſophers of antiquity, fixed the number to four, which have retained the name of elements ever ſince. They are, fire, air, earth, and water; each of which they imagined was naturally diſpoſed to hold its own place in the univerſe. Thus, the earth, as heavieſt, naturally tended towards the centre, and occupied the lower parts; the water, as approaching next to it in gravity, was ſpread chiefly on the outſide of the earth; the air, being more ſubtle and rare, occupied the middle place; while the fire, being ſtill more ſubtile and active, receded to the greateſt diſtance of all, and was ſuppoſed to compoſe the planets and ſtars. This ſyſtem was extended to all the productions of nature. Meteors were produced from a combination of fire and air; animals were conſidered as compoſed of earth and water; and thoſe that were warm had likewiſe a proportion of the element of fire. Thus they went on, explaining ſome of the moſt ſtriking qualities of the ſeveral productions of nature from the different proportions of the four elements they contained.

But though this ſyſtem appears not at all deſtitute of beauty and propriety, and on this account has been in ſome meaſure received even to the preſent time, we find reaſon to doubt whether theſe four ſubſtances be really elementary bodies; nor do they anſwer our purpoſe in forming a ſyſtem, as we know too little of the intimate ſtructure and texture of them to enable us to explain other bodies by them. See CHEMISTRY, p. 371.

ELEMENT, in a figurative ſenſe, is uſed for the principles and foundations of any art or ſcience; as Euclid's Elements, &c.

ELEMENTS, in aſtronomy, are thoſe principles deduced from aſtronomical obſervations and calculations, and thoſe fundamental numbers which are employed in the conſtruction of tables of the planetary motions. Thus, the elements of the theory of the ſun, or rather of the earth, are his mean motion and eccentricity, and the motion of the aphelia. The elements of the theory of the moon are its mean motion; that of its node and apogee, its eccentricity, the inclination of its orbit to the plane of the ecliptic, &c.

ELEMI, in the materia medica. See AMYRIS.

ELENCHUS, in antiquity, a kind of ear-rings ſet with large pearls.

ELENCHUS, in logic, by the Latins called *argumentum* and *inquiſitio*, is a vicious or fallacious argument, which deceives under the appearance of a truth; the ſame with what is otherwiſe called *ſophiſm*.

ELEPHANT, in zoology. See ELEPHAS.

American ELEPHANT; an animal only known in a foſſile ſtate, and that but partially, from the teeth, ſome of the jawbones, the thigh-bones, and vertebræ, found with many others five or ſix feet beneath the ſurface on the banks of the Ohio. But theſe bones differ in ſeveral reſpects from thoſe of the elephant; for which, ſee *Foſſil* BONES. As yet the living animal has evaded our ſearch. Mr. Pennant thinks it "more than probable, that it ſtill exiſts in ſome of thoſe remote parts of the vaſt new continent unpenetrated yet by Europeans. Providence maintains and continues every created ſpecies; and we have as much aſſurance that no race of animals will any more ceaſe while the earth remains, than *ſeed-time and harveſt, cold and heat, ſummer and winter, day or night*. See MAMMUTH.

ELEPHANT-*Beetle*. See SCARABÆUS.

Knights of the ELEPHANT, an order of knighthood in Denmark, conferred upon none but perſons of the firſt quality and merit. It is alſo called the *order of St. Mary*. Its inſtitution is ſaid to have been owing to a gentleman among the Daniſh croiſés having killed an elephant, in an expedition againſt the Saracens, in 1184; in memory of which, king Canutus inſtituted this order, the badge of which is a towered elephant, with an image of the holy virgin encircled with rays, and hung on a watered ſky-coloured ribbon, like the George in England.

ELEPHANTA, an iſland on the W. coaſt of the Deccan of Hindooſtan, five miles from Bombay. It contains one of the moſt inexplicable antiquities in the world. The figure of an

elephant, of the natural ſize, cut coarſely in ſtone, appears on the landing-place, near the foot of a mountain. An eaſy ſlope then leads to a ſtupendous ſubterranean temple, hewn out of the ſolid rock, 80 or 90 feet long, and 40 broad. The roof, which is cut flat, is ſupported by regular rows of pillars, about ten feet high, with capitals reſembling round cuſhions, as if preſſed by the incumbent mountain. At the farther end are three gigantic figures, which were mutilated by the abſurd zeal of the Portugueſe, when this iſland was in their poſſeſſion. There are various other objects worthy the attention of a viſitor. Mr. Groſe, who has given a copious deſcription of the whole, is of opinion, that the immenſe work of ſuch an excavation is a far bolder attempt than that of the pyramids of Egypt; and major Rennell thinks that this, and the ſubterraneous temple in the adjacent iſland of Salſette, are monuments of a ſuperſtition anterior to that of the Hindoos. Elephanta was ceded to the Engliſh by the Mahrattas.

ELEPHANTIASIS, called alſo the *lepra of the Arabians*, in medicine, a chronical diſeaſe, one of the two ſpecies of leproſy which affects the whole body, where even the bones as well as the ſkin are covered with ſpots and tumors, which being red at laſt turn black. See MEDICINE.

ELEPHANTINE, in Roman antiquity, an appellation given to the books wherein were regiſtered the tranſactions of the ſenate and magiſtrates of Rome, of the emperors or generals of armies, and even of the provincial magiſtrates; the births and claſſes of the people, and other things relating to the cenſus. They are ſuppoſed to have been ſo called, as being made of leaves of ivory or elephants' tuſks.

ELEPHANTOPHAGI, an ancient people of ETHIOPIA.

ELEPHANTOPUS, in botany; a genus of the polygamia ſegregatæ order, belonging to the ſyngeneſia claſs of plants; and in the natural method ranking under the 49th order, *Compoſitæ*. The calyculus is quadriflorous, with hermaphrodite florets ligulated or plane; the receptacle is naked; the pappus briſtly.

ELEPHAS, the ELEPHANT, in zoology, a genus of quadrupeds belonging to the order of bruta. The characters are theſe: The elephant has no foreteeth in either jaw, and the dog-teeth are very long: the proboſcis or trunk is long, and capable of laying hold of any thing; and the body is ſomewhat naked.

The elephant is the largeſt of all land-animals. From the front to the origin of the tail he is generally about 16 feet long, from the end of the trunk 25 feet, and about 14 feet high. The circumference of the neck is 17 feet, and the circumference of the body at the groſſeſt part 25 feet 10 inches; the tail is about 6 feet long, and 2½ in circumference. The circumference of the legs is about 6 feet. Theſe are the largeſt dimenſions. But the animal differs in ſize in different countries; in ſome not exceeding 7 feet in height. The eyes are ſmall in proportion to the ſize of the animal. The muzzle is very different from that of any other quadruped; it is nothing but the origin of a long trunk which hangs between the two large tuſks; the mouth appears behind the trunk, which ſerves in place of an upper lip, and the under lip terminates in a point. The feet are ſhort, round, clumſy, and only diſtinguiſhable by the toes. The trunk is, properly ſpeaking, the noſe extended, and terminated by a couple of noſtrils. But, beſides ſerving as an organ of ſmell, the trunk performs all the functions of a ſtrong and dexterous arm. The trunk of an elephant is about 8 feet long, 5½ feet in circumference near the mouth, and one foot and a half near the extremity: it is a pipe of an irregular conical figure, and widened at the end: the ſuperior ſide of the trunk is convex, and furrowed tranſverſely; and the inferior ſide is flat, and has two longitudinal rows of ſmall protuberances reſembling the tentacula of the ſilk-worm and moſt other caterpillars. The upper part of the trunk correſponds with the extremity of the noſe in other quadrupeds, and anſwers the ſame intention; the inferior part ſerves as an upper lip, including the noſtrils at the ſame time. For the trunk is a continued canal, divided into two cavities by a longitudinal partition: theſe cavities aſcend along the forepart of the upper jaw, where they make a turn inward, and deſcend into the palate, and then terminate in two ſeparate orifices; they have likewiſe each a ſeparate orifice at the end of the trunk. At the place where theſe cavities make a turn, and before they enter into the bones of the head, there is a moveable cartilaginous plate ſituated in ſuch a manner as enables the animal to ſhut the canal, and to prevent the water with which it occaſionally fills the trunk from entering into the paſſage of the noſe where the organs ſerving for the ſenſation of ſmell are placed. The elephant can move the trunk in all directions; he can extend or ſhorten it at pleaſure, without altering the diameters of the two canals within. By this means reſpiration is not interrupted, whatever be the ſituation of the trunk; and the water is allowed to remain till the animal chooſes to throw it out by an exſpiration. Each canal is lined with a ſmooth ſtrong membrane, and the ſurface of the trunk is covered with another ſtrong membrane or ſkin. The ſubſtance contained between the exterior and interior membranes, is a compoſition of longitudinal and tranſverſe muſcles, which ſerve to extend and contract the length of the trunk. At the extremity of the trunk there is a concave protuberance, in the bottom of which are the two paſſages of the noſtrils. The inferior part of the protuberance is thicker than the ſides, and the ſuperior part is ſtretched out like a finger about five inches long; which, together with the edges of the whole extremity of the trunk, takes on different figures according to the neceſſities of the animal. It is by this organ that the animal lays hold of food or other ſubſtances; which he manages with as much dexterity as a man does his hand, taking up grains of corn, or the ſmalleſt piles of graſs, and conveying them to his mouth. When he drinks, he thruſts his trunk into the water, and fills it by drawing in his breath and exhauſting the air: when the trunk is thus filled with water, he can either throw it out to a great diſtance, or drink it by putting the end of the trunk in his mouth.

The two large tuſks, which ſome call the *horns* of the elephant, are of a yellowiſh colour, and extremely hard. The bony ſubſtance of which they are compoſed is known by the name of IVORY, and much uſed in different branches of manufacture.

The ears are very large, and reſemble thoſe of an ape. The ſkin of the elephant has but few hairs on it, and placed at great diſtances from each other. It is full of wrinkles, like thoſe on the palm of a man's hand, beſides many chapped and greaſy ridges. The female has two dugs, one on each ſide of the breaſt.

M. Buffon ſuppoſed the ancients to have been "deceived, when they tell us, that the elephants copulate like other quadrupeds, the female only lowering her crupper for the more eaſy reception of the male. The ſituation of the parts ſeems to render this mode of junction impoſſible. The female elephant has not like other quadrupeds the orifice of the vagina adjacent to the anus; for it is ſituated nearly in the middle of the belly, about two and a half or three feet diſtant from the anus. On the other hand, the male organ is by no means proportioned to the magnitude of his body, nor to ſo long an interval, which in the ſituation ſuppoſed would preclude the practicability of his approach. Naturaliſts as well as travellers agree in affirming, that the male organ of the elephant exceeds not either in length or diameter that of a horſe. It is, therefore, impoſſible that he ſhould attain his end in the ordinary poſition of quadrupeds. The female muſt neceſſarily lie on her back. De Feynes and Tavernier poſitively aſſert, and the ſituation of the parts confirms their evidence, that theſe animals cannot intermix in any other manner. They require, therefore, more time and conveniense for this operation than other quadrupeds; and it is perhaps for this reaſon that they never copulate but when they en-

joy full liberty, and have every neceſſary article at their command. The female muſt not only conſent, but ſolicit the male, by a poſition which ſhe never aſſumes unleſs when ſhe thinks herſelf in perfect retirement." The fact, however, has been controverted by others.

Elephants, even in a ſavage ſtate, are peaceable and gentle creatures. They never uſe their weapons but in defence of themſelves or companions. Their ſocial diſpoſitions are ſo ſtrong, that they are ſeldom found alone, but march always in large troops: the oldeſt and moſt experienced lead the van; the younger, or lame ones, keep in the middle; and thoſe of a ſecond rate, as to age, walk in the rear. The females carry their young on their tuſks, embracing them at the ſame time with their trunk. They ſeldom march in this regular order but when they reckon the journey dangerous, ſuch as an expedition to cultivated lands, where they expect to meet with reſiſtance. On other occaſions they are leſs cautious; ſome of them falling behind or ſeparating from the reſt, but ſeldom ſo far as to be without the reach of aſſiſtance by alarming and aſſembling their companions. It is dangerous to offer them the leaſt injury; for they run ſtraight upon the offender; and although the weight of their body be great, their ſteps are ſo large, that they eaſily outrun the ſwifteſt man, whom they either pierce with their tuſks, or ſeize with their trunk, dart him in the air like a ſtone, and then trample him under their feet. But they never attack any perſon unleſs when provoked. However, as they are extremely ſenſible and delicate with regard to injuries, it is always prudent to keep out of their way. Travellers who frequent theſe countries kindle large fires, and beat drums during the night, in order to prevent their approach. After being once attacked by men, or falling into any ambuſh, they are ſaid never to forget the injury, but ſearch for every opportunity of getting revenge. As they are endowed perhaps with a more exquiſite ſenſation of ſmell than any other animal, owing to the great extent of their noſe, they can ſcent a man at a very great diſtance, and trace him by his footſteps.

Elephants are peculiarly fond of the banks of rivers, deep valleys, and marſhy grounds, eſpecially when well ſhaded with trees. They delight in drawing up water into their trunks, even when they do not drink it, and amuſe themſelves in daſhing the water around. They cannot endure cold, and are equally averſe to an exceſs of heat: in order to avoid the ſcorching heat of the ſun, they retire to the thickeſt and moſt ſhady parts of the foreſt. The bulk of their bodies is ſo enormous, that they do not chooſe to go into deep waters ſo frequently as ſome other quadrupeds; although the length of their trunk, which they raiſe ſtraight up, and by which they reſpire, is a great advantage in ſwimming.

The ordinary food of elephants is roots, herbs, leaves, the tender branches of trees, fruits, and grains: but they abhor fleſh or fiſh. When any one of them diſcovers a fine paſture, he immediately calls and invites his companions to come and eat with him. As they devour a large quantity of food in a ſhort time, they are always ſhifting their paſture; when they meet with cultivated grounds, they make a prodigious deſolation, and deſtroy more plants by their feet than they uſe for nouriſhment: which laſt is very conſiderable, amounting to 150 pounds of herbage every day: by this means, as they conſtantly graze in large troops, they lay waſte whole fields in an hour. The Indians and negroes employ every art to prevent them from viſiting their cultivated lands, making great noiſes, and burning large fires round their fields. However, theſe precautions are not always ſufficient to prevent the elephants from viſiting them. They chaſe away the domeſtic animals, put the men to flight, and ſometimes even throw down their limber huts. Elephants are hardly ſuſceptible of fear: the only things which can ſurpriſe them or ſtop their courſe are artificial fires, ſuch as ſquibs, crackers, &c. the effects of which are ſo ſudden and ſo quickly repeated, that the elephants frequently turn back; and when one runs, all the reſt inſtantly follow his example.

Although the ſocial diſpoſition in the elephant be exceeding ſtrong, yet whenever the females come in ſeaſon, it immediately gives place to the ſtronger and more intereſting paſſion of love. They obſerve the greateſt delicacy in their amours, abhorring nothing ſo much as to be ſeen by their companions. The troop divide themſelves into couples, ſteal off into the moſt ſecret places of the foreſt, and then give way to all the impulſes of nature, which are lively and laſting in proportion to the long period of abſtinence; for, according to all accounts, except that of M. Bles, the female goes with young two years, and it is only once in three years that the ſeaſon of love returns. They bring forth but one at a time; which, as ſoon as it comes into the world, is as large as a wild boar, and is furniſhed with teeth: however, the large tuſks do not make their appearance till ſome time after, and at the age of ſix months they are ſeveral inches long. Elephants of this age are as large as an ox when in a natural ſtate.

The manner of taking and taming elephants, therefore, merits our attention. In foreſts and ſuch places as are frequented by elephants, the Indians chooſe a ſpot and incloſe it with ſtrong palliſades: they uſe the largeſt trees as the principal ſtakes, to which are fixed ſmaller ones in a tranſverſe direction. Theſe croſs trees are fixed ſo as to allow a man to paſs eaſily through. There is likewiſe a large port left for the elephant, over which is ſuſpended a ſtrong barrier, which is let down as ſoon as he enters. In order to decoy him into the incloſure, the hunters take along with them a tame female in ſeaſon, and travel about till they come ſo near as that the cry of the female can reach a male, whom they previouſly obſerve in the foreſt; then the guide of the female makes her give the cry peculiar to the ſeaſon of love: the male inſtantly replies, and ſets out in queſt of her. The guide then makes the female proceed towards the artificial incloſure, repeating her cries from time to time as ſhe goes along. She enters into the incloſure, the male follows her, and the Indians immediately ſhut the port behind him. He no ſooner diſcovers the hunters, and that he is incloſed, than his paſſion for the ſex is converted into rage and fury. The hunters entangle him with ſtrong ropes; they fetter his legs and trunk; they bring two or three tame elephants in order to pacify and reconcile him to his condition. In a word, they reduce him to obedience in a few days, by a proper application of torture and careſſes. There are many other methods of catching elephants. Inſtead of making large incloſures with palliſades, like the kings of Siam, and other monarchs, the poor Indians content themſelves with a very ſimple apparatus: they dig deep pits in the roads frequented by elephants, covering them over with branches of trees, turf, &c. When an elephant falls into one of theſe pits, he is unable to get out again.

The elephant, when tamed, is the moſt friendly and obedient of all animals: he is entirely attached to the perſon who feeds and takes care of him. In a ſhort time he underſtands ſigns, and the ſound of his maſter's voice. He diſtinguiſhes the language of paſſion, of command, of ſatisfaction; and acts accordingly. He receives his orders with attention, and executes them with prudence and alacrity, but without precipitation. He eaſily learns to bow his knees and lower his body, for the convenience of thoſe who mount him. He careſſes his friends with his trunk. He lifts burdens with his trunk, and aſſiſts thoſe who are loading him in laying them on his back. He delights in ſhining harneſs and trappings. When yoked in a cart or waggon, he pulls equally and cheerfully, unleſs he be abuſed by injudicious chaſtiſements. His guide is generally mounted on his neck, with a ſmall rod of iron ſharp at the point

in his hand; he directs his motion by pricking him on the ears and head; but, for the moſt part, a word is ſufficient.

A tame elephant will do more labour than ſix horſes; but then he requires a proportional quantity of food. They are the principal beaſts of burden in many parts of Africa and the Eaſt Indies. They carry ſacks and bundles of all kinds on their neck, back, and tuſks. They never loſe or damage any thing committed to their care: they will ſtand on the edge of a river, take bundles off their necks and tuſks, lay them carefully in a boat wherever they are deſired, and try with their trunk whether they are properly ſituated; if they be loaded with caſks, they go in queſt of ſtones to prop them and prevent them from rolling.

The elephant is not only the moſt tractable, but the moſt intelligent of animals; ſenſible of benefits, reſentful of injuries, and endowed even with a ſenſe of glory. In India, they were once employed in the launching of ſhips: one was directed to force a very large veſſel into the water; the work proved ſuperior to his ſtrength: his maſter, with a ſarcaſtic tone, bid the keeper take away this lazy beaſt and bring another: the poor animal inſtantly repeated his efforts, fractured his ſkull, and died on the ſpot. In Delhi, an elephant paſſing along the ſtreets, put his trunk into a taylor's ſhop, where ſeveral people were at work: one of them pricked the end with his needle: the beaſt paſſed on; but in the next dirty puddle filled his trunk with water, returned to the ſhop, and ſpurting every drop among the people who had offended him, ſpoiled their work.

An elephant in Adimeer, that often paſſed through the bazar or market, as he went by a certain herb-woman, always received from her a mouthful of greens: at length he was ſeized with one of his periodical fits of rage, broke his fetters, and, running through the market, put the crowd to flight, and among others, this woman, who, in haſte, forgot a little child ſhe had brought with her. The animal recollecting the ſpot where his benefactreſs was wont to ſit, took up the infant gently on his trunk, and placed it in ſafety on a ſtall before a neighbouring houſe. Another, in his madneſs, killed his *cornac* or governor: the wife, ſeeing the misfortune, took her two children, and flung them before the elephant, ſaying, "Now you have deſtroyed their father, you may as well put an end to their lives and mine." It inſtantly ſtopped, relented, took the greateſt of the children, placed him on its neck, adopted him for his *cornac*, and never afterwards would permit any body elſe to mount it.

A ſoldier at Pondicherry, who was accuſtomed, whenever he received the portion that came to his ſhare, to carry a certain quantity of it to one of theſe animals, having one day drank rather too freely, and finding himſelf purſued by the guards, who were going to take him to priſon, took refuge under the elephant's body and fell aſleep. In vain did the guard try to force him from this aſylum, as the elephant protected him with his trunk. The next morning, the ſoldier, recovering from his drunken fit, ſhuddered with horror to find himſelf ſtretched under the belly of this huge animal. The elephant, which without doubt perceived the man's embarraſſment, careſſed him with his trunk, in order to inſpire him with courage and make him underſtand that he might now depart in ſafety.

A painter was deſirous of drawing the elephant that was kept in the menagerie at Verſailles in an uncommon attitude, namely, that of holding his trunk raiſed up in the air with his mouth open. The painter's boy, in order to keep the animal in this poſture, threw fruit into his mouth; but as the lad frequently deceived him, and made an offer only of throwing him the fruit, he grew angry; and, as if he had known that the painter's intention of drawing him was the cauſe of the affront that was offered him, inſtead of revenging himſelf on the lad, he turned his reſentment on the maſter, and taking up a quantity of water in his trunk, threw it on the paper on which the painter was drawing, and ſpoiled it.

At the Cape of Good Hope, it is cuſtomary to kill theſe animals, for the ſake of their teeth, by the chaſe. Three horſemen, well mounted, and armed with lances, attack the elephant alternately, each relieving the other as they ſee their companion preſſed, till the beaſt is ſubdued. Three Dutchmen (brothers), who had made large fortunes by this buſineſs, determined to retire to Europe, and enjoy the fruits of their labours; but reſolved, before they went, to have a laſt chaſe by way of amuſement: they met with their game, and began the attack in the uſual manner; but unfortunately one of their horſes fell down and flung its rider; the enraged animal inſtantly ſeized the unhappy man with its trunk, flung him up to a vaſt height in the air, and received him on one of his tuſks; then turning towards the two other brethren, as if it were with an aſpect of revenge and inſult, held out to them the impaled wretch writhing on the bloody tooth.

From the earlieſt accounts in hiſtory, the eaſtern nations have employed elephants in war; Alexander the Great was the firſt European who ever mounted an elephant. He carried a number of them into Greece, which Pyrrhus employed ſome years after againſt the Romans at the battle of Tarentum. Both the Greeks and Romans ſoon learned to get the better of thoſe monſtrous animals: they opened their ranks and allowed them to paſs through; neither did they attempt to hurt them, but threw darts, &c. at their guides. Now that fire-arms are the principal inſtruments of war, elephants, which are terrified at the noiſe and flame, inſtead of being uſeful, would only tend to embarraſs and confuſe an army. However, in Cochin and other parts of Malabar, as alſo in Tonquin, Siam, and Pegu, where fire-arms are little underſtood, they are ſtill uſed in battle. The guide ſits aſtride upon the neck, and the combatants ſit or ſtand upon the other parts of the body. They are alſo extremely ſerviceable in fording of rivers, and carrying over the baggage on their backs. After the keepers have loaded them with ſeveral hundred weight, they faſten ropes to them; of which the ſoldiers taking hold, either ſwim or are drawn acroſs the river. In time of action, they now and then fix a heavy iron chain to the end of their trunks, which they whirl round with ſuch agility, as to make it impoſſible for an enemy to approach them at that time. Another uſe they ſtill have for this creature in war, is to force open the gates of a city or garriſon which is cloſely beſieged. This he does by ſetting his backſide againſt them, riggling backwards and forwards with his whole weight, till he has burſt the bars, and forced an entrance: to prevent which, moſt of the garriſons in this country have large ſpikes ſtuck in their gates, that project to a conſiderable diſtance. However, after all, thoſe prodigious animals are kept more for ſhow and grandeur than for uſe, and their keeping is attended with a very great expence, for they devour vaſt quantities of proviſion; and you muſt ſometimes regale them with a plentiful repaſt of cinnamon, of which they are exceſſively fond. It is ſaid to be no uncommon thing with a Nabob, if he has a mind to ruin a private gentleman, to make him a preſent of an elephant, which he is ever afterwards obliged to maintain at a greater expence than he can afford: by parting with it, he would certainly fall under the diſpleaſure of the grandee, beſides forfeiting all the honour which his countrymen think is conferred upon him by ſo reſpectable a preſent.

When the elephant is properly managed, he lives very long even in a ſtate of ſlavery and labour. That ſome have lived in this ſtate 130 years, is pretty well authenticated. In a natural ſtate, they often exceed 200 years, and propagate their ſpecies till they are 120. It is 30 years before they come to their full growth.

The elephant inhabits India, and ſome of its greater iſlands, Cochin China, and ſome of the provinces of China. It abounds in the ſouthern parts of Africa, from the river Senegal to the Cape; and from thence as high as Ethiopia on the other ſide. They are found in the greateſt numbers in the interior parts, where there are vaſt foreſts, near the ſides of rivers. The wild elephants of Ceylon live in troops or families diſtinct and ſeparate from all others, and ſeem to avoid the ſtrange herds with particular care. When a family removes from place to place, the largeſt-tuſked males put themſelves at the head; and if they meet with a large river, are the firſt to paſs it. On arriving on the oppoſite bank, they try whether the landing place is ſafe: in caſe it is, they give a ſignal of a note from the trunk, as if it were the ſound of a trumpet, on which the remaining part of the old elephants ſwim over; the little elephants follow, holding one another by locking their trunks together; and the reſt of the old ones bring up the rear. In the woods is often ſeen a ſolitary male elephant, wandering like an outlaw baniſhed from the herd and all the race. He ſeems as if in a ſtate of deſperation, and is very dangerous. A ſingle man will put to flight whole herds of ſocial elephants: this alone fears not his preſence, but will ſtand firm, ſetting his power at defiance. Elephants are not at preſent domeſticated in Africa, but only in the more civilized parts of Aſia. They are much more numerous in Africa. In ſome parts they ſwarm ſo, that the negroes are obliged to make their habitations under ground for fear of them. They are killed and eaten by the natives, and the trunk is ſaid to be a delicious morſel. Elephants teeth are brought from Africa: they are frequently picked up in the woods; ſo that it is uncertain whether they are ſhed teeth, or thoſe of dead animals. The African teeth which come from Moſambique are ten feet long; thoſe of Malabar only three or four; the largeſt in Aſia are thoſe of Cochin China, which even exceed the ſize of the elephants of Moſambique. The ſkin is thick, and, when dreſſed, proof againſt a muſket ball. The fleſh, the gall, the ſkin, and the bones, are ſaid to be uſed medicinally by the Chineſe. See plate 11.

ELEVATION OF THE HOST, in the church of Rome, that part of the maſs where the prieſt raiſes the hoſt above his head for the people to adore.

ELEVATOR, in anatomy, the name of ſeveral muſcles, ſo called from their ſerving to raiſe the parts of the body to which they belong. See ANATOMY, *Table of the Muſcles*.

ELEVATORY, in ſurgery, an inſtrument uſed for raiſing depreſſed or fractured parts of the ſkull, to be applied after the integuments and perioſteum are removed. See SURGERY.

ELEVE, a term purely French, though of late uſed alſo in our language. Literally it ſignifies a diſciple or ſcholar bred up under any one, being formed from the Italian *allievo*, an "apprentice" or "novice." It was firſt uſed by the French writers in ſpeaking of painters; ſuch a painter was an eleve of Da Vinci, of Raphael, &c. From painting it came to be applied to ſuch as ſtudied or learned any other art under a maſter. In the Royal Academy of Sciences, there were 20 eleves: and in that of inſcriptions, 10 eleves. The eleves are to act in concert with the penſionaries. See ACADEMY. The denomination *eleve*, however, has been ſince ſuppreſſed, and that of *adjoint* ſubſtituted in its room; becauſe every body did not know the ſenſe affixed to it by the academy: and now the penſionary academiſts have not, as formerly, each of them an eleve; but the eleves are become adjoints, or aſſociates of the academy.

ELEVENTH, or chord of the eleventh. See INTERVAL.

ELEUSINIA, in Grecian antiquity, a feſtival kept in honour of Ceres, every fourth year by ſome ſtates, but by others every fifth. The Athenians celebrated it at Eleuſis, a town of Attica; whence the name.

Ceres, ſays an Athenian orator (Iſocrates), wandering in queſt of her daughter Proſerpine, came into Attica, where ſome good offices were done her, which it is unlawful for thoſe who are not initiated to hear. In return ſhe conferred two unparalleled benefits; to wit, the knowledge of agriculture, by which the human race is raiſed above the brute creation; and the myſteries, from which the partakers derive ſweeter hopes than other men enjoy, both as to the preſent life and to eternity. It was the popular opinion, that the Eleuſinian goddeſſes ſuggeſted prudent counſel to their votaries, and influenced their conduct; that theſe were reſpected in the infernal regions, and had precedence in the aſſemblies of the bleſſed; while the unhallowed were in utter darkneſs, wallowing in mire, or labouring to fill a leaky veſſel. The Athenians were ſolicitous to ſecure theſe advantages to their children, by having them initiated as ſoon as was allowed.

Ceres was ſuppoſed to be particularly partial to Eleuſis and its vicinity. *There* were the memorials of her preſence and of her bounty; the well-named *Callichorus*, by which ſhe had reſted, in the reign of Erectheus; the ſtone on which ſhe ſat, named *the ſorrowful*; the Rharian plain, where barley was firſt ſown; and the threſhing-floor and altar of Triptolemus, a herdſman whom ſhe inſtructed in the culture of that grain, the uſe of which ſucceeded to acorns. Her myſteries continued to poſſeſs a pre-eminence in holineſs, and to be accounted as much ſuperior to all other religious feſtivals as the gods were to the heroes. Even the garments worn at the ſolemnity were ſuppoſed to partake of their efficacy, and to be endued with ſignal virtues. It was uſual to retain them until they were periſhing; and then to dedicate them in the temple, or to reſerve them for the purpoſe of enwrapping new-born children.

The myſtic temple, as it was called, provided by Pericles for the ſolemnity, created ſuch awe by its ſanctity as could be equalled only by the effect of its beauty and magnitude, which excited aſtoniſhment in every beholder. The profane or uninitiated were forbidden to enter it on any pretence. Two young Acarnanians happened inadvertently to mix with the crowd at the ſeaſon of the myſteries, and to go in; but the queſtion ſuggeſted by their ignorance preſently betrayed them, and their intruſion was puniſhed with death. The chief prieſt, hierophant, or myſtagogue, was taken from the Eumolpidæ, a holy family flouriſhing at Athens, and deſcended from Eumolpus, a ſhepherd and favourite of Ceres. He was enjoined celibacy, and wore a ſtole or long garment, his hair, and a wreath of myrtle. The grand requiſites in his character were ſtrength and melody of voice, ſolemnity of deportment, magnificence, and great decorum. Under him, beſides many of inferior ſtation, was the daduchus or torch-bearer, who had likewiſe his hair, with a fillet; the prieſt, who officiated at the altar; and the hierceryx or ſacred herald; all very important perſonages. The latter was of a family which claimed the god Mercury and Aglaucos the daughter of Cecrops for its anceſtors.

The ſecrecy in which the myſteries were enveloped, ſerved to enhance the idea of their conſequence, and to increaſe the deſire of participation. It was ſo particular, that no perſon was allowed even to name the hierophant by whom he had been initiated. Public abhorrence and deteſtation awaited the babbler, and the law directed he ſhould die.

The Athenians ſuffered none to be initiated into theſe myſteries but ſuch as were members of their city. This regulation, which compelled Hercules, Caſtor, and Pollux, to become citizens of Athens, was ſtrictly obſerved in the firſt ages of the inſtitution; but afterwards all perſons, barbarians excepted, were freely initiated.

The feſtivals were divided into great and leſs myſteries. The leſs were inſtituted from the following circumſtance: Hercules paſſed near Eleuſis while the Athenians were celebrating the myſteries, and deſired to be initiated. As this could not be done, becauſe he was a ſtranger, and as Eumolpus was unwilling to diſpleaſe him on account of his great power, and the ſervices which he had done to the Athenians, another feſtival was inſtituted without violating the laws. It was called μικρα, and Hercules was ſolemnly admitted to the celebration, and initiated. Theſe leſs myſteries were obſerved at Agræ near the Iliſſus. The greater were celebrated at Eleuſis, from which place Ceres has been called *Eleuſinia*. In later times the ſmaller feſtivals were preparatory to the greater, and no perſon could be initiated at Eleuſis without a previous purification at Agræ. This purification they performed by keeping themſelves pure, chaſte, and unpolluted, during nine days; after which they came and offered ſacrifices and prayers, wearing garlands of flowers, called ισλερα or ιμηρα, and having under their feet Διος κωδιον, *Jupiter's ſkin*, which was the ſkin of a victim offered to that god. The perſon who aſſiſted was called υδρανος from υδωρ *water*, which was uſed at the purification, and they themſelves were called μυσται, *the initiated*.

A year after the initiation at the leſs myſteries, they ſacrificed a ſow to Ceres, and were admitted in the greater, and the ſecrets of the feſtivals were ſolemnly revealed to them, from which they were called εφοροι and εποπται, *inſpectatores*.

This feſtival was obſerved in the month Boedromion or September, and continued nine days, from the 15th till the 23d.

The ſtory of Ceres and Proſerpine, the foundation of the Eleuſinian myſteries, was partly local. It was both verbally delivered, and repreſented in allegorical ſhow. Proſerpine was gathering flowers when ſhe was ſtolen by Pluto. Hence the proceſſion of the holy baſket, which was placed on a car dragged along by oxen, and followed by a train of females, ſome carrying the myſtic cheſts, ſhouting, *Hail, Ceres!* At night a proceſſion was made with lighted torches, to commemorate the goddeſs ſearching for her daughter. A meaſure of barley, the grain which, it was believed, ſhe had given, was the reward of the victors in the gymnaſtic exerciſes; and the tranſaction at the temple had a reference to the legend. A knowledge of theſe things and places, from which the profane were excluded, was the amount of initiation; and the mode of it, which had been deviſed by craft, was ſkilfully adapted to the reigning ſuperſtitions. The operation was forcible, and the effect in proportion. The prieſthood flouriſhed as piety increaſed. The diſpenſation was corrupt, but its tendency not malignant. It produced ſanctity of manners and an attention to the ſocial duties; a deſire to be as diſtinguiſhed by what was deemed virtue as by ſilence.

Some have ſuppoſed the principal rites at this feſtival to have been obſcene and abominable, and that from thence proceeded all the myſterious ſecrecy. They were carried from Eleuſis to Rome in the reign of Adrian, where they were obſerved with the ſame ceremonies as before, though perhaps with more freedom and licentiouſneſs. They laſted about 1800 years, and were at laſt aboliſhed by Theodoſius the Great.

ELEUSIS, a town in Attica between Megara and the Piræus, celebrated for the feſtivals of Ceres. See the preceding article.—Thoſe rites were finally extinguiſhed in Greece upon the invaſion of Alaric the Goth.

ELEUTHERIA, a feſtival celebrated at Platæa in honour of Jupiter *Eleutherius*, or "the aſſertor of liberty," by delegates from almoſt all the cities of Greece. Its inſtitution originated in this: After the victory obtained by the Grecians under Pauſanias over Mardonius the Perſian general in the country of Platæa, an altar and ſtatue were erected to Jupiter Eleutherius, who had freed the Greeks from the tyranny of the barbarians. It was further agreed upon in a general aſſembly, by the advice of Ariſtides the Athenian, that deputies ſhould be ſent every fifth year, from the different cities of Greece, to celebrate Eleutheria, feſtivals of liberty. The Platæans celebrated alſo an anniverſary feſtival in memory of thoſe who had loſt their lives in that famous battle. There was alſo a feſtival of the ſame name obſerved by the Samians in honour of the god of love. Slaves alſo, when they obtained their liberty, kept a holiday, which they called *Eleutheria*.

ELF, a term now almoſt obſolete, formerly uſed to denote a fairy or hobgoblin; an imaginary being, the creature of ignorance, ſuperſtition, and craft. See Fairy.

Elf-*Arrows*, in natural hiſtory, a name given to the flints anciently faſhioned into arrow-heads, and ſtill found foſſile in Scotland, America, and ſeveral other parts of the world: they are believed by the vulgar to be ſhot by fairies, and that cattle are ſometimes killed by them.

ELGIN, the capital of the county of Moray in Scotland, and formerly a biſhop's ſee, is ſituated on the river Loſey about ſix miles north from the Spey, in W. long. 2. 25. N. lat. 57. 40.

ELIQUATION, in chemiſtry, an operation by which a more fuſible ſubſtance is ſeparated from one that is leſs ſo, by means of a heat ſufficiently intenſe to melt the former, but not the latter. Thus an alloy of copper and lead may be ſeparated by a heat capable of melting the latter, but not the former.

ELISION, in grammar, the cutting off or ſuppreſſing a vowel at the end of a word, for the ſake of ſound or meaſure, the next word beginning with a vowel. Eliſions are pretty frequently met with in Engliſh poetry, but more frequently in the Latin, French, &c. They chiefly conſiſt in ſuppreſſions of the *a*, *e*, and *i*; though an eliſion ſuppreſſes any of the other vowels.

ELIXATION, in pharmacy, the extracting the virtues of ingredients by boiling or ſtewing.

ELIXIR, in medicine, a name heretofore given to any compound tincture extracted from various ingredients. The term is now out of uſe.

ELK, in zoology. See Cervus.

ELL, *ulna*, a meaſure, which obtains, under different denominations, in moſt countries, whereby cloths, ſtuffs, linens, ſilks, &c. are uſually meaſured; anſwering nearly to the yard of England, the canna of Italy, the vara of Spain, the palm of Sicily, &c. Servius will have the ell to be the ſpace contained between the two hands when ſtretched forth; but Suetonius makes it only the cubit. The ells moſt frequently uſed with us are the Engliſh and Flemiſh; the former containing three feet nine inches, or one yard and a quarter; the latter only 27 inches, or three quarters of a yard; ſo that the ell Engliſh is to the Flemiſh ell as five to three. In Scotland, the ell contains $37\frac{2}{10}$ Engliſh inches. M. Richard, in his Treatiſe of Commerce, reduces the ells thus: 100 ells of Amſterdam are equal to $98\frac{1}{4}$ of Brabant, Antwerp, and Bruſſels; to $58\frac{1}{2}$ of England and France; to 120 of Hamburgh, Francfort, Leipſic, and Cologne; 125 of Breſlaw; 110 of Bergen and Drontheim; and 117 of Stockholm.

ELLIPOMACROSTYLA, in natural hiſtory, the name of a genus of cryſtals. The word is derived from the Greek, ελλιπης *imperfect*, μακρος *long*, and στυλος *a column*; and expreſſes an imperfect cryſtal with a long column. The perfect figure of cryſtal being a column terminated by a pyramid at each end, thoſe which want this character are eſteemed imperfect; and accordingly the bodies of this genus are defined to be imperfect cryſtals with ſingle pyramids; one end of their column being affixed to ſome ſolid body, and compoſed of thin

and ſlender hexangular columns, terminated by hexangular pyramids.

ELLIPOPACHYSTYLA, in natural hiſtory, the name of a genus of cryſtals. The word is derived from the Greek, ελλιπης *imperfect*, παχυς *thick*, and ςυλος *a column*; and expreſſes a cryſtal of the imperfect kind with a thick column. The bodies of this genus are cryſtals compoſed of an hexangular column, conſiderably thick and ſhort, affixed irregularly at one end to ſome ſolid body, and terminated at the other by an hexangular pyramid.

ELLIPSIS, in geometry, a curve line returning into itſelf, and produced from the ſection of a cone by a plane cutting both its ſides, but not parallel to the baſe. See CONIC *Sections*.

ELLIPSIS, in grammar, a figure of ſyntax, wherein one or more words are not expreſſed; and from this deficiency it has got the name *ellipſis*.

ELLIPTIC, or ELLIPTICAL, ſomething belonging to an ellipſis.

ELLISIA, in botany; a genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 28th order, *Luridæ*. The corolla is monopetalous and funnel-ſhaped; the berry carnous and bilocular; there are two ſeeds muricated or ſet with ſmall raiſed points, the one higher than the other.

ELM, in botany. See ULMUS.

ELMACINUS (George), author of a *Hiſtory of the Saracens*, was born in Egypt towards the middle of the 13th century. His hiſtory comes down from Mahomet to the year of the Hegira 512, anſwering to the year of our Lord 1134; in which he ſets down year by year, in a very conciſe manner, whatever regards the Saracen empire, intermixed with ſome paſſages relating to the eaſtern Chriſtians. His abilities muſt have been conſiderable; ſince, though he profeſſed Chriſtianity, he held an office of truſt near the perſons of the Mahometan princes. He was ſon to Yaſer Al Amid, ſecretary to the council of war under the ſultans of Egypt for 45 years; and in 1238, when his father died, ſucceeded him in his place. His hiſtory of the Saracens was tranſlated from Arabic into Latin by Erpinius; and printed in theſe two languages in folio, at Leyden, in 1625. Erpinius died before the publication; but Golius took care of it, and added a preface. It was dedicated by Erpinius's widow to Dr. Andrews, biſhop of Wincheſter.

ELOCUTION. See ORATORY.

ELOGY, or EULOGY, a praiſe or panegyric beſtowed on any perſon or thing, in conſideration of its merit. The beauty of elogy conſiſts in an expreſſive brevity. Eulogiums ſhould not have ſo much as one epithet, properly ſo called, nor two words ſynonymous: they ſhould ſtrictly adhere to truth; for extravagant and improbable elogies rather leſſen the character of the perſon or thing they would extol.

ELOHI, ELOI, or *Elohim*, in ſcripture, one of the names of God. But it is to be obſerved, that angels, princes, great men, judges, and even falſe gods, are ſometimes called by this name. The ſequel of the diſcourſe is what aſſiſts us in judging rightly concerning the true meaning of this word. It is the ſame as *Eloha*. One is the ſingular, the other the plural. Neverthe-leſs *Elohim* is often conſtrued in the ſingular number, particularly when the true God is ſpoken of; but when falſe gods are ſpoken of, it is conſtrued rather in the plural.

ELOINED, in law, ſignifies reſtrained or hindered from doing ſomething: thus it is ſaid, that if thoſe within age be eloined, ſo that they cannot ſue perſonally, their next friend ſhall ſue for them.

ELONGATION, in aſtronomy, the digreſſion or receſs of a planet from the ſun, with reſpect to an eye placed on our earth. The term is chiefly uſed in ſpeaking of Venus and Mercury, the arch of a great circle intercepted between either of theſe planets and the ſun being called the *elongation* of that planet from the ſun.

ELOPEMENT, in law, is where a married woman departs from her huſband, and cohabits with an adulterer; in which caſe the huſband is not obliged to allow her any alimony out of his eſtate, nor is he chargeable for neceſſaries for her of any kind. However, the bare advertiſing a wife in the gazette, or other public paper, is not a legal notice to perſons in general not to truſt her; though a perſonal notice given by the huſband to particular perſons is ſaid to be good. An action lies, and large damages may be recovered, againſt a perſon for carrying away and detaining another man's wife.

ELOQUENCE, the art of ſpeaking well, ſo as to affect and perſuade. See ORATORY.

ELSHEIMER (Adam), a celebrated painter, born at Francfort on the Maine, 1574. He was firſt a diſciple of Philip Uffenbach a German; but his deſire of improvement carrying him to Rome, he ſoon became a moſt excellent artiſt in landſcapes, hiſtory, and night-pieces, with ſmall figures. His works are but few; and the great pains he beſtowed in finiſhing them raiſed their prices ſo high, that they are hardly any where to be found but in the cabinets of princes. He was of a melancholy turn, and ſunk under the embarraſſments of his circumſtances in 1610. James Erneſt Thomas of Landau was his diſciple; and imitated his ſtyle ſo nicely, that their performances are not eaſily diſtinguiſhed.

ELSIMBURG, a port-town of Sweden, in the province of Gothland, and territory of Schonen, ſeated on the ſide of the Sound, over againſt Elſinore. It was formerly a fortreſs belonging to the Danes; but all the fortifications were demoliſhed in 1679, and there is only one tower of a caſtle which remains undemoliſhed. It now belongs to Sweden. E. long. 13. 20. N. lat. 56. 2.

ELSINORE, or ELSINOOR, a ſeaport of Denmark, ſeated on the Sound, in the iſle of Zealand. It was a ſmall village, containing a few fiſhermen's huts, until 1445, when it was made a ſtaple town by Eric of Pomerania, who conferred upon the new ſettlers conſiderable immunities, and built a caſtle for their defence. From that period it gradually increaſed in ſize and wealth, and is now the moſt commercial place in Denmark, next to Copenhagen. It contains 5000 inhabitants, among whom are a conſiderable number of foreign merchants, and the conſuls of the principal nations trading to the Baltic. The paſſage of the Sound is guarded by the fortreſs of Cronborg, ſituated on the edge of a peninſular promontory, the neareſt point of land from the oppoſite coaſt of Sweden. It is fortified towards the ſhore by ditches, baſtions, and regular entrenchments; and toward the ſea by ſeveral batteries, mounted with 60 cannon, the largeſt of which are 48 pounders. Every veſſel, as it paſſes, lowers her top-ſails, and pays a toll at Elſinore. It is aſſerted, that this fortreſs guards the Sound, and that all ſhips muſt, on account of the ſhoal waters and currents, ſteer ſo near the batteries as to be expoſed to their fire in caſe of refuſal. This, however, is a miſtaken notion. On account, indeed, of the numerous and oppoſite currents in the Sound, the ſafeſt paſſage lies near the fortreſs; but the water in any part is of ſufficient depth for veſſels to keep at a diſtance from the batteries, and the largeſt ſhips can even ſail cloſe to the coaſt of Sweden. The conſtant diſcharge, however, of the toll, is not ſo much owing to the ſtrength of the fortreſs as to compliance with the public law of Europe. Many diſputes have ariſen concerning the right by which the crown of Denmark impoſes ſuch a duty. The kings of Sweden, in particular, claiming an equal title to the free paſſage of the Strait, were for ſome time exempted by treaty from paying it; but in 1720, Frederic I. agreed that all Swediſh veſſels ſhould, for the future, be ſubject to the uſual impoſts. All veſſels, beſide a ſmall duty, are rated at $1\frac{1}{4}$ *per cent.* of their cargoes, except the Engliſh, French, Dutch, and Swediſh, which pay only one *per cent.* and, in return, the crown takes the charge of conſtructing lighthouſes, and erecting ſignals to mark the ſhoals and rocks, from the Categate to the entrance into the Baltic. The tolls of the

Sound, and of the two Belts, ſupply an annual revenue of above 100,000l. E. lon. 13. 23. N. lat. 56. 0.

ELVAS, a large and ſtrong town of Portugal, in Alentejo, with a caſtle and biſhop's ſee. It is one of the moſt important places in Portugal. The ſtreets are handſome, and the houſes well-built. There is a ciſtern ſo large, that it will hold water enough for the town for ſix months. It is brought by a magnificent aqueduct, three miles in length, which is in ſome places ſupported by four or five high arches, one upon another. On the ſide of it is a foreſt of olive-trees, three miles in length, among which are walks and fine fountains. It was bombarded by the French in 1706, to no purpoſe. An academy for young gentlemen was founded here, by the king, in 1733. It is ſeated on a mountain, near the river Guadiana, 50 miles N. E. of Evora, and 100 E. of Liſbon. W. lon. 7. 3. N. lat. 38. 43.

ELUDING, the act of evading or rendering a thing vain and of no effect; a dexterous getting clear, or eſcaping out of an affair, difficulty, embarraſſment, or the like. We ſay, to *elude* a propoſition, &c. The deſign of chicanery is, to *elude* the force of the laws: this doctor has not reſolved the difficulty, but *eluded* it. Alexander, ſays the hiſtorian, in cutting the Gordian knot, either *eluded* the oracle or fulfilled it: *Ille, nequicquam luctatus cum latentibus nodis, Nihil, inquit, intereſt, quomodo ſolvatur; gladioque ruptis omnibus loris, oraculi ſortem vel* eludit, *vel implevit.*

ELVELA, in botany; a genus of the natural order of fungi, belonging to the cryptogamia claſs of plants. The fungus is turbinated, or like an inverted cone.

ELUL, in ancient chronology, the 12th month of the Jewiſh civil year, and the ſixth of the eccleſiaſtical: it conſiſted of only 29 days, and anſwered pretty nearly to our Auguſt.

ELUTRIATION, in chemiſtry, an operation performed by waſhing ſolid ſubſtances with water, ſtirring them well together, and haſtily pouring off the liquid, while the lighter part remains ſuſpended in it, that it may thereby be ſeparated from the heavier part. By this operation metallic ores are ſeparated from earth, ſtones, and other unmetallic particles adhering to them.

ELY, a town of Cambridgeſhire, with a biſhop's ſee, and a market on Saturday. It is ſeated on the river Ouſe (which is navigable hence to Lynn) in the fenny and unwholeſome tract called the Iſle of Ely. The aſſizes are held here once a year only. It is a county of itſelf, including the territory around it, and has a diſtinct civil and criminal juriſdiction, of which the biſhop is the head, in the ſame manner as the biſhop of Durham is of that county. It has a very fine cathedral, but is otherwiſe a mean place. It is 17 miles N. of Cambridge, and 68 N. of London. E. long. 0. 9. N. lat. 52. 24.

ELY, *Iſle of.* See CAMBRIDGESHIRE.

ELYMAIS, the capital city of the land of Elam, or the ancient Perſia. We are told (1 Mac. vi. 1.) that Antiochus Epiphanes, having underſtood that there were very great treaſures lodged in a temple at Elymais, determined to go and plunder it: but the citizens getting intelligence of his deſign, raiſed an inſurrection, forced him out of the city, and obliged him to fly. The author of the ſecond book of Maccabees (ix. 2.) calls this city *Perſepolis,* in all probability becauſe formerly it was the capital of Perſia: for it is known from other accounts, that Perſepolis and Elymais were two very different cities, the latter ſituated upon the Eulæus, the former upon the Araxis.

ELYMUS, in botany; a genus of the digynia order, belonging to the triandria claſs of plants; and in the natural method ranking under the fourth order, *Gramina.* The calyx is lateral, bivalved, aggregate, and multiflorous.

ELYOT (Sir Thomas), a gentleman of eminent learning in the 16th century, was educated at Oxford, travelled into foreign countries, and upon his return was introduced to court. His learning recommended him to Henry VIII. who conferred the honour of knighthood on him, and employed him in ſeveral embaſſies; particularly in 1532, to Rome, about the divorce of queen Catharine, and afterwards to Charles V. about 1536. He wrote, *The Caſtle of Health, The Governor, Banquet of Sapience, Of the Education of Children, De rebus memorabilibus Angliæ,* and other books; and was highly eſteemed by all his learned contemporaries.

ELYSIUM, Ελυσιος, in the antient theology, or rather mythology, a place in the *inferi* or lower world, furniſhed with fields, meads, agreeable woods, groves, ſhades, rivers, &c. whither the ſouls of good people were ſuppoſed to go after this life. Orpheus, Hercules, and Æneas, are ſuppoſed to have deſcended into Elyſium in their life-time, and to have returned again; (Virg. lib. vi. ver. 638, &c.) Tibullus (lib. i. eleg. 3.) gives us fine deſcriptions of the Elyſian fields. Virgil oppoſes Elyſium to Tartarus; which was the place where the wicked underwent their puniſhment. He aſſigns Elyſium to thoſe who died for their country, to thoſe of pure lives, to truly inſpired poets, to the inventors of arts, and to all who have done good to mankind.

Some authors take the fable of Elyſium to have been borrowed from the Phœnicians; as imagining the name *Elyſium* formed from the Phœnician עלז *alaz,* or עלץ *alats,* or עלס *alas,* "to rejoice," or "to be in joy;" the letter *a* being only changed into *e,* as we find done in many other names; as in *Enakim* for *Anakim,* &c. On which footing, Elyſian fields ſhould ſignify the ſame thing as a place of pleaſure; or,

——— *Locos lætos, & amena vireta*
Fortunatorum nemorum, ſedeſque beatas. Virg.

Others derive the word from the Greek λυω *ſolvo,* "I deliver, I let looſe or diſengage;" becauſe here men's ſouls are freed or diſincumbered from the fetters of the body. Beroaldus, and Hornius (Hiſt. Philoſoph. lib. iii. cap. 2.) take the place to have derived its name from Eliza, one of the firſt perſons who came into Greece after the deluge, and the author and father of the Ætolians.

The Elyſian fields were, according to ſome, in the Fortunate Iſlands on the coaſt of Africa; in the Atlantic. Others place them in the iſland of Leuce; and, according to the authority of Virgil, they were ſituated in Italy. According to Lucian, they were near the moon; or in the centre of the earth, if we believe Plutarch. Olaus Wormius contends, that it was in Sweden the Elyſian fields were placed.

ELZEVIRS, celebrated printers at Amſterdam and Leyden, who greatly adorned the republic of letters by many beautiful editions of the beſt authors of antiquity. They fell ſomewhat below the Stephenſes in point of learning, as well as in their editions of Greek and Hebrew authors; but as to the choice of good books, they ſeem to have equalled, and in the neatneſs and elegance of their ſmall characters, greatly to have exceeded them. Their Virgil, Terence, and Greek Teſtament, have been reckoned their maſter-pieces; and are indeed ſo very fine, that they juſtly gained them the reputation of being the beſt printers in Europe. There were five of theſe Elzevirs, namely, Lewis, Bonaventure, Abraham, Lewis, and Daniel. Lewis began to be famous at Leyden in 1595, and was remarkable for being the firſt who obſerved the diſtinction between the *v* conſonant and *u* vowel, which had been recommended by Ramus and other writers long before, but never regarded. Daniel died in 1680 or 1681; and though he left children who carried on the buſineſs, paſſes nevertheleſs for the laſt of his family who excelled in it. The Elzevirs have printed ſeveral catalogues of their editions; but the laſt, publiſhed by Daniel, is conſiderably enlarged, and abounds with new books. It was printed at Amſterdam, 1674, in 12mo, and divided into ſeven volumes.

EMANCIPATION, in the Roman law, the ſetting free a ſon from the ſubjection of his father; ſo that whatever moveables he acquires belong in property to him, and not to his fa-

ther, as before emancipation. Emancipation puts the ſon in a capacity of managing his own affairs, and of marrying without his father's conſent, though a minor. Emancipation differs from manumiſſion, as the latter was the act of a maſter in favour of a ſlave, whereas the former was that of a father in favour of his ſon. There were two kinds of emancipation: the one tacit, which was by the ſon's being promoted to ſome dignity, by his coming of age, or by his marrying, in all which caſes he became his own maſter of courſe. The other, expreſs; where the father declared before a judge, that he emancipated his ſon. In performing this, the father was firſt to ſell his ſon imaginarily to another, whom they called *pater fiduciarius*, father in truſt; of whom being bought back again by the natural father, he manumitted him before the judge by a verbal declaration.

EMARGINATED, among botaniſts. See BOTANY, p. 48.

EMASCULATION, the act of caſtrating or depriving a male of thoſe parts which characteriſe his ſex. See CASTRATION, and EUNUCH.

EMBALMING, is the opening a dead body, taking out the inteſtines, and filling the place with odoriferous and deſiccative drugs and ſpices, to prevent its putrefying. The Egyptians excelled all other nations in the art of preſerving bodies from corruption; for ſome that they have embalmed upwards of 2000 years ago, remain whole to this day, and are often brought into other countries as great curioſities. Their manner of embalming was thus: they ſcooped the brains with an iron ſcoop out at the noſtrils, and threw in medicaments to fill up the vacuum: they alſo took out the entrails, and having filled the body with myrrh, caſſia, and other ſpices proper to dry up the humours, they pickled it in nitre, where it lay ſoaking for 70 days. The body was then wrapped up in bandages of fine linen and gums, and ſo was delivered to the kindred of the deceaſed, entire in all its features, the very hairs of the eye-lids being preſerved. They uſed to keep the bodies of their anceſtors, thus embalmed, in little houſes magnificently adorned, and took great pleaſure in beholding them, alive as it were, without any change in their ſize, features, or complexion. The Egyptians alſo embalmed birds, &c. The prices for embalming were different; the higheſt was a talent, the next 29 minæ, and ſo decreaſing to a very ſmall matter: but they who had not wherewithal to anſwer this expence, contented themſelves with infuſing, by means of a ſyringe, through the anus, a certain liquor extracted from the cedar; and, leaving it there, wrapped up the body in nitre. The oil thus preſerved the inteſtines, which dried, and were not in the leaſt putrefied: the body being encloſed in nitre, alſo grew dry, and nothing remained beſides the ſkin glued upon the bones.

The method of embalming uſed by the modern Egyptians, according to Maillet, is to waſh the body ſeveral times with roſe-water, which, he elſewhere obſerves, is more fragrant in that country than with us; they afterwards perfume it with incenſe, aloes, and a quantity of other odours, of which they are by no means ſparing; and then they bury the body in a winding ſheet, made partly of ſilk and partly of cotton, and ſoaked, as is ſuppoſed, with ſome ſweet-ſcented water or liquid perfume, though Maillet uſes only the term *moiſtened*; this they cover with another cloth of unmixed cotton, to which they add one of the richeſt ſuits of clothes of the deceaſed. The expence, he ſays, on theſe occaſions, is very great, though nothing like what the genuine embalming coſt in former times.

The principle of embalming depends either on the abſorption of the fluids of the body, or the impregnation of them with ſome ſubſtance which will preſerve the ſolids from putrefaction. Hence abſorbing powders have been uſed, and alſo nitre, which powerfully acts on the fleſh, though, like all other ſaline matter, it tends to prevent the body from drying. Dr. Hunter recommended the injecting of oil of turpentine impregnated with camphor and other aromatic gums into the blood veſſels, which is a very rational method.

EMBARCADERO, in commerce, a Spaniſh term, much uſed along the coaſts of America, particularly thoſe on the ſide of the South Sea. It ſignifies a place which ſerves ſome other conſiderable city farther within land, for a port or place of ſhipping, *i. e.* of embarking and diſembarking commodities. Thus Calao is the embarcadero of Lima, the capital of Peru; and Arica the embarcadero of Potoſi. There are ſome embarcaderos 40, 50, and even 60 leagues off the city, which they ſerve in that capacity.

EMBARGO, in commerce, an arreſt on ſhips or merchandiſe, by public authority; or a prohibition of ſtate, commonly on foreign ſhips, in time of war, to prevent their going out of port, ſometimes to prevent their coming in, and ſometimes both, for a limited time. The king may lay embargoes on ſhips, or employ thoſe of his ſubjects, in time of danger, for the ſervice and defence of the nation; but they muſt not be for the private advantage of a particular trader or company; and therefore a warrant to ſtay a ſingle ſhip is no legal embargo. No inference can be made from embargoes which are only in wartime; and are a prohibition by advice of council, and not at proſecution of parties. If goods be laden on board, and after an embargo or reſtraint from the prince or ſtate comes forth, and then the maſter of the ſhip breaks ground, or endeavours to ſail, if any damage accrues, he muſt be reſponſible for the ſame; the reaſon is, becauſe his freight is due, and muſt be paid, even though the goods be ſeized as contraband.

EMBASSADOR. See AMBASSADOR.

EMBASSY, the office or function of an ambaſſador.

EMBDEN, a port-town and city of Germany, capital of a county of the ſame name, now in poſſeſſion of the king of Pruſſia; it is ſituated at the mouth of the river Ens. E. long. 6. 45. N. lat. 53. 50.

EMBER-WEEKS, are thoſe wherein the *ember* or *embring days* fall. In the laws of king Alfred, and thoſe of Canute, thoſe days are called *ymbren*, that is, circular days, from whence the word was probably corrupted into *ember-days*: by the canoniſts they are called *quatuor anni tempora*, the four cardinal ſeaſons, on which the circle of the year turns: and hence Henſhaw takes the word to have been formed, viz. by corruption from *temper* of *tempora*. The ember-days are, the Wedneſday, Friday, and Saturday, after Quadrageſima Sunday, after Whitſunday, after Holy-rood day in September, and after St. Lucia's day in December: which four times anſwer well enough to the four quarters of the year, Spring, Summer, Autumn, and Winter. Mr. Somner thinks they were originally faſts, inſtituted to beg God's bleſſing on the fruits of the earth. Agreeably to which, Skinner ſuppoſes the word *ember* taken from the aſhes, *embers*, then ſtrewed on the head. Theſe ember-weeks are now chiefly taken notice of, on account of the ordination of prieſts and deacons; becauſe the canon appoints the Sundays next ſucceeding the ember-weeks, for the ſolemn times of ordination: though the biſhops, if they pleaſe, may ordain on any Sunday or holiday.

EMBERIZA, in ornithology, a genus of birds belonging to the order of paſſeres. The bill is conical, and the mandibles recede from each other towards the baſe; the inferior mandible has the ſides narrowed inwards, but the upper one is ſtill narrower. The moſt remarkable ſpecies are,

1. The *nivalis*, or great pyed mountain-finch of Ray, and the ſnow-bird of Edwards, has white wings, but the outer edges of the prime-feathers are black; the tail is black, with three white feathers on each ſide. Theſe birds are called in Scotland *ſnow-flakes*, from their appearance in hard weather and in deep ſnows. They arrive in that ſeaſon among the Cheviot-hills and in the Highlands in amazing flocks. A few breed in the Highlands, on the ſummit of the higheſt hills, in the ſame

places with the *ptarmigans*; but the greateſt numbers migrate from the extreme north. They appear in the Shetland iſlands; then in the Orkneys; and multitudes of them often fall, wearied with their flight, on veſſels in the Pentland Frith. Their appearance is a certain fore-runner of hard weather, and ſtorms of ſnow, being driven by the cold from their common retreats. Their progreſs ſouthward is probably thus; Spitzbergen and Greenland, Hudſon's Bay, the Lapland Alps, Scandinavia, Iceland, the Ferroe Iſles, Shetland, Orkneys, Scotland, and the Cheviot-hills. They viſit at that ſeaſon all parts of the northern hemiſphere, Pruſſia, Auſtria, and Siberia. They arrive lean, and return fat. In Auſtria, they are caught and fed with millet, and, like the ortolan, grow exceſſively fat. In their flights, they keep very cloſe to each other, mingle moſt confuſedly together, and fling themſelves collectively into the form of a ball; at which inſtant the fowler makes great havock among them.

2. The *miliaris*, or grey emberiza, is of a greyiſh colour, ſpotted with black in the belly, and the orbits are reddiſh. It is the bunting of Engliſh authors, and a bird of Europe.

3. The *hortulana*, or ortolan, has black wings; the firſt three feathers on the tail are white on the edges, only the two lateral are black outwardly. The orbits of the eyes are naked and yellow; the head is greeniſh, and yellow towards the inferior mandible. It feeds principally upon the panick-graſs; grows very fat; and is reckoned a delicate morſel by certain epicures, eſpecially when fattened artificially. Theſe birds are found in ſeveral parts of Europe, but are not met with in Britain; are common in France and Italy, and ſome parts of Germany and Sweden, migrating from one to the other in ſpring and autumn; and in their paſſage are caught in numbers, in order to fatten for the table. This ſpecies will ſometimes ſing very prettily, and has been kept for that purpoſe. The ſong is not unlike that of the yellow-hammer, but finer and ſweeter. In ſome parts it makes the neſt in a low hedge; in others, on the ground. It is careleſsly conſtructed, not unlike that of the lark. The female lays four or five greyiſh eggs, and in general has two broods in a year. Theſe birds receive both their Greek and Latin name from their food, the millet. Ariſtotle calls them *cynchromi*; and the Latins, *miliariæ*. The latter kept and fattened them in their *ornithones*, or fowl-yards, as the Italians do at preſent.

4. The *citrinella*, or yellow-hammer, has a blackiſh tail, only the two outward ſide-feathers are marked on the inner edge with a ſharp white ſpot. It is a bird of Europe, and comes about houſes in winter: it builds its neſt on the ground on meadows.

5. The *ſchœniclas*, or reed-ſparrow, has a black head, a blackiſh-grey body, and a white ſpot on the quill-feathers. It inhabits marſhy places, moſt commonly among reeds, from which it takes its name. Its neſt is worthy of notice for the artful contrivance of it, being faſtened to four reeds, and ſuſpended by them like a hammock, about three feet above the water; the cavity of the neſt is deep, but narrow; and the materials are buſhes, fine bents, and hairs. It lays four or five eggs of a blueiſh white, marked with irregular purpliſh veins, eſpecially on the larger end. It is a bird much admired for its ſong; and, like the nightingale, it ſings in the night.

6. The *oryzivora*, or rice-bunting, with the head and whole under ſide of the body black; hind part of the neck in ſome pale yellow, and in others white; coverts of the wings, and primaries, black, the laſt edged with white; part of the ſcapulars, leſſer coverts of the wings, and rump, white; back black, edged with dull yellow; tail of the ſame colours, and each feather ſharply pointed; the legs are red. The head, upper part of the neck, and back, of the female, is yellowiſh brown ſpotted with black; the under part, of a dull yellow; the ſides thinly ſtreaked with black.

Theſe birds inhabit in vaſt numbers the iſland of Cuba, where they commit great ravages among the early crops of rice, which precede thoſe of Carolina. They arrive very lean, but ſoon grow ſo fat, as to fly with difficulty; and, when ſhot, often burſt with the fall. They continue in Carolina not much above three weeks, and retire by the time the rice begins to harden; going on to other parts, and ſtaying in each only ſo long as the rice continues green. They come into Rhode Iſland and New York at the end of April, or the ſecond week in May, frequenting the borders of fields, and live on inſects, &c. till the maize is fit for their palate; when they begin by pecking holes in the ſides of the huſks, and after ſatiating themſelves go on to another; which leaves room for the rain to get in, and effectually ſpoils the plants. They continue there during the ſummer, and breed; returning, as autumn approaches, to the ſouthward. The males and females do not arrive together; the females come firſt. They are eſteemed to be the moſt delicate birds of thoſe parts; and the male is ſaid to have a fine note. This ſpecies is known in the country by the names of *bob lincoln* and *conquedle*; likewiſe called by ſome the *white-backed maize-thief*.

There are above 50 other ſpecies; two of which, *viz.* the black-throated bunting a native of America, and the cinereous bunting an inhabitant of Canada, are figured in plate 2, as ſpecimens of the genus.

EMBLEM, a kind of painted ænigma, which, repreſenting ſome obvious hiſtory, with reflections underneath, inſtructs us in ſome moral truth or other matter of knowledge. See DEVICE, ÆNIGMA, &c. Such is that very ſignificant image of Scævola holding his hand in the fire; with the words, *Agere et pati fortiter Romanum eſt*, "To do and ſuffer courageouſly is Roman." The word is pure Greek, formed of the verb εμϐαλλειν, "to caſt in, to inſert." Suetonius relates, that Tiberius made the word be eraſed out of the decree of the Roman ſenate, becauſe borrowed from another language. The emblem is ſomewhat plainer and more obvious than the ænigma. Gale defines emblem an ingenious picture, repreſenting one thing to the eye, and another to the underſtanding.

The Greeks alſo gave the name EMBLEMS, εμϐληματα, to inlayed or Moſaic works, and even to all kinds of ornaments of vaſes, moveables, garments, &c. And the Latins uſed *emblema* in the ſame ſenſe. Accordingly, Cicero, reproaching Verres with the ſtatues and fine-wrought works he had plundered from the Sicilians, calls the ornaments fixed thereto (and which on occaſion might be ſeparated from them) *emblemata*. Add, that Latin authors frequently compare the figures and ornaments of diſcourſe to theſe *emblemata*. Thus, an ancient Latin poet, praiſing an orator, ſays, that all his words were ranged like the pieces in Moſaic:

> *Quam lepide* λεξεις *compoſtæ, ut teſſerulæ omnes,*
> *Arte pavimenti, atque* emblemate *vermiculato.*

With us, emblem ordinarily ſignifies no more than a painting, baſſo-relievo, or other repreſentation, intended to hold forth ſome moral or political inſtruction. What diſtinguiſhes an emblem from a deviſe is, that the words of an emblem have a full complete ſenſe of themſelves; nay, all the ſenſe and ſignification which they have together with the figure. But there is a yet further difference between emblem and deviſe: for a deviſe is a ſymbol appropriated to ſome perſon, or that expreſſes ſomething which concerns him particularly; whereas an emblem is a ſymbol that regards all the world alike. Theſe differences will be more apparent, from comparing the emblem above quoted, with the deviſe of a candle lighted, and the words *Juvando conſumor*, "I waſte myſelf in doing good." See DEVISE.

EMBOLISMUS, Εμϐολισμος, in chronology, ſignifies "intercalation." The word is formed of εμϐαλλειν, "to inſert." As the Greeks made uſe of the lunar year, which is only 354

days, in order to bring it to the solar, which is 365 days, they had every two or three years an embolism, i. e. they added a 13th lunar month every two or three years, which additional month they called *embolimæus*, εμβολιμαιος, because inserted, or intercalated.

EMBOSSING, or Imbossing, in architecture and sculpture, the forming or fashioning works in relievo, whether cut with a chisel or otherwise. Embossing is a kind of sculpture, wherein the figures stick out from the plane whereon it is cut: and according as the figures are more or less prominent, they are said to be in alto, mezzo, or basso-relievo; or high, mean, or low, relief. See Enchasing.

EMBOTHRIUM, in botany; a genus of the monogynia order, belonging to the tetrandria class of plants. There is no calyx; the corolla consists of four linear oblique petals; the stamina are four very short filaments; the antheræ are pretty large, oblong, and seated within the cavity of the petal. The pericarpium is a round unilocular follicle, sharpened at both ends; the seeds are four or five in number, egg-shaped, and compressed.

EMBRASURE, in architecture, the enlargement made of the aperture of a door or window, on the inside of the wall; its use being to give the greater play for the opening of the door or casement, or to admit the more light.

EMBROCATION, in surgery and pharmacy, an external kind of remedy, which consists in an irrigation of the part affected, with some proper liquor, as oils, spirits, &c. by means of a woollen or linen cloth, or a spunge, dipped in the same.

EMBROIDERY, a work in gold, or silver, or silk thread, wrought by the needle upon cloth, stuffs, or muslin, into various figures. In embroidering stuffs, the work is performed in a kind of loom; because the more the piece is stretched, the easier it is worked. As to muslin, they spread it upon a pattern ready designed; and sometimes, before it is stretched upon the pattern, it is starched, to make it more easy to handle. Embroidery on the loom is less tedious than the other, in which, while they work flowers, all the threads of the muslin, both lengthwise and breadthwise, must be continually counted; but, on the other hand, this last is much richer in points, and susceptible of greater variety. Cloths too much milled are scarcely susceptible of this ornament, and in effect we seldom see them embroidered. The thinnest muslins are chosen for this purpose; and they are embroidered to the greatest perfection in Saxony: in other parts of Europe, however, they embroider very prettily, and especially in France.

There are several kinds of embroidery: as, 1. Embroidery on the stamp; where the figures are raised and rounded, having cotton or parchment put under them to support them. 2. Low embroidery; where the gold and silver lie low upon the sketch, and are stitched with silk of the same colour. 3. Guimped embroidery: this is performed either in gold or silver; they first make a sketch upon the cloth, then put on cut vellum, and afterwards sew on the gold and silver with silk thread: in this kind of embroidery they often put gold and silver cord, tinsel, and spangles. 4. Embroidery on both sides; that which appears on both sides of the stuff. 5. Plain embroidery; where the figures are flat and even, without cord, spangles, or other ornaments.

By stat. 22 Geo. II. c. 36. no foreign embroidery, or gold and silver brocade, shall be imported, upon pain of being forfeited and burnt, and penalty of 100l. for each piece. No person shall sell, or expose to sale, any foreign embroidery, gold or silver thread, lace, fringe, brocade, or make up the same into any garment, on pain of having it forfeited and burnt, and penalty of 100l. All such embroidery, &c. may be seized and burnt; and the mercer, &c. in whose custody it was found, shall forfeit 100l.

EMBRUN, an ancient and considerable city of France, in the department of the Upper Alps and late province of Dauphiny. Before the revolution, it was an archbishop's see, but is now only a bishopric, suffragan to Aix. It is a strong place, and one of the most elevated towns in Europe. The cathedral, and the episcopal palace, are worthy of attention. It surrendered by capitulation to the duke of Savoy, in 1693; but he was compelled to evacuate it three weeks after. It is seated near the river Durance, on a craggy rock, 17 miles E. of Gap. E. lon. 6. 34. N. lat. 44. 34.

EMBRYO, in physiology, the first rudiments of an animal in the womb, before the several members are distinctly formed; after which period it is denominated a *fœtus*. See Generation, and Fœtus.

EMERALD, a genus of precious stones belonging to the order of siliceous earths. The word is derived, according to some, from the French *esmaraude*, and that from the Latin *smaragdus*, signifying the same thing; by others it is said to be derived from the Italian *smeraldo*, or the Arabian *zomorrad*. According to Cronstedt, the emerald is the softest of all the precious stones, though other naturalists place it the next after the diamond in this respect. It is perhaps the most beautiful of all the gems, and, according to Wallerius, when heated in the fire, changes its colour to a deep blue, and becomes phosphorescent; but recovers its green colour when cold. When pulverised it has a white appearance, and, with borax, melts to a very thin and colourless glass. It becomes electric by being rubbed, and some have the property of the tourmalin, viz. of being electrified by heat, and in that state attracting ashes or other light substances; though the emeralds are less powerful than the tourmalin, and after having attracted the ashes, they retain them without any signs of repulsion.

Pliny mentions twelve different kinds of these precious stones; though it appears, from the vast size of some of them, that they must have been only certain kinds of green spar, or other green stone, which at that time went under the name of *emerald* among the ancients. The true emerald is found only in very small crystals, from the size $\frac{1}{18}$th of an inch in diameter to that of a walnut. Theophrastus, however, mentions one four cubits long and three broad; likewise an obelisk composed of only four emeralds, the whole length being 40 cubits and the breadth from four to two.

Engestroom informs us, that the emeralds, in their rough or native state, consist of hexagonal columns mostly truncated at both ends; and that he had some in his possession, which in a gentle heat became colourless; but in a strong heat white and opaque, without any mark of fusion. Brunick distinguishes them into two classes. 1. The pale green emerald, which comes from the east and from Peru, the figure being that of an hexagonal truncated prism, and the basis a vein of white quartz. 2. The dark green emerald, which is also columnar, but very dark-coloured, striped longitudinally, and has little transparency. The points are generally broken off longitudinally, though Davila mentions one resembling a blunt triangular pyramid; and in the Imperial cabinet at Vienna, there is one with a five-sided pyramid. These are the emeralds which become electrical by heat; though all of them do not; and those which do so cannot be known but by actual experiment. The finest specimen of the former kind of emeralds is to be seen in the treasure of the holy chapel of Loretto, containing upwards of 100 of these precious stones great and small. A fellow to this was made by art, and both were presents to the king of Sicily, designed to represent two mount Calvaries.

Emeralds are distinguished by the jewellers into two kinds, the oriental and occidental. The true oriental emerald is very scarce, and at present only found in the kingdom of Cambay. So great indeed is the scarcity of them, that an opinion prevailed

that there are no oriental emeralds. This opinion is adopted, among others, by Mr. Bruce; who informs us, that he made an excurſion to the iſland of emeralds in the Red Sea, and endeavours to ſhow that there never were any emeralds but what came from America, and that thoſe ſaid to have been found in the Eaſt Indies were imported from that continent. It is probable indeed, that in former times any kind of cryſtal tinged of a green colour might be called an *emerald*, and hence the green cochle ſpar brought from Egypt may have obtained the name of *mother of emeralds*; but of late ſome emeralds have been brought from Cambay into Italy which greatly excelled thoſe of America. The beſt emeralds of the weſtern continent come from Peru, and are called *oriental* by the jewellers: ſome are found in Europe, principally in the duchy of Sileſia in Germany.

Rough EMERALDS. Thoſe of the firſt and coarſeſt ſort, called *plaſmes*, for grinding, are worth 27 ſhillings ſterling the marc, or 8 ounces. The demi-morillons, 8l. ſterl. per marc. Good morillons, which are only little pieces, but of fine colour, from 13l. to 15l. per marc. Emeralds, larger than morillons, and called *of the third colour* or *ſort*, are valued at from 50l. to 60l. the marc. Emeralds, called *of the ſecond ſort*, which are in larger and finer pieces than the preceding, are worth from 65l. to 75l. per marc. Laſtly, thoſe of the firſt colour, otherwiſe called *negres cartes*, are worth from 110l. to 115l.

EMERALDS *ready cut, or poliſhed and not cut, being of good ſtone, and a fine colour, are worth*,

	£.	s.
Thoſe weighing one caract, or four grains	0	10
Thoſe of two caracts ——— ———	1	7
Thoſe of three caracts ——— ———	2	5
Thoſe of four caracts ——— ———	3	10
Thoſe of five caracts ——— ———	4	10
Thoſe of ſix caracts ——— ———	7	10
Thoſe of ſeven caracts ——— ———	15	0
Thoſe of eight caracts ——— ———	19	0
Thoſe of nine caracts ——— ———	23	0
Thoſe of ten caracts ——— ———	33	0

Counterfeit EMERALDS, are made thus: Take of natural cryſtal, four ounces; of red-lead, four ounces; verdegris, forty-eight grains; crocus martis, prepared with vinegar, eight grains: let the whole be finely pulverized and ſifted; put this into a crucible, leaving one inch empty: lute it well, and put it into a potter's furnace, and let it ſtand there as long as they do their pots. When cold, break the crucible; and you will find a matter of a fine emerald colour, which, after it is cut and ſet in gold, will equal in beauty an oriental emerald.

EMERSION, in phyſics, the riſing of any ſolid above the ſurface of a fluid ſpecifically heavier than itſelf, into which it had been violently immerged or thruſt. It is one of the known laws of hydroſtatics, that a lighter ſolid being forced down into a heavier fluid, immediately endeavours to emerge; and that with a force or moment equal to the exceſs of weight of a quantity of the fluid above that of an equal bulk of the ſolid. Thus, if a ſolid be immerged in a fluid of double its ſpecific gravity, it will emerge again till half its bulk or body be above the ſurface of the fluid.

EMERSION, in aſtronomy, is when the ſun, moon, or other planet, begins to re-appear, after its having been eclipſed, or hid by the interpoſition of the moon, earth, or other body. The difference of longitude is ſometimes found by obſerving the immerſions and emerſions of the firſt of Jupiter's ſatellites. The immerſions are obſerved from the time of Jupiter's being in conjunction with the ſun to his oppoſition; and the emerſion, from the oppoſition to the conjunction; which two intervals are uſually ſix months a-piece, and divide the year between them. But when Jupiter is in conjunction with the ſun, and 15 days before and afterwards, there is nothing to be obſerved; the planet, with his ſatellites, being then loſt in the light of the ſun. Emerſion is alſo uſed when a ſtar, before hid by the ſun, as being too near him, begins to re-appear, and to get out of his rays.

EMERSON (William), a late eminent mathematician, was born in June 1701, at Hurworth, a village about three miles ſouth of Darlington; at leaſt it is certain that he reſided here from his childhood. His father Dudley Emerſon was a tolerable proficient in mathematics; and without his books and inſtructions, perhaps his own genius (moſt eminently fitted for mathematical diſquiſitions) would have never been unfolded. He was inſtructed in the learned languages by a young clergyman, then curate of Hurworth, who was boarded at his father's houſe. In the earlier part of his life he attempted to teach a few ſcholars: but whether from his conciſe method (for he was not happy in explaining his ideas), or the warmth of his natural temper, he made no progreſs in his ſchool: he therefore ſoon left it off; and ſatisfied with a moderate competence left him by his parents, he devoted himſelf to a ſtudious retirement. Towards the cloſe of the year 1781 (being ſenſible of his approaching diſſolution), he diſpoſed of the whole of his mathematical library to a bookſeller at York; and on May 20th 1782, he died of a lingering and painful diſorder at his native village, aged near 81 years.

Mr. Emerſon in his perſon was rather ſhort, but ſtrong and well-made, with an open countenance and ruddy complexion. He was exceedingly ſingular in his dreſs. He had but one coat, which he always wore open before, except the lower button; no waiſtcoat; his ſhirt quite the reverſe of one in common uſe, no opening before, but buttoned cloſe at the collar behind; a kind of flaxen wig which had not a crooked hair in it, and probably had never been tortured with a comb from the time of its being made. He always walked up to London when he had any thing to publiſh, reviſing ſheet by ſheet himſelf: Truſting no eyes but his own, was always a favourite maxim with him. He never advanced any mathematical propoſition that he had not firſt tried in practice, conſtantly making all the different parts himſelf on a ſmall ſcale, ſo that his houſe was filled with all kinds of mechanical inſtruments together or diſjointed. He would frequently ſtand up to his middle in water while fiſhing, a diverſion he was remarkably fond of. He uſed to ſtudy inceſſantly for ſome time, and then for relaxation take a ramble to any pot-alehouſe where he could get any body to drink with and talk to. The duke of Mancheſter was highly pleaſed with his company, and uſed often to come to him in the fields and accompany him home, but could never perſuade him to get into a carriage. On theſe occaſions he would ſometimes exclaim, "Damn your whim-wham! I had rather walk." He was a married man; and his wife uſed to ſpin on an old-faſhioned wheel, whereof a very accurate drawing is given in his mechanics. He was deeply ſkilled in the ſcience of muſic, the theory of ſounds, and the various ſcales both ancient and modern, but was a very poor performer.

The following is a liſt of Mr. Emerſon's works. 1. The Doctrine of Fluxions. 2. The Projection of the Sphere, orthographic, ſtereographic, and gnomonical. 3. The Elements of Trigonometry. 4. The Principles of Mechanics. 5. A Treatiſe of Navigation on the Sea. 6. A Treatiſe of Algebra, in two books. 7. The Arithmetic of Infinites, and the differential Method, illuſtrated by Examples. 8. Mechanics; or the Doctrine of Motion. 9. The Elements of Optics, in four books. 10. A Syſtem of Aſtronomy, 11. The Laws of Centripetal and Centrifugal Force. 12. The Mathematical Principles of Geography, 13. Tracts, 8vo. 14. Cyclomatheſis; or an eaſy Introduction to the ſeveral Branches of the Mathematics. 15. A

ſhort Comment on Sir Iſaac Newton's Principia; to which is added, A Defence of Sir Iſaac againſt the Objections that have been made to ſeveral Parts of his Works. 16. A Miſcellaneous Treatiſe, containing ſeveral Mathematical Subjects, 8vo. 1776.

EMERY, in natural hiſtory, a rich iron-ore found in large maſſes of no determinate ſhape or ſize, extremely hard, and very heavy. It is uſually of a duſky browniſh red on the furface; but when broken, is of a fine bright iron-grey, but not without ſome tinge of redneſs; and is ſpangled all over with ſhining ſpecks, which are ſmall flakes of a foliaceous talc, highly impregnated with iron. It is alſo ſometimes very red, and then uſually contains veins of gold. It makes no effervefcence with any of the acid menſtruums; and is found in the iſland of Guernſey, in Tuſcany, and many parts of Germany.

Dr Lewis is of opinion, that ſome kinds of emery may contain the metal called *platina*, and on this ſubject has the following curious obſervations. "Alonſo Barba mentions a ſubſtance called *chumpi*; which is a hard ſtone of the emery kind, participating of iron, of a grey colour ſhining a little, very hard to work, becauſe it reſiſts the fire much, found in Potoſi, Chocaya, and other places, along with blackiſh and reddiſh ores that yield gold. If platina is really found in large maſſes, either generally or only now and then, one might reaſonably expect thoſe maſſes to be ſuch as are here deſcribed.

"Of the ſame kind perhaps alſo is the mineral mentioned by ſeveral authors under the name of Spaniſh emery, *ſmiris Hiſpanica*, which ſhould ſeem, from the accounts given of it, to be no other than platina or its matrix. The *ſmiris* is ſaid to be found in the gold mines, and its exportation prohibited; to contain films or veins of native gold; to be in great requeſt among the alchemiſts; to have been ſometimes uſed for the adulteration of gold; to ſtand, equally with the noble metal, cupellation, quartation, antimony, and the regal cement; and to be ſeparable from it by amalgamation with mercury, which throws out the *ſmiris* and retains the gold; properties ſtrongly characteriſtic of platina, and which do not belong to any known ſubſtance beſides. This debaſement of gold *per extractum ſmiridis Hiſpanici* is mentioned by Becher in his *Minera arenaria*, and ſeveral times hinted at in his *Phyſica ſubterranea*. Both Becher and Stahl indeed call the ſubſtance which the gold receives from the emery an earth, whereas platina is undoubtedly a metal; but this does not at all invalidate our ſuppoſition, for they give the name of earth alſo to the ſubſtance which copper receives from calamine in being made into braſs, which is now known to be metallic.

"From theſe obſervations I have been led to ſuſpect, that the European emeries likewiſe might poſſibly participate of platina. If this was certain, it would account ſatisfactorily for the uſe which ſome of the alchemiſts are ſaid to have made of emeries and other ferrugineous ores; and we ſhould no longer doubt, or wonder, that by treating gold with theſe kinds of minerals, they obtained a permanent augmentation; that this augmentation, though it reſiſted lead, antimony, aquafortis, and the regal cement, was ſeparable, as Becher owns it was, by quickſilver; and that, when it exceeded certain limits, it rendered the gold pale and brittle.

"If emery contains platina, I imagined it might be diſcoverable by boiling the powdered mineral in melted lead, and afterwards working off the lead upon a teſt or cupel. The experiment was made with eight ounces of the fineſt powder of common emery, and the ſame quantity of lead; which were covered with black flux to prevent the ſcorification of the lead, and urged with a ſtrong fire for two or three hours. The lead became hard, rigid, of a dark colour, and a granulated texture, as if it had really imbibed ſome platina from the emery; but in cupellation it worked almoſt entirely off, leaving only a bead about the ſize of a ſmall pin's head, which was probably no other than ſilver contained in the lead.

"I repeated the experiment with ſome variation, thinking to obtain a more perfect reſolution of the emery by vitrifying it with the lead. Two ounces of fine emery and ſix ounces of minium were well mixed together, and urged with a ſtrong fire, in a cloſe crucible, for an hour: they melted into an uniform dark-browniſh glaſs. The glaſs was powdered, mixed with four ounces of fixt alkaline ſalt and ſome powdered charcoal, and put into a freſh crucible, with ſome common ſalt on the ſurface: the fire was pretty ſtrongly excited; but the fuſion was not ſo perfect as could be wiſhed, and only about two ounces of lead were found revived. This lead had ſuffered nearly the ſame change as that in the foregoing experiment; and, like it, gave no appearance of platina on being cupelled.

"It ſeems to follow from theſe experiments, that the emery employed in them contained no platina; but as it is not to be ſuppoſed that all emeries are of one compoſition, other ſorts may deſerve to be ſubmitted to the ſame trials. As gold is contained in ſome parcels of common minerals, and by no means in all the individuals of any one ſpecies; platina may poſſibly in like manner be found in ſome European ores, though there is not the leaſt footſtep of it in other parcels of the ſame kind of ore."

EMETICS, medicines that induce vomiting.

EMIMS, ancient inhabitants of the land of Canaan beyond Jordan, who were defeated by Chedorlaomer and his allies, Gen. xiv. 5. Moſes tells us that they were beaten in Shaveh Kirjathaim, which was in the country of Sihon conquered from the Moabites, Joſh. xiii. 19—21. The Emims were a warlike people, of a gigantic ſtature, great and numerous, and tall as the Anakims.

EMINENCE, in geography, a little hillock or aſcent above the level of the adjoining campaign.

EMINENCE is alſo a title of honour given to cardinals. The decree of the pope, whereby it was appointed that the cardinals ſhould be addreſſed under the quality of *eminence*, bears date the 10th of January 1630. They then laid aſide the titles of *illuſtriſſimi*, and *reverendiſſimi*, which they had borne before. The grand maſter of Malta is likewiſe addreſſed under the quality of *eminence*. The popes John VIII. and Gregory VII. gave the ſame title to the kings of France. The emperors have likewiſe borne it.

Eminentiſſimus, the ſuperlative of *eminens*, has of late been attributed to the cardinals.

EMIR, a title of dignity among the Turks, ſignifying a prince. This title was firſt given to the caliphs; but when they aſſumed the title of Sultans, that of emir remained to their children; as that of Cæſar among the Romans. At length the title came to be attributed to all who were judged to deſcend from Mahomet by his daughter Fatimah, and who wear the green turban inſtead of the white. The Turks make an obſervation, that the emirs, before their fortieth year, are men of the greateſt gravity, learning and wiſdom; but after this, if they are not great fools, they diſcover ſome ſigns of levity and ſtupidity. This is interpreted by the Turks as a ſort of divine impulſe in token of their birth and ſanctity. The Turks alſo call the vizirs, baſhaws, or governors of provinces, by this name.

EMISSARY, in a political ſenſe, a perſon employed by another to ſound the opinions of people, ſpread certain reports, or act as a ſpy over other people's actions.

EMISSARY *Veſſels*, in anatomy, the ſame with thoſe more commonly called EXCRETORY.

EMISSION, in medicine, a term uſed chiefly to denote the ejaculation of the ſemen in the act of coition. See COITION, and GENERATION.

EMMANUEL, or IMMANUEL, a Hebrew word which ſignifies, "God with us." Iſaiah (viii 14.), in that celebrated

prophecy, wherein he declares to Ahaz the birth of the Meſſiah, who was to be born of a virgin, ſays, This child ſhall be called, and really be, Emmanuel, that is, '*God with us.*' The ſame prophet (viii. 8.) repeats the ſame thing, while he is ſpeaking of the enemy's army, which, like a torrent, was to overflow Judea. 'The ſtretching out of his wings ſhall fill the breadth of thy land, O Emmanuel.' The evangeliſt Matthew (i. 23.) informs us, that this prophecy was accompliſhed in the birth of Chriſt, born of the virgin Mary, in whom the two natures divine and human were united, and ſo in this ſenſe he was really Emmanuel, or 'God with us.'

EMMERICK, a rich fortified town of Germany, in the circle of Weſtphalia, and duchy of Cleves. It carries on a good trade with the Dutch, and both Proteſtants and Catholics have the free exerciſe of their religion. The ſtreets are neat and regular, and the houſes tolerably built. It was taken by the French in 1672, and delivered to the elector of Brandenburgh in 1673, under whoſe juriſdiction it now is. It is ſeated near the Rhine. E. long. 5. 29. N. lat. 52. 5.

EMMIUS (Ubbo), born at Gretha in Eaſt Frieſland in 1547, was a very learned profeſſor, and choſen rector of the college of Norden in 1579. This ſeminary flouriſhed exceedingly under his care; and declined as viſibly after he was ejected, in 1587, for refuſing to ſubſcribe the Confeſſion of Augſburg. The year after he was made rector of the college of Leer; and when the city of Groningen confederated with the United Provinces, the magiſtrates appointed him rector of that college: which employment he filled with the higheſt repute near twenty years. The college being erected into a univerſity, he was the firſt rector, and one of the chief ornaments of it by his lectures, till his infirmities prevented his public appearance. His wiſdom was equal to his learning; ſo that the governor of Frieſland and Groningen often conſulted him, and ſeldom failed to follow his advice. He wrote *Vetus Græcia illuſtrata*, 3 vols.; *Decades Rerum Freſicarum*; and many other valuable works. He died in 1625.

EMMENAGOGUES, Εμμηναγωγα, in medicine, ſuch remedies as promote the menſtrual diſcharge. They are thus called from Εν "in," μην "month," αγω *duco*, "I lead," becauſe their natural periods of flowing are once a month.

EMOLLIENTS, in ſurgery, are ſuch remedies as relax and ſupple the parts to which they are applied. Fomentations and poultices are the principal remedies of this claſs.

EMOLUMENT, is properly applied to the profits ariſing daily from an office or employ. The word is formed of the Latin *emolumentum*, which, according to ſome, primarily ſignifies the profits redounding to the miller from his mill; of *molo*, *molere*, "to grind." The patent, or other inſtrument, whereby a perſon is preferred to an office, gives him a right to enjoy all the dues, honours, profits, and emoluments belonging thereto. *Emolument* is alſo uſed, in ſomewhat greater latitude, for profit or advantage in general.

EMOTION and PASSION, in the human mind, are thus diſtinguiſhed by Lord Kaimes. An internal motion or agitation of the mind, when it paſſeth away without deſire, is denominated *an emotion:* when deſire follows, the motion or agitation is denominated *a paſſion*. A fine face, for example, raiſeth in me a pleaſant feeling: if that feeling vaniſh without producing any effect, it is in proper language an *emotion*; but if the feeling, by reiterated views of the object, becomes ſufficiently ſtrong to occaſion deſire, it loſes its name of *emotion* and acquires that of *paſſion*. The ſame holds in all the other paſſions. The painful feeling raiſed in a ſpectator by a ſlight injury done to a ſtranger, being accompanied with no deſire of revenge, is termed an emotion; but that injury raiſeth in the ſtranger a ſtronger emotion, which, being accompanied with a deſire of revenge, is a paſſion. External expreſſions of diſtreſs produce in the ſpectator a painful feeling, which being ſometimes ſo ſlight as to paſs away without any effect, is an emotion; but if the feeling be ſo ſtrong as to prompt deſire of affording relief, it is a paſſion, and is termed *pity*. Envy is emulation in exceſs: if the exaltation of a competitor be barely diſagreeable, the painful feeling is an emotion; if it produce a deſire to depreſs him, it is paſſion. See PASSION.

EMOUY, or HIA-MEN, an iſland and port of China, under the juriſdiction of the province of FO-KIEN. The port is properly but an anchoring-place for ſhips, incloſed on one ſide by the iſland from which it takes its name, and on the other by the main-land: but it is ſo extenſive, that it can contain ſeveral thouſands of veſſels; and the depth of its water is ſo great, that the largeſt ſhips may lie cloſe to the ſhore without danger. In the beginning of the preſent century it was much frequented by European veſſels; but few viſit it at preſent, as all the trade is carried on at Canton. The Emperor keeps here a garriſon of 6 or 7000 men, commanded by a Chineſe general. In entering this road, a large rock muſt be doubled which ſtands at the mouth of it, and divides it almoſt as the Mingant divides the harbour of Breſt. This rock is viſible, and riſes ſeveral feet above the ſurface of the water.

The iſland of Emouy is particularly celebrated on account of the magnificence of its pagodas, the principal of which is conſecrated to the deity Fo, and is ſituated in a plain, terminated on one ſide by the ſea, and on the other by a lofty mountain. Before it the ſea, flowing through different channels, forms a large ſheet of water, which is bordered with turf of the moſt beautiful verdure. The front of this edifice is 180 feet in length, and its gate is adorned with figures in relief, which are the uſual ornaments of the Chineſe architecture.

EMPALEMENT, an ancient kind of puniſhment, which conſiſted in thruſting a ſtake up the fundament. The word comes from the French *empaler*, or the Italian *impalare*; or rather, they are all alike derived from the Latin *palus* "a ſtake," and the prepoſition *in*, "in or into." We find mention of empaling in Juvenal. It was frequently practiſed in the time of Nero, and continues to be ſo in Turkey.

EMPALEMENT *of a Flower*, the ſame with CALYX.

EMPANELLING. See IMPANELLING.

EMPARLANCE. See IMPARLANCE.

EMPEDOCLES, a celebrated philoſopher and poet, was born at Agrigentum, a city in Sicily. He followed the Pythagorean philoſophy, and admitted the metempſychoſis. He conſtantly appeared with a crown of gold on his head; to maintain, by this outward pomp, the reputation he had acquired of being a very extraordinary man. Yet Ariſtotle ſays, that he was a great lover of liberty, extremely averſe to ſtate and command, and that he even refuſed a kingdom that was offered him. His principal work was a Treatiſe in verſe on the Nature and Principles of Things. Ariſtotle, Lucretius, and all the ancients, make the moſt magnificent elogiums on his poetry and eloquence. He taught rhetoric; and often alleviated the anxieties of his mind, as well as the pains of his body, with muſic. It is reported, that his curioſity to viſit the flames of the crater of Ætna proved fatal to him. Some maintain that he wiſhed it to be believed that he was a god; and that his death might be unknown, he threw himſelf into the crater and periſhed in the flames. His expectations, however, were fruſtrated; and the volcano, by throwing up one of his ſandals, diſcovered to the world that Empedocles had periſhed by fire. Others report that he lived to an extreme old age; and that he was drowned in the ſea about 440 years before the Chriſtian era.

EMPEROR *(imperator)*, among the ancient Romans, ſignified a general of an army, who for ſome extraordinary ſucceſs had been complimented with this appellation. Thus Auguſtus, having obtained no leſs than twenty famous victories, was as of-

ten ſaluted with the title *emperor*; and Titus was denominated *emperor* by his army after the reduction of Jeruſalem. Afterwards, it came to denominate an abſolute monarch or ſupreme commander of an empire. In this ſenſe Julius Cæſar was called *emperor*: the ſame title deſcended with the dignity to Octavius, Auguſtus, Tiberius, and Caligula; and afterwards it became elective.

In ſtrictneſs, the title *emperor* does not add any thing to the rights of ſovereignty: its effect is only to give precedence and pre-eminence above other ſovereigns, and as ſuch, it raiſes thoſe inveſted with it to the ſummit of all human greatneſs. It is diſputed, whether or not emperors have the power of diſpoſing of the regal title. It is true, they have ſometimes taken upon them to erect kingdoms; and thus it is that Bohemia and Poland are ſaid to have been raiſed to the dignity: thus alſo, the emperor Charles the Bald, in the year 877, gave Provence to Boſon, putting the diadem on his head, and decreeing him to be called "king," *ut more priſcorum imperatorum regibus videretur dominari*. Add, that the emperor Leopold erected the ducal Pruſſia into a kingdom in favour of the elector of Brandenburg; and though ſeveral of the kings of Europe refuſed for ſome time to acknowledge him in that capacity, yet by the treaty of Utrecht in 1712 they all came in.

In the Eaſt, the title and quality of emperor are more frequent than they are among us; thus, the ſovereign princes of China, Japan, Mogul, Perſia, &c. are all emperors of China, Japan, &c. In the year 1723 the czar of Muſcovy aſſumed the title of *emperor of all Ruſſia*, and procured himſelf to be recognized as ſuch by moſt of the princes and ſtates of Europe. In the Weſt, the title has been a long time reſtrained to the emperors of Germany. The firſt who bore it was Charlemagne, who had the title of emperor conferred on him by Pope Leo III. though he had all the power before. The imperial prerogatives were formerly much more extenſive than they are at preſent. At the cloſe of the Saxon race, A. D. 1024, they exerciſed the right of conferring all the eccleſiaſtical benefices in Germany; of receiving the revenues of them during a vacancy; of ſucceeding to the effects of inteſtate eccleſiaſtics; of confirming or annulling the elections of the popes; of aſſembling councils, and of appointing them to decide concerning the affairs of the church; of conferring the title of king on their vaſſals; of granting vacant fiefs; of receiving the revenues of the empire; of governing Italy as its proper ſovereigns; of erecting free cities, and eſtabliſhing fairs in them; of aſſembling the diets of the empire, and fixing the time of their duration; of coining money, and conferring the ſame privilege on the ſtates of the empire; and of adminiſtering both high and low juſtice within the territories of the different ſtates: but in the year 1437 they were reduced to the right of conferring all dignities and titles, except the privilege of being a ſtate of the empire; of *preces primariæ*, or of appointing once during their reign a dignitary in each chapter or religious houſe; of granting diſpenſations with reſpect to the age of majority; of erecting cities, and conferring the privilege of coining money; of calling the meetings of the diet, and preſiding in them.

To theſe ſome have added, 1. That all the princes and ſtates of Germany are obliged to do them homage, and ſwear fidelity to them. 2. That they, or their generals, have a right to command the forces of all the princes of the empire, when united together. 3. That they receive a kind of tribute from all the princes and ſtates of the empire, for carrying on a war which concerns the whole empire, which is called the *Roman month*. For the reſt, there is not a foot of land or territory annexed to his title: but ever ſince the reign of Charles IV. the emperors have depended entirely on their hereditary dominions as the only ſource of their power, and even of their ſubſiſtence. See Diet and Electors.

The kings of France were anciently alſo called emperors, at the time when they reigned with their ſons, whom they aſſociated to the crown. Thus Hugh Capet, having aſſociated his ſon Robert, took the title of emperor, and Robert that of king; under which titles they are mentioned in the Hiſtory of the Council of Rheims, by Gerbert, &c. King Robert is alſo called emperor of the French by Helgau of Fleury. Louis le Gros, upon aſſociating his ſon, did the ſame. In the Firſt Regiſter of the King's Charters, fol. 166, are found letters of Louis le Gros, dated in 1116, in favour of Raymond biſhop of Maguelonne, wherein he ſtyles himſelf *Ludovicus, Dei ordinante providentia, Francorum imperator auguſtus*. The kings of England had likewiſe anciently the title of emperors, as appears from a charter of king Edgar; *Ego Edgarus Anglorum baſileus, omniumque regum inſularum oceani quæ Britanniam circumjacent, &c. imperator & dominus.*

EMPETRUM, berry-bearing Heath; a genus of the triandria order, belonging to the monœcia claſs of plants. In the natural method this genus is ranked by Linnæus under the 54th order, *Miſcellaneæ*; and likewiſe among thoſe of which the order is doubtful. The male calyx is tripartite; the corolla tripetalous; the ſtamina long; the female calyx is tripartite; the corolla tripetalous; the ſtyles nine; the berry nine-ſeeded. There are two ſpecies; one of which, viz. the nigrum, which bears the crow-crake berries, is a native of Britain. It grows wild on boggy heaths and mountains. Children ſometimes eat the berries; but, when taken in too great quantity, they are apt to occaſion a headach. Grouſe feed upon them. When boiled with alum, they afford a dark purple dye. Goats are not fond of it. Cows, ſheep, and horſes refuſe it.

EMPHASIS, in rhetoric, a particular ſtreſs of the voice and action, laid on ſuch parts or words of the oration as the orator wants to enforce upon his audience. See Declamation, Oratory, and Reading.

EMPHYSEMA, in ſurgery, a windy ſwelling of the body, generally occaſioned by a fracture of the ribs, in which the lungs have been penetrated. The air inſinuating itſelf, by the wound, between the ſkin and muſcles, into the ſubſtance of the cellular membrane, ſpreads afterwards up to the neck, head, belly, and other parts, much after the manner in which butchers blow up their veal.

EMPIRE, *imperium*, in political geography, a large extent of land, under the juriſdiction or government of an emperor. See Emperor. In ancient hiſtory we read of four great monarchies or empires, viz. that of the Babylonians, Chaldeans, and Aſſyrians; that of the Medes and Perſians; that of the Greeks; and that of the Romans. The firſt ſubſiſted from the time of Nimrod, who founded it in the year of the world 1800, according to the computation of Uſher, to Sardanapalus their laſt king in 3257, and conſequently laſted above 1450 years. The empire of the Medes commenced under Arbace, in the year of the world 3257, and was united to that of the Babylonians and Perſians under Cyrus, in the year 3468, and it cloſed with the death of Darius Codomannus in 3674. The Grecian empire laſted only during the reign of Alexander the Great, beginning in the year of the world 3674, and terminating with the death of this conqueror in 3681, his conqueſts being divided among his captains. The Roman empire commenced with Julius Cæſar, when he was made perpetual dictator, in the year of the city 708, and of the world 3956, 48 years after Chriſt. The ſeat of the empire was removed to Byzantium by Conſtantine, in the year of our Lord 334; the eaſt and weſt were then united under the title of the Roman empire, till the Romans proclaimed Charlemagne emperor, A. D. 800. From this epocha the eaſt and weſt formed two ſeparate empires; that of the eaſt, governed by Greek emperors, commenced A. D.

802: and being gradually weakened, terminated under Constantine Palæologus in 1453. The western empire was afterwards known by the appellation of the Empire, or German empire. Antiquaries distinguish between the medals of the *upper*, and *lower* or *bas, empire*.—The curious only value those of the upper empire, which commences with Cæsar or Augustus, and ends in the year of Christ 260. The lower empire comprehends near 1200 years, reckoning down to the destruction of Constantinople in 1453. They usually distinguish two ages, or periods, of the lower empire: the first beginning where the upper ends, viz. with Aurelian, and ending with Anastasius, including 200 years; the second beginning with Anastasius, and ending with the Palæologi, which includes 1000 years.

EMPIRE, or *The empire*, used absolutely and without any addition, signifies the empire of Germany; called also, in juridical acts and laws, the holy Roman empire. It had its beginning with the ninth century; Charlemagne being created first emperor by Pope Leo III. who put the crown on his head in St. Peter's church on Christmas-day in the year 800. Authors are at a loss under what form of government to range the empire. Some of them maintain it to be a monarchical state, because all the members thereof are obliged to ask the investiture of their states of the emperor, and to take an oath of fidelity to him. Others consider it as a republic, or aristocratic state, because the emperor cannot resolve or determine any thing without the concurring suffrages of the princes. It is added, that if they require investiture from, and swear fealty to him, it is only as head of the republic, and in the name of the republic, and not in his own; just as at Venice every thing is transacted in the name of the doge. Others will have the empire to be a monarcho-aristocratic state, *i. e.* a mixture of monarchy and aristocracy; because, though the emperor in many cases seems to act sovereignly, yet his decrees and resolves have no force, in case the state refuse to confirm them. Lastly, it has been called an aristo-democratic state, because the diet, wherein the sovereignty is lodged, is composed of princes and the deputies of the cities; and is divided into three orders or bodies, called *colleges*, viz. the college of electors, the college of princes, and the college of cities. We say, diet of the empire, circles of the empire, fiefs of the empire, princes of the empire, estates of the empire, members of the empire, capitulations of the empire. See DIET, CIRCLE, PRINCE, CAPITULATION, &c.

The *states* or *estates* of the empire are of two kinds, mediate and immediate. The immediate states are those which hold immediately of the empire: whereof, again, there are two kinds; the first, such as have seats and voices in the imperial diet; the second, such as have none. The mediate states are those that hold of the immediate. The states which now compose the empire are, The princes of the empire, the counts of the empire, the free barons of the empire, the prelates of the empire, the princesses or abbesses of the empire, the nobles of the empire, and the imperial cities.

EMPIRIC, an appellation given to those physicians who conduct themselves wholly by their own experience, without studying physic in a regular way. It is common to use the term, in a still worse sense, for a quack who prescribes at random, without being at all acquainted with the principles of the art.

EMPIS, in zoology, a genus of insects belonging to the order Diptera; of which the characters are these: The proboscis is of an horny substance, bivalve, reflexed under the head and breast, and longer than the thorax. See a specimen in plate 2.

EMPLASTER. See PLASTER.

EMPORIÆ, a double city of the Hither Spain, near the Pyrenees; separated by a wall; one part occupied by the Greeks of Phocæa, whence originally are the Massilienses; the other, by native Spaniards, to whom was added by Augustus a Roman colony. Now Ampurias, in Catalonia. E. lon. 2. 50. N. lat. 42. 15.

EMPORIUM, in medicine, is often used for the common sensory in the brain. See BRAIN.

EMPRESS, the spouse of an emperor, or a woman who governs an empire. See EMPEROR.

EMPROSTHOTONOS, a species of convulsion, wherein the head bends forward.

EMPYŒMA, in medicine, a disorder wherein purulent matter is contained in the thorax or chest, after an inflammation and suppuration of the lungs and pleura. See MEDICINE.

EMPYREAL AIR. So Dr. Higgins denominates that which Dr. Priestley calls *dephlogisticated* air, and later chemists *oxygenous gas*. See AEROLOGY.

EMPYREUMA, a term used by divines for the highest heaven, where the blessed enjoy the beatific vision. The word is formed of εν, and πυρ *fire*, because of its splendour.

EMPYREUMA, in chemistry, signifies a very disagreeable smell produced from burnt oils. It is often perceived in distillations of animal as well as vegetable substances when they are exposed to a quick fire.

EMRODS. See HEMMORRHOIDS.

EMULATION, a generous ardour kindled by the praiseworthy examples of others, which impels us to imitate, to rival, and, if possible, to excel them. This passion involves in it esteem of the person whose attainments or conduct we emulate, of the qualities and actions in which we emulate him, and a desire of resemblance, together with a joy springing from the hope of success. The word comes originally from the Greek αμιλλα, *dispute, contest*; whence the Latin, *æmulus*; and thence our *emulation*. Plato observes of emulation, that it is the daughter of envy; if so, there is a great difference between the mother and the offspring; the one is a virtue and the other a vice. Emulation admires great actions, and strives to imitate them; envy refuses them the praises that are their due; emulation is generous, and only thinks of surpassing a rival; envy is low, and only seeks to lessen him. Perhaps, therefore, it would be more just to suppose emulation the daughter of admiration: admiration, however, is a principal ingredient in the composition of it.

EMULGENT, or RENAL ARTERIES, those which supply the kidneys with blood; being sometimes single, sometimes double, on each side. See ANATOMY, p. 195.

EMULSION, a soft liquid remedy for a cough, of a colour and consistence resembling milk. See PHARMACY.

EMUNCTORY, in anatomy, a general term for all those parts which serve to carry off the excrementitious parts of the blood. Such more especially are the kidneys, bladder, and most of the glands.

ENALLAGE, in grammar, is when one word is substituted for another of the same part of speech: A substantive for an adjective; as *exercitus victor*, for *victoriosus*; *scelus*, for *scelestus*: A primitive for a derivative; as *Dardana arma*, for *Dardania*: An active for a passive; as *nox humida cœlo præcipitat*, for *precipitatur*, &c.

ENAMEL, in general, is a vitrified matter betwixt the parts of which is dispersed some unvitrified matter: hence enamel ought to have all the properties of glass except transparency. Enamels have for their basis a pure crystal glass or frit, ground up with a fine calx of lead and tin prepared for the purpose, with the addition usually of white salt of tartar. These ingredients baked together are the matter of all enamels, which are made by adding colours of this or that kind in powder to this

matter, and melting or incorporating them together in a furnace. For white enamel, Neri *(De Arte Vitriar.)* directs only manganese to be added to the matter which constitutes the basis. For azure, zaffer mixed with calx of brass. For green, calx of brass with scales of iron, or with crocus martis. For black, zaffer with manganese or with crocus martis; or manganese with tartar. For red, manganese, or calx of copper and red tartar. For purple, manganese with calx of brass. For yellow, tartar and manganese. And for violet-coloured enamel, manganese with thrice-calcined brass.

In making these enamels, the following general cautions are necessary to be observed. 1. That the pots must be glazed with white glass, and must be such as will bear the fire. 2. That the matter of enamels must be very nicely mixed with the colours. 3. When the enamel is good, and the colour well incorporated, it must be taken from the fire with a pair of tongs. 4. The general way of making the coloured enamel is this: Powder, sift, and grind, all the colours very nicely, and first mix them with one another, and then with the common matter of enamels: then set them in pots in a furnace; and when they are well mixed and incorporated, cast them into water; and when dry, set them in a furnace again to melt; and when melted, take a proof of it. If too deep-coloured, add more of the common matter of enamels; and if too pale, add more of the colours.

Enamels are used either in counterfeiting or imitating precious stones, in painting in enamel; or by enamellers, jewellers, and goldsmiths, in gold, silver, and other metals. The two first kinds are usually prepared by the workmen themselves who are employed in these arts. That used by jewellers, &c. is brought to us chiefly from Venice or Holland, in little cakes of different sizes, commonly about four inches diameter, having the mark of the maker struck upon it with a punch. It pays 1s. $7\frac{41}{100}$ d. the pound on importation, and draws back 1s. $5\frac{70}{100}$ d. at the rate of 4s. per pound.

ENAMELLING, the art of laying enamel upon metals, as gold, silver, copper, &c. and of melting it at the fire, or of making divers curious works in it at a lamp. It signifies also to paint in enamel.

The method of painting in ENAMEL. This is performed on plates of gold or silver, and most commonly of copper, enamelled with the white enamel; whereon they paint with colours which are melted in the fire, where they take a brightness and lustre like that of glass. This painting is the most prized of all for its peculiar brightness and vivacity, which is very permanent, the force of its colours not being effaced or injured by time as in other painting, and continuing always as fresh as when it came out of the workmen's hands. It is used for miniatures, it being the more difficult the larger it is, by reason of certain accidents it is liable to in the operation. Enamelling should only be practised on plates of gold, the other metals being less pure: copper, for instance, scales with the application, and yields fumes; and silver turns the yellow white. Nor must the plates be made flat; for in that case, the enamel cracks; to avoid which, they usually forge them a little round or oval, and not too thick. The plate being well and evenly forged, they usually begin the operation by laying on a couch of white enamel (as was observed above) on both sides, which prevents the metal from swelling and blistering; and this first layer serves for the ground of all the other colours. The plate being thus prepared, they begin at first by exactly drawing out the subject to be painted with red vitriol, mixed with oil of spike, marking all parts of the design very lightly with a small pencil. After this, the colours (which are to be previously ground with water in a mortar of agate extremely fine, and mixed with oil of spike somewhat thick) are to be laid on, observing the mixtures and colours that agree to the different parts of the subject; for which it is necessary to understand painting in miniature. But here the workman must be very cautious of the good or bad qualities of the oil of spike he employs to mix his colours with, for it is very subject to adulterations. Great care must likewise be taken, that not the least dust imaginable come on the colours while painting or grinding them; for the least speck, when it is worked up with it, and when the work comes to be put into the reverberatory to be red hot, will leave a hole, and so deface the work.

When the colours are all laid, the painting must be gently dried over a slow fire to evaporate the oil, and the colours afterwards melted to incorporate them with the enamel, making the plate red-hot in a fire like what the enamellers use. Afterwards that part of the painting must be passed over again which the fire hath any thing effaced, strengthening the shades and colours, and committing it again to the fire, observing the same method as before, which is to be repeated till the work be finished.

Method of ENAMELLING *by the Lamp*. Most enamelled works are wrought at the fire of a lamp, in which, instead of oil, they put melted horse-grease, which they call *caballine oil*. The lamp, which is of copper, or white iron, consists of two pieces; in one of which is a kind of oval plate, six inches long, and two high, in which they put the oil and the cotton. The other part, called the *box*, in which the lamp is inclosed, serves only to receive the oil which boils over by the force of the fire. This lamp, or, where several artists work together, two or three more lamps, are placed on a table of a proper height. Under the table, about the middle of its height, is a double pair of organ-bellows, which one of the workmen moves up and down with his foot to quicken the flame of the lamps, which are by this means excited to an incredible degree of vehemence. Grooves made with a gauge in the upper part of the table, and covered with parchment, convey the wind of the bellows to a pipe of glass before each lamp; and that the enamellers may not be incommoded with the heat of the lamp, every pipe is covered at six inches distance with a little tin plate, fixed into the table by a wooden handle. When the works do not require a long blast, they only use a glass-pipe, into which they blow with the mouth.

It is incredible to what a degree of fineness and delicacy the threads of enamel may be drawn at the lamp. Those which are used in making false tufts of feathers are so fine, that they may be wound on the reel like silk or thread. The fictitious jets of all colours, used in embroideries, are also made of enamel; and that with so much art, that every small piece has its hole to pass the thread through wherewith it is sewed. These holes are made by blowing them into long pieces; which they afterwards cut with a proper tool.

It is seldom that the Venetian or Dutch enamels are used alone: they commonly melt them in an iron-ladle, with an equal part of glass or crystal; and when the two matters are in perfect fusion, they draw it out into threads of different sizes, according to the nature of the work. They take it out of the ladle while liquid, with two pieces of broken tobacco-pipes, which they extend from each other at arm's length. If the thread is required still longer, then another workman holds one end, and continues to draw it out, while the first holds the enamel to the flame. Those threads, when cold, are cut into what lengths the workman thinks fit, but commonly from 10 to 12 inches; and as they are all round, if they are required to be flat, they must be drawn through a pair of pinchers while yet hot. They have also another iron instrument in form of pinchers, to draw out the enamel by the lamp when it is to be worked and disposed in figures. Lastly, they have glass-tubes of various sizes, serving to blow the enamel into various figures, and preserve the necessary vacancies therein; as also to spare the

ſtuff, and form the contours. When the enameller is at work, he ſits before the lamp with his foot on the ſtep that moves on the bellows; and holding in his left hand the work to be enamelled, or the braſs or iron-wires the figures are to be formed on, he directs with his right the enamel thread, which he holds to the flame with a management and patience equally ſurpriſing. There are few things they cannot make or repreſent with enamel; and ſome figures are as well finiſhed, as if done by the moſt ſkilful carvers.

ENARTHROSIS, in anatomy, a ſpecies of DIARTHROSIS.

ENCÆNIA, the name of three ſeveral feaſts celebrated by the Jews in memory of the dedication, or rather purification, of the temple, by Judas Maccabæus, Solomon, and Zorobabel. This term is likewiſe uſed in church-hiſtory for the dedication of Chriſtian churches.

ENCAMPMENT, the pitching of a CAMP.

ENCANTHIS, in ſurgery, a tubercle ariſing either from the caruncula lachrymalis, or from the adjacent red ſkin; ſometimes ſo large, as to obſtruct not only the puncta lachrymalia, but alſo part of the ſight or pupil itſelf.

ENCAUSTIC and ENCAUSTUM, the ſame with enamelling and enamel. See ENAMELLING and ENAMEL.

ENCAUSTIC *Painting*, a method of painting made uſe of by the ancients, in which wax was employed to give a gloſs to their colours, and to preſerve them from the injuries of the air.

This ancient art, after having been long loſt, was reſtored by Count Caylus, a member of the Academy of Inſcriptions in France; and the method of painting in wax was announced to the Academy of Painting and Belles Letters, in the year 1753; though M. Bachelier, the author of a treatiſe *De l'Hiſtoire & du Secret de la Peinture en Cire*, had actually painted a picture in wax in 1749; and he was the firſt who communicated to the public the method of performing the operation of inuſtion, which is the principal characteriſtic of the encauſtic painting. The Count kept his method a ſecret for ſome time, contenting himſelf with exhibiting a picture at the Louvre in 1754, repreſenting the head of Minerva, painted in the manner of the ancients, which excited the curioſity of the public, and was very much admired. In the interval of ſuſpenſe, ſeveral attempts were made to recover the ancient method of painting. The firſt ſcheme adopted was that of melting wax and oil of turpentine together, and uſing this compoſition as a vehicle for mixing and laying on the colours. But this method did not explain Pliny's meaning, as the wax is not burnt in this way of managing it. In another attempt, which was much more agreeable to the hiſtorian's deſcription of encauſtic painting, the wax was melted with ſtrong lixivium of ſalt of tartar, and with this the colours were ground. When the picture was finiſhed, it was gradually preſented to the fire, ſo as to melt the wax; which was thus diffuſed through all the particles of the colours, ſo that they were fixed to the ground, and ſecured from the acceſs of air or moiſture. But the method of count Caylus is much more ſimple: the cloth or wood, which he deſigned for the baſis of his picture, is waxed over, by only rubbing it ſimply with a piece of bees-wax; the wood or cloth, ſtretched on a frame, being held horizontally over, or perpendicularly before a fire, at ſuch a diſtance, that the wax might gradually melt, whilſt it is rubbed on, diffuſe itſelf, penetrate the body, and fill the interſtices of the texture of the cloth, which, when cool, is fit to paint upon; but as water colours, or thoſe that are mixed up with common water, will not adhere to the wax, the whole picture is to be firſt rubbed over with Spaniſh chalk or white, and then colours are applied to it; when the picture is dry, it is put near the fire, whereby the wax melts, and abſorbs all the colours.

Mr. J. H. Muntz, in a treatiſe on this ſubject, has propoſed ſeveral improvements in the art of encauſtic. When the painting is on cloth, he directs it to be prepared by ſtretching it on a frame, and rubbing one ſide ſeveral times over with a piece of bees-wax, or virgin wax, till it is covered with a coat of wax of conſiderable thickneſs. In fine linen, this is the only operation neceſſary previous to painting; but coarſe cloth muſt be rubbed gently on the unwaxed ſide with a pumice ſtone, to take off all thoſe knots which would prevent the free and accurate working of the pencil. Then the ſubject is to be painted on the unwaxed ſide with colours prepared and tempered with water; and when the picture is finiſhed, it muſt be brought near the fire, that the wax may melt and fix the colours. This method, however, can only be applied to cloth or paper, through the ſubſtance of which the wax may paſs; but in wood, ſtone, metals, or plaſter, the former method of Count Caylus muſt be obſerved.

Mr. Muntz has alſo diſcovered a method of forming grounds for painting with crayons, and fixing theſe, as well as water-colours, employed with the pencil. On the unwaxed ſide of a linen cloth, ſtretched and waxed as before, lay an even and thick coat of the colour proper for the ground; having prepared this colour by mixing ſome proper pigment with an equal quantity of chalk, and tempering them with water. When the colour is dry, bring the picture to the fire that the wax may melt, paſs through the cloth, and fix the ground. An additional quantity of wax may be applied to the back of the picture, if that which was firſt rubbed on ſhould not be ſufficient for the body of colour; but as this muſt be laid on without heat, the wax ſhould be diſſolved in oil of turpentine, and applied with a bruſh, and the canvas be again expoſed to the fire, that the freſh ſupply of wax may paſs through the cloth, and be abſorbed by the colour; and thus a firm and good body will be formed for working on with the crayons. If cloth and paper are joined together, the cloth muſt be firſt fixed to the ſtraining frame, and then the paper muſt be paſted to it with a compoſition of paſte made with wheaten flour, or ſtarch, and water, and about a twelfth part of its weight of common turpentine. The turpentine muſt be added to the paſte when it is almoſt ſufficiently boiled, and the compoſition well ſtirred, and left to ſimmer over the fire for five or ſix minutes; let wax be diſſolved in oil of turpentine to the conſiſtence of a thin paſte; and when the cloth and paper are dry, let them be held near a fire; and with a bruſh lay a coat of the wax and turpentine on both ſides the joined cloth and paper, to ſuch a degree of thickneſs, that both ſurfaces may ſhine throughout without any appearance of dull ſpots. Then expoſe the cloth to the fire or to the ſun; by which means the oil will evaporate, and the wax become ſolid, and be fit to receive any compoſition of colour proper for a ground, which is to be laid on as above directed in the caſe of cloth without paper.

Almoſt all the colours that are uſed in oil-painting may be alſo applied in the encauſtic method. Mr. Muntz objects, indeed, to brown, light pink, and unburnt *terra di Sienna*; becauſe theſe, on account of their gummy or ſtony texture, will not admit ſuch a coheſion with the wax as will properly fix them; but other colours which cannot be admitted in oil-painting, as red lead, red orpiment, cryſtals of verdegris, and red precipitate of mercury, may be uſed here. The crayons uſed in encauſtic painting are the ſame with thoſe uſed in the common way of crayon painting, excepting thoſe that in their compoſition are too tenacious; and the method of uſing them is the ſame in both caſes.

The encauſtic painting has many peculiar advantages: though the colours have not the natural varniſh or ſhining which they acquire with oil, they have all the ſtrength of paintings in oil,

and all the airinefs of water-colours, without partaking of the apparent character or defects of either; they may be looked at in any light and in any fituation, without any falfe glare: the colours are firm, and will bear wafhing; and a picture, after having been fmoked, and then expofed to the dew, becomes as clean as if it had been but juft painted. It may alfo be retouched at pleafure, without any detriment to the colours; for the new colours will unite with the old ones, without fpots, as is the cafe in common fize painting; nor is it neceffary to rub the places to be retouched with oil as in oil pictures; it is not liable to crack, and eafily repaired, if it fhould chance to fuffer any injury. The duration of this painting is alfo a very material advantage; the colours are not liable to fade and change; no damp can affect them, nor any corrofive fubftance injure them; nor can the colour fall off in fhivers from the canvafs. However, notwithftanding all thefe and other advantages enumerated by the abbé Mazeas and Mr. Muntz, this art has not yet been much practifed. Many of thefe properties belong to a much higher fpecies of encauftic painting afterwards difcovered in England, the colours of which are fixed by a very intenfe heat; nor are the colours or grounds on which they are laid liable to be diffolved or corroded by any chemical menftruum; nor, like the glaffy colours of enamel, to run out of the drawing on the fire. This method is defcribed in the fecond part of the xlixth volume of the Philofophical Tranfactions, N° 100. Yet, notwithftanding the ingenuity of this communication, we find the ancient or fome fimilar method of painting in wax remained a defideratum upwards of 25 years; and till, in 1787, a method was communicated to the Society of Arts by Mifs Greenland. The ground of her information fhe received at Florence, through the acquaintance of an amateur of painting, who procured her the fatisfaction of feeing fome paintings in the ancient Grecian ftyle, executed by Signora Parenti, a profeffor at that place, who had been inftructed by a Jefuit at Pavia, the perfon who made the fartheft difcoveries in that art. Mifs Greenland's friend, knowing fhe was fond of painting, informed her what were the materials the paintrefs ufed, but could not tell her the proportions of the compofition; however, from her anxiety to fucceed in fuch an acquifition, fhe made various experiments, and at laft obtained fuch a fufficient knowledge of the quantities of the different ingredients as to begin and finifh a picture, which fhe afterwards prefented to the fociety for their infpection.

Her method is as follows: " Take an ounce of white wax, and the fame weight of gum maftich powdered. Put the wax in a glazed earthen veffel over a very flow fire; and when it is quite diffolved, ftrew in the maftich, a little at a time, ftirring the wax continually until the whole quantity of gum is perfectly melted and incorporated: then throw the pafte into cold water; and when it is hard, take it out of the water, wipe it dry, and beat it in one of Mr. Wedgwood's mortars, obferving to pound it at firft in a linen cloth to abforb fome drops of water that will remain in the pafte, and would prevent the poffibility of reducing it to a powder, which muft be fo fine as to pafs through a thick gauze. It fhould be pounded in a cold place, and but a little while at a time, as after long beating the friction will in a degree foften the wax and gum, and inftead of their becoming a powder they will return to a pafte.

" Make fome ftrong gum arabic water; and when you paint, take a little of the powder, fome colour, and mix them together with the gum-water. Light colours require but a fmall quantity of the powder, but more of it muft be put in proportion to the body and darknefs of the colours; and to black there fhould be almoft as much of the powder as colour.

" Having mixed the colours, and no more than can be ufed before they grow dry, paint with fair water, as is practifed in painting with water colours, a ground on the wood being firft painted of fome proper colour prepared in the fame manner as is defcribed for the picture; walnut-tree and oak are the forts of wood commonly made ufe of in Italy for this purpofe. The painting fhould be very highly finifhed; otherwife, when varnifhed, the tints will not appear united.

" When the painting is quite dry, with rather a hard brufh, paffing it one way, varnifh it with white wax, which is put into an earthen veffel, and kept melted over a very flow fire till the picture is varnifhed, taking great care the wax does not boil. Afterwards hold the picture before a fire, near enough to melt the wax, but not to make it run; and when the varnifh is entirely cold and hard, rub it gently with a linen cloth. Should the varnifh blifter, warm the picture again very flowly, and the bubbles will fubfide. When the picture is dirty, it need only be wafhed with cold water."

The opinion given by the fociety upon the above is: The method made ufe of by Mifs Greenland provides againft all inconveniencies; and the brilliancy of the colours in the picture painted by her, and exhibited to the fociety, fully juftifies the opinion, that the art of painting in wax, as above defcribed, highly merited the reward of a gold pallet voted to her on this occafion.

ENCEINTE, in fortification, is the wall or rampart which furrounds a place, fometimes compofed of baftions or curtains, either faced or lined with brick or ftone, or only made of earth. The enceinte is fometimes only flanked by round or fquare towers, which is called a *Roman wall*.

ENCEPHALI, in medicine, worms faid to be generated in the head, where they caufe pain and delirium. Thofe worms that generate in the nofe, ears, and teeth, are alfo called *encephali*.

ENCHANTER, a perfon fuppofed to practife enchantment or fafcination. See FASCINATION, WITCHCRAFT, &c.

ENCHANTER'S *Nightfhade*, in botany. See CIRCÆA.

ENCHASING, INCHASING, or *Chafing*, the art of enriching and beautifying gold, filver, and other metal-work, by fome defign or figures reprefented thereon in low relievo. Enchafing is practifed only on hollow thin works, as watch-cafes, cane-heads, tweezer-cafes, or the like. It is performed by punching or driving out the metal, to form a figure, from withinfide, fo as to ftand out prominent from the plane or furface of the metal. In order to this, they provide a number of fine fteel blocks or puncheons of divers fizes; and the defign being drawn on the furface of the metal, they apply the infide upon the heads or tops of thefe blocks, directly under the lines or parts of the figures; then, with a fine hammer, ftriking on the metal, fuftained by the block, the metal yields, and the block makes an indenture or cavity on the infide, correfponding to which there is a prominence on the outfide, which is to ftand for that part of the figure. Thus the workman proceeds to chafe and finifh all the parts by the fucceffive application of the block and hammer to the feveral parts of the defign. And it is wonderful to confider with what beauty and juftnefs, by this fimple piece of mechanifm, the artifts in this kind will reprefent foliages, grotefques, animals, hiftories, &c.

ENCLITICA, in grammar, particles which are fo clofely united with other words as to feem part of them, as in *virumque*, &c.—There are three enclitic particles in Latin, viz. *que*, *ne*, *ve*.

ENCRATITES, in church-hiftory, heretics who appeared towards the end of the fecond century: they were called *Encratites*, or *Continentes*, becaufe they gloried in abftaining from marriage and the ufe of wine and animal food.

ENCURECK, in natural hiftory, a venomous infect found in Perfia, and faid to be a kind of tarantula. According to Olearius, as quoted by Mr. Boyle, it neither ftings nor bites; but lets fall its venom like a drop of water, which caufes in-

ſufferable pain in the part for a time, and afterwards ſo profound a ſleep, that nothing can awake the patient except the ridiculous expedient of cruſhing one of the creatures on the part affected. It is nevertheleſs ſaid, that the ſheep eat theſe inſects without damage.

ENCYCLOPÆDIA, a term nearly ſynonymous with CYCLOPÆDIA; but adopted in preference to it in denominating the preſent work, as being more definite and of better authority. According to an obſervation of the late learned printer Mr. Bowyer, the prepoſition EN makes the meaning of the word more preciſe: for *Cyclopædia* may denote "the inſtruction OF a circle," as *Cyropædia* is "the inſtruction OF Cyrus," whereas in EN*cyclopædia* the prepoſition determines the word to be from the dative of *cyclus*, "inſtruction IN a circle." And Voſſius in his book *De vitiis ſermonis*, has obſerved, "That *Cyclopædia* is uſed by ſome authors, but *Encyclopædia* by the beſt."

ENDEMIC, or ENDEMICAL, DISEASES, thoſe to which the inhabitants of particular countries are ſubject more than others, on account of the air, water, ſituation, and manner of living.

ENDIVE, in botany. See CICHORIUM.

ENDLESS, ſomething without an end: thus authors mention endleſs rolls, the endleſs ſcrew, &c.

ENDORSE, in heraldry, an ordinary, containing the eighth part of a pale, which Leigh ſays is only uſed when a pale is between two of them.

ENDORSED, in heraldry, is ſaid of things borne back to back, more uſually called ADOSEE.

ENDORSEMENT, in law and commerce. See INDORSEMENT.

ENDOWMENT, in law, denotes the ſettling a dower on a woman: though ſometimes it is uſed figuratively, for ſettling a proviſion upon a parſon, on the building of a church; or the ſevering a ſufficient portion of tithes for a vicar, when the benefice is appropriated.

ENDYMION, in fabulous hiſtory, a ſhepherd, ſon of Æthlius and Calyce. It is ſaid that he required of Jupiter to grant to him to be always young, and to ſleep as much as he would; whence came the proverb of *Endymionis ſomnum dormire*, to expreſs a long ſleep. Diana ſaw him naked as he ſlept on mount Latmos; and was ſo ſtruck with his beauty, that ſhe came down from heaven every night to enjoy his company. Endymion married Chromia daughter of Itonus; by whom he had three ſons Pæon, Epeus, and Æolus, and a daughter called *Eurydice*. The fable of Endymion's amours with Diana, or the moon, aroſe from his knowledge of aſtronomy; and as he paſſed the night on ſome high mountain to obſerve the heavenly bodies, it came to be reported that he was courted by the moon. Some ſuppoſe that there were two of that name; the ſon of a king of Elis, and the ſhepherd or aſtronomer of Caria. The people of Heraclea maintained that Endymion died on mount Latmos, and the Eleans pretended to ſhow his tomb at Olympia in Peloponneſus.

ENEMY, in law, an alien or foreigner, who publicly invades the kingdom.

ENERGUMENS, in church-hiſtory, perſons ſuppoſed to be poſſeſſed by the devil, concerning whom there were many regulations among the primitive Chriſtians. They were denied baptiſm and the euchariſt; at leaſt, this was the practice of ſome churches: and though they were under the care of exorciſts, yet it was thought a becoming act of charity, to let them have the public prayers of the church, at which they were permitted to be preſent. See EXORCISM.

ENERGY, a term of Greek origin, ſignifying the power, virtue, or efficacy of a thing. It is alſo uſed, figuratively, to denote emphaſis of ſpeech.

ENFANS PERDUS, the ſame with forlorn-hope. See FORLORN.

ENFILADE, in the art of war, is uſed in ſpeaking of trenches, or other places, which may be ſcoured by the enemy's ſhot along their whole length. In conducting the approaches at a ſiege, care muſt be taken that the trenches be not enfiladed from any work of the place.

ENFINE', formerly ANTINOE; a city of Egypt, built by Adrian in honour of his favourite Antinous. It is ſituated towards the middle of the Said, or Upper Egypt, and ſtill contains ſeveral ſtately monuments of antiquity. In ancient times this city was very magnificent.

ENFRANCHISEMENT, in law, the incorporating a perſon into any ſociety, or body politic.

ENGASTRIMYTHI, in Pagan theology, the Pythians, or prieſteſſes of Apollo, who delivered oracles from within, without any action of the mouth or lips. The ancient philoſophers, &c. are divided upon the ſubject of the engaſtrimythi. Hippocrates mentions it as a diſeaſe. Others will have it a kind of divination. Others attribute it to the operation or poſſeſſion of an evil ſpirit. And others to art and mechaniſm. M. Scottus maintains that the engaſtrimythi of the ancients were poets, who, when the prieſts could not ſpeak, ſupplied the defect by explaining in verſe what Apollo dictated in the cavity of the baſon on the ſacred tripod.

ENGENDERING, a term ſometimes uſed for the act of producing or forming any thing: thus meteors are ſaid to be engendered in the middle region of the atmoſphere, and worms in the belly.

ENGINE, in mechanics, is a compound machine, made of one or more mechanical powers, as levers, pullies, ſcrews, &c. in order to raiſe, caſt, or ſuſtain any weight, or produce any effect which could not be eaſily effected otherwiſe. The word is formed of the French *engin*, from the Latin *ingenium* "wit;" by reaſon of the ingenuity required in the contrivance of engines to augment the effect of moving powers.

ENGINE *for extinguiſhing Fires*. See HYDROSTATICS.

Pile ENGINE, one contrived for driving piles. See PILE-*Engine*.

Steam-ENGINE, a machine to raiſe water by fire, or rather by the force of water turned into ſteam. See STEAM-*Engine*.

ENGINEER, in the military art, an able expert man, who, by a perfect knowledge in mathematics, delineates upon paper or marks upon the ground, different ſorts, and other works proper for offence and defence. He ſhould underſtand the art of fortification, ſo as to be able not only to diſcover the defects of a place, but to find a remedy proper for them; as alſo how to make an attack upon, as well as to defend, the place. Engineers are extremely neceſſary for theſe purpoſes: wherefore it is requiſite, that beſides being ingenious, they ſhould be brave in proportion. When at a ſiege the engineers have narrowly ſurveyed the place, they are to make their report to the general, by acquainting him which part they judge the weakeſt, and where approaches may be made with moſt ſucceſs. Their buſineſs is alſo to delineate the lines of circumvallation and contravallation, taking all the advantages of the ground; to mark out the trenches, places of arms, batteries, and lodgments, taking care that none of their works be flanked or diſcovered from the place. After making a faithful report to the general of what is doing, the engineers are to demand a ſufficient number of workmen and utenſils, and whatever elſe is neceſſary.

ENGLAND, the ſouthern and moſt conſiderable part of the iſland of Great Britain; bounded on the N. by Scotland, on the N. E. and E. by the German Ocean, on the S by the Engliſh Channel, and on the W. by St. George's Channel, the principality of Wales, and the Iriſh Sea. It lies between 2° E. and 7° W. long. and between 49° and 56° N. lat. It is of a triangular form. From the S. Foreland in Kent, which may be termed the E. point of the triangle, to Berwick upon Tweed, which is

the N. its length in a ſtraight line is 345 miles; from that point to the Land's End, in Cornwall, which is the W. it is 425; and the breadth thence to the S. Foreland is 340. But the breadth diminiſhes, in general, as we approach the North; and, on the other hand, the length would be conſiderably more, if we were to follow all the windings of the ſea-coaſt. "The face of the country in England," ſays Dr. Aikin, in his England Delineated, "affords all that beautiful variety which can be found in the moſt extenſive tracts of the globe. In ſome parts, verdant plains extend as far as the eye can reach, watered by copious ſtreams, and covered by innumerable cattle. In others, the pleaſing viciſſitudes of gently-riſing hills and bending vales, fertile in corn, waving with wood, and interſperſed with meadows, offer the moſt delightful landſcapes of rural opulence and beauty. Some tracts abound with proſpects of a more romantic kind; lofty mountains, craggy rocks, deep narrow dells, and rumbling torrents. Nor are there wanting, as a contraſt to ſo many agreeable ſcenes, the gloomy features of black barren moors and wide uncultivated heaths. On the whole, however, few countries have a ſmaller proportion of land abſolutely ſteril and incapable of culture." The richeſt parts are, in general, the midland and ſouthern. Toward the N. it partakes of the barrenneſs of the neighbouring Scotland. The E. coaſt is, in many parts, ſandy and marſhy. A range of rude and elevated land, ſometimes riſing into lofty mountains, extends from the borders of Scotland to the very heart of England, running from N. to S. and forming a natural diviſion between the E. and W. ſides of the kingdom. Cornwall is alſo a rough hilly tract; and a ſimilar character prevails in part of the adjacent counties. Theſe mountainous tracts abound with various mineral treaſures. The rivers are numerous; but the comparatively ſmall extent of England will not permit them to vie, in length of courſe, with the great rivers on the continent. The moſt conſiderable of them are the Thames, Severn, Medway, Trent, Ouſe, Tyne, Tees, Eden, Avon, Derwent, Dee, Merſey, &c. which, with many others, are deſcribed under their reſpective heads. The lakes are neither numerous nor extenſive. They are chiefly in the N. W. counties; and thoſe of Weſtmorland and Cumberland, in particular, exhibit ſuch varieties of beautifully romantic and picture ſque ſcenery, as to have become, for ſome years paſt, the faſhionable object of ſummer excurſions from the metropolis, and every part of the country. "With reſpect to climate," ſays Dr. Aikin, "England is ſituated in the N. part of the temperate zone, ſo that it enjoys but a ſcanty ſhare of the genial influence of the ſun. Its atmoſphere is inclined to chillneſs and moiſture, ſubject to frequent and ſudden changes; and is more favourable to the growth, than to the ripening, of the products of the earth. No country is clothed with ſo beautiful and laſting a verdure; but the harveſts, eſpecially in the northern parts, frequently ſuffer from unſeaſonable rains; and the fruits often fall ſhort of their perfect maturity. The rigours of winter, however, as well as the parching heats of ſummer, are felt here in a much leſs degree than in parallel climates on the continent; a circumſtance common to all iſlands. While the ſeaports of Holland and Germany are, every winter, locked up with ice, thoſe of England, and even of Scotland, are never known to ſuffer this inconvenience. The weſtern ſide of the kingdom, receiving firſt the great clouds from the Atlantic Ocean, which are afterwards intercepted in their paſſage by the middle ridge of hills, is conſiderably more expoſed to rain than the eaſtern; but the latter is more frequently involved in fogs and miſts. The whole country, ſome particular ſpots excepted, is ſufficiently healthy; and the natural longevity of its inhabitants is equal to that of almoſt any region. All the moſt valuable productions, both animal and vegetable, of this country, have been imported from the continent, and have been kept up and improved by conſtant attention. Originally, this great iſland ſeems to have been, like the wilds of America, almoſt entirely over run with wood, and peopled only by the inhabitants of the foreſt. Here formerly roamed the bear, the wolf, and the wild boar, now totally extirpated. Large herds of ſtags ranged through the woods, roebucks bounded over the hills, and wild bulls grazed in the marſhy paſtures. By degrees, the woods were deſtroyed, in order to make way for cultivation; the marſhes were drained; and the wild animals, invaded in their retreats, gradually diſappeared, and their places were ſupplied by the domeſtic kinds. England now poſſeſſes no other wild quadrupeds than ſome of the ſmaller kinds; ſuch as the fox, the wild cat, the badger, the marten, and others of the weaſel kind; the otter, the hedge-hog, the hare and rabbit; the ſquirrel, dormouſe, mole, and ſeveral ſpecies of the rat and mouſe. On the other hand, every kind of domeſtic animal, imported from abroad, has been reared to the greateſt degree of perfection. The horſe has been trained up for all the various purpoſes of ſtrength and ſwiftneſs, ſo as to excel in thoſe qualities the ſame animal in every other country. The horned cattle have been brought to the largeſt ſize and greateſt juſtneſs of ſhape. The different races of ſheep, in England, are variouſly diſtinguiſhed, either for uncommon ſize, goodneſs of fleſh, and plenty or fineneſs of wool. The deer of our parks, which are originally a foreign breed, are ſuperior in beauty of ſkin, and delicacy of fleſh, to thoſe of moſt countries. Even the ſeveral kinds of dogs have been trained to degrees of courage, ſtrength, and ſagacity, rarely to be met with elſewhere. The improvement in the vegetable products of this iſland is not leſs ſtriking than in the animal. Nuts, acorns, crabs, and a few wild berries, were almoſt all the variety of vegetable food which our woods could boaſt. To foreign countries, and to the efforts of culture, we are indebted for bread, the roots and greens of our tables, and all our garden fruits. The barley and hops for our malt liquors, and apples for our cider, are equally the gifts of other lands. The meaneſt labourer is now fed with more wholeſome and delicate aliments than the petty kings of the country could obtain in its ſavage and uncultivated ſtate. The rivers and ſeas of England are ſtocked with a great variety of fiſh, which yield a plentiful article of proviſion to all ranks of people. The river fiſh, indeed, from the populouſneſs of the country, and the number of fiſhers, are, in many parts, much diminiſhed. But the ſea is an inexhauſtible ſource; and every exertion of induſtry, to procure food from thence, is amply repaid. The fiſheries, at preſent, are a great object of attention; and the whole ſea-coaſt is enlivened by numerous inhabitants, who gain their chief ſubſiſtence from the deep." The manufactures and commerce of this country are ſo vaſt, ſo extenſive, and ſo various, that an account of them would lead us beyond our limits. Referring, therefore, to the various counties, cities, and towns, under their reſpective heads, for farther information on the ſubject, it is hardly neceſſary to obſerve here, that in the woollen, cotton, and hardware manufactories, this country has long maintained a pre-eminence; and, though nature has denied it the rich fruits of other countries, yet the manufacture, if it may be ſo called, of our home-made wines, in imitation of all the varieties of the foreign, has been brought to an uncommon degree of perfection. The government of this country is a limited monarchy; the legiſlative power reſiding in the king, the houſe of lords, and the houſe of commons; and the executive power in the king, the great officers of ſtate, the judges, and all the inferior gradations of magiſtracy. Under this free conſtitution, we have enjoyed a degree of proſperity and happineſs, ſo uniform and uninterrupted, as to be the admiration and envy of ſurrounding nations. The civil diviſion of the country is into circuits, and ſhires, or counties; theſe laſt are ſubdivided into wapentakes, or hun-

dreds, and pariſhes. The circuits (which are ſix in number, and in each of which, for the moſt part, two of the judges adminiſter juſtice twice a-year) contain 38 counties. They are, 1. The Home Circuit, which contains the counties of Eſſex, Herts, Kent, Surry, and Suſſex. 2. The Norfolk Circuit, containing the counties of Bucks, Bedford, Huntingdon, Cambridge, Suffolk, and Norfolk. 3. The Oxford Circuit, containing the counties of Oxford, Berks, Glouceſter, Worceſter, Monmouth, Hereford, Salop, and Stafford. 4. The Midland Circuit, containing the ſhires of Warwick, Leiceſter, Derby, Nottingham, Lincoln, Rutland, and Northampton. 5. The Northern Circuit, containing the counties of York, Durham, Northumberland, Lancaſter, Weſtmorland, and Cumberland. 6. The Weſtern Circuit, containing Hants, Wilts, Dorſet, Somerſet, Devon, and Cornwall. Middleſex being the ſeat of the ſupreme court of juſtice, and Cheſhire being a county palatine, are not included in any circuit. The eſtabliſhed religion of the country, as contained in the 39 articles of the Church of England, is Calviniſm; but theſe articles are interpreted, by the clergy in general, according to the more liberal principles of Arminius. But all religions are tolerated in England; and, of late years, the Roman Catholics and Proteſtant Diſſenters, in particular, have been releaſed from all apprehenſions on account of many ſevere penal laws, which, in leſs enlightened times, were enacted againſt them; and, if they have not been reſtored to the complete enjoyment of their rights as Engliſh ſubjects, without any civil diſqualification on account of their religious opinions, it is, no doubt, becauſe the legiſlature have thought, that ſo cloſely connected as is the religious eſtabliſhment of this country with the civil government, any farther conceſſions might be dangerous, if not fatal, to the ſafety of both. The eccleſiaſtical diviſion of England is into two archbiſhoprics, called the provinces of Canterbury and York. That of Canterbury (whoſe archbiſhop is metropolitan and primate of all England) contains the dioceſes of London, Wincheſter, Bath and Wells, Briſtol, Chicheſter, Ely, Exeter, Glouceſter, Hereford, Lichfield and Coventry, Lincoln, Norwich, Oxford, Peterborough, Rocheſter, Saliſbury, and Worceſter, beſide the four Welch biſhoprics of St. David, Bangor, Llandaff, and St. Aſaph. The province of York contains the dioceſes of Durham, Cheſter, and Carliſle, and that of Sodor and Man; and all the prelates of the ſees enumerated (the latter excepted) have a ſeat in the houſe of lords.

England, New, a country of N. America, bounded on the N. by Canada, on the E. by Nova Scotia and the Atlantic Ocean; on the S. by that ocean and Long Iſland Sound, and on the W. by New York. It contains the following five ſtates; namely, New Hampſhire, Maſſachuſetts, Rhode Iſland, Connecticut, and Vermont; which ſee reſpectively. New England has no one ſtaple commodity. The ocean and the foreſts afford the two principal articles of export. Codfiſh, mackarel, ſhad, ſalmon, and other fiſh; whale oil and whale bone; maſts, boards, ſcantling, ſtaves, hoops, and ſhingles, have been, and are ſtill, exported in large quantities. The annual amount of cod and other fiſh for foreign exportation, including the profits ariſing from the whale-fiſhery, is eſtimated at upwards of half a million. Beſides the articles enumerated, they export from the various parts of New England, ſhips built for ſale, horſes, mules, live ſtock, pickled beef and pork, pot-aſh, pearl-aſh, flax-ſeed, butter and cheeſe, rum, &c. The balance of trade, as far as imperfect calculations will enable us to judge, has generally been againſt New England; not from any unavoidable neceſſity, but from her extravagant importations. From a view of the annual imports into New England, it appears that the greateſt part of them conſiſts of the luxuries, or at beſt the diſpenſable conveniencies of life; the country afford the neceſſaries in great abundance.

ENGLISH, or the English *Tongue*, the language ſpoken by the people of England, and, with ſome variation, by thoſe of Scotland, as well as part of Ireland, and the reſt of the Britiſh dominions. The ancient language of Britain is generally allowed to have been the ſame with the Gallic, or French; this iſland, in all probability, having been firſt peopled from Gallia, as both Cæſar and Tacitus affirm, and prove by many ſtrong and concluſive arguments, as by their religion, manners, cuſtoms, and the nearneſs of their ſituation. But now we have very ſmall remains of the ancient Britiſh tongue, except in Wales, Cornwall, the Iſlands and Highlands of Scotland, part of Ireland, and ſome provinces of France; which will not appear ſtrange, when what follows is conſidered.

Julius Cæſar, ſome time before the birth of our Saviour, made a deſcent upon Britain, though he may be ſaid rather to have diſcovered than conquered it; but about the year of Chriſt 45, in the time of Claudius, Aulus Plautius was ſent over with ſome Roman forces, by whom two kings of the Britons, Togodumnus and Caractacus, were both overcome in battle: whereupon a Roman colony was planted at Malden in Eſſex, and the ſouthern parts of the iſland were reduced to the form of a Roman province: after that, the iſland was conquered as far north as the friths of Dunbarton and Edinburgh, by Agricola, in the time of Domitian; whereupon a great number of the Britons, in the conquered part of the iſland, retired to the weſt part called *Wales*, carrying their language with them.

The greateſt part of Britain being thus become a Roman province, the Roman legions, who reſided in Britain for above 200 years, undoubtedly diſſeminated the Latin tongue; and the people being afterwards governed by laws written in Latin, muſt neceſſarily make a mixture of languages. This ſeems to have been the firſt mutation the language of Britain ſuffered.

Thus the Britiſh tongue continued, for ſome time, mixed with the provincial Latin, till, the Roman legions being called home, the Scots and Picts took the opportunity to attack and haraſs England: upon which, K. Vortigern, about the year 440, called the Saxons to his aſſiſtance; who came over with ſeveral of their neighbours, and, having repulſed the Scots and Picts, were rewarded for their ſervices with the iſle of Thanet and the whole county of Kent; but growing too powerful, and not being contented with their allotment, diſpoſſeſſed the inhabitants of all the country on this ſide of the Severn: thus the Britiſh tongue was in a great meaſure deſtroyed, and the Saxon introduced in its ſtead.

What the Saxon tongue was long before the conqueſt, about the year 700, we may obſerve in the moſt ancient manuſcript of that language, which is a gloſs on the Evangeliſts, by biſhop Edfrid, in which the three firſt articles of the Lord's prayer run thus: "Uren fader thic arth in heofnas, ſic gehalgud thin noma, ſo cymeth thin ric. Sic thin willa ſue is heofnas, and in eortho," &c. In the beginning of the ninth century the Danes invaded England; and getting a footing in the northern and eaſtern parts of the country, their power gradually increaſed, and they became ſole maſters of it in about 200 years. By this means the ancient Britiſh obtained a tincture of the Daniſh language; but their government being of no long continuance, did not make ſo great an alteration in the Anglo-Saxon as the next revolution, when the whole land, A. D. 1067, was ſubdued by William the conqueror, Duke of Normandy in France: for the Normans, as a monument of their conqueſt, endeavoured to make their language as generally received as their commands, and thereby rendered the Britiſh language an entire medley.

About the year 900, the Lord's prayer, in the ancient Anglo-Saxon, ran thus: "Thue ur fader the eart on heofenum, ſi thin nama gehalgod; cume thin rice ſi thin willa on eorthan ſwa, ſwo on heofenum," &c.

About the year 1160, under Henry II. it was rendered thus by Pope Adrian, an Englishman, in rhyme:

" Ure fader in heaven rich,
" Thy name be halyed ever lich,
" Thou bring us thy michel blisse:
" Als hit in heaven y doe,
" Evar in yearth been it also," &c.

Dr. Hicks gives us an extraordinary specimen of the English, as spoken in the year 1385, upon the very subject of the English tongue. " As it is knowe how meny maner peple beeth in this lond; ther beeth also so meny dyvers longages and tonges. Notheless Walschemen and Scottes that beeth nought medled with other nation, holdeth wel nyh hir firste longage and speche; but yif the Scottes, that were sometime confederate and woned with the Pictes, drawe somewhat after hir speche; but the Flemynges, that woneth on the west side of Wales, haveth lost her strange spech, and speketh Sexonliche now. Also Englishemen, they had from the bygynnynge thre maner speche; northerne, southerne, and middel speche in the middel of the lond, as they come of thre maner of peple of Germania: notheless by commyxtion and mellynge first with Danes, and afterwards with Normans, in meny the contrary longage is apayred *(corrupted)*.

" This apayrynge of the burth of the tunge is bycause of tweie things; oon is for children in scole, agenst the usuage and maner of all other nations, beeth compelled for to leve hir own longage, and for to construe hir lessons and here thinges in Frensche, and so they haveth sethe Normans come first into Engelond. Also gentlemen children beeth taught to speke Frensche from the tyme that they beeth roked in here cradel, and kunneth speke and play with a childe's broche; and uplondissche men will lykene hymself to gentilmen, and fondeth with great besynesse for to speak Frensche to be told of.—Hit seemeth a greet wonder how Englischemen and hir own longage and tonge is so dyverse of sown in this oon iland: and the longage of Normandie is comlynge of another lond, and hath oon maner soun amonge alle men that speketh hit arigt in Engelond. Also of the foresaid Sexon tonge that is deled *(divided)* a three, and is abide scarceliche with fewe uplondissche men, is greet wonder. For men of the est, with men of the west, is, as it were, undir the same partie of hevene accordeth more in sownynge of speche, than men of the north with men of the south. Therefore it is that Mercii, that beeth men of myddel Engelond, as it were, parteners of the endes, understondeth bettre the side longes northerne and southerne, than northerne and southerne understondeth either other.—All the longage of the Northumbers, and spechialliche at York, is so scharp, slitting and frotynge, and unschape, that we southerne men may that longage unnethe understonde," &c.

In the year 1537, the Lord's prayer was printed as follows: " O oure father which arte in heven, hallowed be thy name: let thy kingdome come, thy will be fulfilled as well in erth as it is in heven; geve us this daye in dayly bred," &c. Where it may be observed, that the diction is brought almost to the present standard, the chief variations being only in the orthography. By these instances, and many others that might be given, it appears, that the English-Saxon language, of which the Normans despoiled us in a great measure, had its beauties, was significant and emphatical, and preferable to what they imposed on us. " Great, verily (says Cambden), was the glory of our tongue before the Norman conquest, in this, that the old English could express most aptly all the conceptions of the mind in their own tongue, without borrowing from any." Of this he gives several examples.

Having thus shown how the ancient British language was in a manner extirpated by the Romans, Danes, and Saxons, and succeeded by the Saxon, and after that the Saxon blended with the Norman French, we shall now mention two other causes of change in the language. The first of these is owing to the Britons having been a long time a trading nation, whereby offices, dignities, names of wares, and terms of traffic, are introduced, which we take with the wares from the persons of whom we have them, and form them anew, according to the genius of our own tongue; and besides this change in the language, arising from commerce, Britain's having been a considerable time subject to the see of Rome, in ecclesiastical affairs, must unavoidably have introduced some Italian words among us. Secondly, As to the particular properties of a language, our tongue has undergone no small mutation, or rather has received no small improvement upon that account: for, as to the Greek and Latin, the learned have, together with the arts and sciences now rendered familiar among us, introduced abundance; nay, almost all the terms of art in the mathematics, philosophy, physic, and anatomy; and we have entertained many more from the Latin, French, &c. for the sake of neatness and elegance; so that, at this day, our language, which, about 1800 years ago, was the ancient British, or Welsh, &c. is now a mixture of Saxon, Teutonic, Dutch, Danish, Norman, and modern French, embellished with the Greek and Latin. Yet this, in the opinion of some, is so far from being a disadvantage to the English tongue as now spoken (for all languages have undergone changes, and do continually participate with each other), that it has so enriched it, as now to render it the most copious, significant, fluent, courteous, and masculine language in Europe, if not in the world.

ENGRAFTING, in gardening. See GRAFTING.

ENGRAILED, or INGRAILED, in heraldry, a term derived from French *gresly*, " hail; and signifying a thing the hail has fallen upon and broke off the edges, leaving them ragged, or with half-rounds, or semicircles, struck out of their edges.

ENGRAVING, the art of cutting metals and precious stones, and representing thereon figures, letters, or whatever device or design the artist fancies. Engraving, properly a branch of sculpture, is divided into several other branches, according to the matter whereon it is employed, and the manner of performing it. For the rudest branch, that of

ENGRAVING *on Wood*, see CUTTING *in Wood*.

ENGRAVING *on Copper*, the making, correspondently to some delineated figure or design, such concave lines on a smooth surface of copper, either by cutting or corrosion, as render it capable, when charged properly with any coloured fluid, of imparting by compression an exact representation of the figure or design to paper or parchment.

Whether we consider the art of engraving, with regard to the utility and pleasure it affords, or the difficulty that attends its execution, we cannot but confess, that on every account it deserves a distinguished rank among the polite arts. It is by means of this art that the cabinets of the curious are adorned with the portraits of the greatest men of all ages and all nations; that their memories, their most remarkable and most glorious actions, are transmitted to the latest posterity. It is by this art also, that the paintings of the greatest masters are multiplied to a boundless number; and that the lovers of the polite arts, diffused over the face of the whole earth, are enabled to enjoy those beauties from which their distant situations seemed to have for ever debarred them; and persons of moderate fortune are hereby enabled to become possessed of all the spirit, and all the poetry, that are contained in those miracles of art, which seemed to have been reserved for the temples of Italy, or the cabinets of princes. When we reflect, moreover, that the engraver, beside the beauties of poetic composition, and the artful ordinance of design, is to express, merely by the means of light and shade,

all the various tints of colours and clair obfcure; to give a relief to each figure, and a truth to each object; that he is now to paint a fky ferene and bright, and then loaded with dark clouds; now the pure tranquil ftream, and then the foaming, raging fea; that here he is to exprefs the character of the man ftrongly marked in his countenance, and there the minuteft ornament of his drefs; in a word, that he is to reprefent all even the moft difficult objects in nature; we cannot fufficiently admire the vaft improvements in this art, and that degree of perfection to which it is at this day arrived.

Engraving is an art, for the greateft part, of modern invention; having its rife no earlier than the middle of the 15th century. The ancients, it is true, practifed engraving on precious ftones and cryftals with very good fuccefs; and there are ftill many of their works remaining equal to any production of the later ages. But the art of engraving on plates and blocks of wood, to afford prints or impreffions, was not known till after the invention of painting in oil.

The different modes of engraving are the following: 1. In ftrokes cut through a thin wax, laid upon the copper, with a point, and thefe ftrokes bitten or corroded into the copper with aquafortis. This is called *etching*. 2. In ftrokes with the graver alone, unaffifted by aquafortis. In this inftance, the defign is traced with a fharp tool, called a *dry point*, upon the plate; and the ftrokes are cut or ploughed upon the copper with an inftrument diftinguifhed by the name of a *graver*. 3. In ftrokes firft etched and afterwards finifhed with the graver: by this expedient the two former methods are united. 4. In dots without ftrokes, which are executed with the point upon the wax or ground, bitten in with the aquafortis, and afterwards harmonized with the graver, by the means of which inftrument fmall dots are made; or with the graver alone, as in the flefh and finer parts, unaffifted with the point. 5. In dots firft etched and afterwards harmonized with the dry point, performed by a little hammer called *opus mallei*, or, *the work of the hammer*, as practifed by Lutma and others. 6. In mezzotinto, which is performed by a dark barb or ground being raifed uniformly upon the plate with a toothed tool. The defign being traced upon the plate, the light parts are fcraped off by inftruments for that purpofe, in proportion as the effect requires. 7. In aquatinta, a newly invented method of engraving. The outline is firft etched, and afterwards a fort of wafh is laid by the aquafortis upon the plate, refembling drawings in Indian ink, bifter, &c. 8. On wood, performed with a fingle block, on which the defign is traced with a pen, and thofe parts which fhould be white carefully hollowed out; and this block is afterwards printed by the letter-prefs printers, in the fame manner as they print a book. 9. On wood, performed with two, three, or more blocks: the firft having the outlines cut upon it; the fecond is referved for the darker fhadows; and the third for the fhadows which terminate upon the lights; and thefe are fubftituted in their turn, each print receiving an impreffion from every block. This mode of engraving is called *chiaro-fcuro*, and was defigned to reprefent the drawings of the old mafters. 10. On wood and on copper: in thefe the outline is engraved in a bold dark ftyle upon the copper; and two or more blocks of wood are fubftituted to produce the darker and lighter fhadows, as before.

Of all thefe modes of engraving, the moft ancient is that on *wood*; or, to fpeak more properly, the firft impreffions on paper were taken from carved wooden blocks. For this invention it appears that we are indebted to the brief-malers or makers of playing-cards, who practifed the art in Germany about the beginning of the 15th century. From the fame fource may perhaps be traced the firft idea of moveable types, which appeared not many years after; for thefe brief-malers did not entirely confine themfelves to the printing and painting of cards, but produced alfo fubjects of a more devout nature; many of which, taken from holy writ, are ftill preferved in different libraries in Germany, with the explanatory text facing the figures; the whole engraved in wood. In this manner they even formed a fpecies of books; fuch as, *Hiftoria fancti Johannis, ejufque Vifiones Apocalypticæ*; *Hiftoria Veteris & Novi Teftamenti*, known by the name of the *Poor Man's Bible*. Thefe fhort mementos were printed only on one fide; and two of them being pafted together, had the appearance of a fingle leaf. The earlieft date on any of thefe wooden cuts is 1423. The fubject is *St. Chriftopher carrying the Infant Jefus over the Sea*, preferved in a convent at Buxheim near Menningen. It is of a folio fize, illuminated in the fame manner as the playing cards; and at the bottom is this infcription, *Chriftoferi faciem die quacunque tueris, Illa nempe die morte mala non morieris. Millefimo CCCC° XX° tertio.*

Upon the invention of moveable types, as Strutt informs us in his Hiftory of Engraving, that branch of the brief-malers bufinefs, fo far as it regarded the making of books, was gradually difcontinued; but the art itfelf of engraving on wood continued in an improving ftate; and towards the end of the 15th and beginning of the 16th century, it became cuftomary for almoft every one of the German engravers on copper to engrave on wood alfo. The works of Albert Durer in this ftyle of engraving are juftly held in the higheft efteem. Italy, France, and Holland, have produced many capital artifts of this kind; but for boldnefs and fpirit, we muft fee the prints of Chriftopher Jegher, who worked under the direction of Rubens, and was without doubt affifted by that great mafter.

The invention of that fpecies of engraving diftinguifhed by the appellation of *chiaro-fcuro*, feems alfo to be juftly claimed by the Germans, and firft practifed by Mair; one of whofe prints of this kind is dated 1499. Many excellent works in chiaro-fcuro have been produced in France; and in Italy it was honoured with the performances of Titian and Parmegiano; but the attempts of Jackfon, Kirkall, and others in England, have not been equally fuccefsful. A fet of excellent prints in this way have lately been publifhed by J. Skippe, Efq. a connoiffeur and man of tafte.

In Germany, about the year 1450, prints from engraved *copper* firft made their appearance. The earlieft date of a copperplate print is indeed only 1461; but however faulty this print may be with refpect to the drawing, or defective in point of tafte, the mechanical part of the execution of it has by no means the appearance of being one of the firft productions of the graver. We have alfo feveral other engravings, evidently the work of the fame mafter; in which the impreffions are fo neatly taken from the plates, and the engravings fo clearly printed in every part, that, according to all appearance, they could not be executed in a much better manner in the prefent day, with all the conveniences which the copperplate printers now poffefs, and the additional knowledge they muft neceffarily have acquired in the courfe of more than three centuries. Hence we may fairly conclude, that if they were not the firft fpecimens of the engraver's workmanfhip, they were much lefs the firft efforts of the copperplate-printer's ability. It is likewife to be obferved, that Martin Schoen, who is faid, with great appearance of truth, to have worked from 1460 to 1486, was apparently the fcholar of Stoltzhirs; for he followed his ftyle of engraving, and copied from him a fet of prints, reprefenting the paffion of our Saviour. Now, allowing Stoltzhirs to have preceded his difciple only ten years, this carries the era of the art back to 1450, as was faid above. There is no ground to fuppofe that it was known to the Italians till at leaft ten years afterwards. The earlieft prints that are known to be theirs are a fet of the feven planets, and an almanack by way of frontifpiece; on which are directions for finding Eafter from the year 1465 to 1517 inclufive: and we may be well affured, that the engravings were not antedated, for the almanack of courfe be-

came leſs and leſs valuable every year. In all probability, therefore, theſe prints muſt have been executed in the year 1464, which is only four years later than the Italians themſelves lay any claim to. The three earlieſt Italian engravers are, Finiguerra, Boticelli, and Baldini. If we are to refer theſe prints to any of the three, we ſhall naturally conclude them to be the work of Finiguerra or Baldini; for they are not equal either in drawing or compoſition to thoſe aſcribed to Boticelli, which we know at leaſt were deſigned by him; and as Baldini is expreſsly ſaid to have worked from the deſigns of Boticelli, it will appear moſt probable that they belong to Finiguerra.

With reſpect to the invention of *etching*, it ſeems to be not well known to whom it is to be aſcribed. One of the moſt early ſpecimens is that print by Albert Durer, known by the name of the *Cannon*, dated 1518, and thought by ſome, with little foundation, to have been worked on a plate of iron. Another etching by the ſame artiſt is Moſes receiving the Tables of the Law, dated 1524. It was alſo practiſed in Italy ſoon after this by Parmegiano, in whoſe etchings we diſcover the hand of the artiſt working out a ſyſtem as it were from his own imagination, and ſtriving to produce the forms he wanted to expreſs. We ſee the difficulty he laboured under; and cannot doubt, from the examination of the mechanical part of the execution of his works, that he had no inſtruction; and that it was ſomething entirely new to him. If the ſtory is true, that he kept an engraver by profeſſion in his houſe, the novelty of the art is rendered ſo much the more probable. He died in 1540.

As to that ſpecies of engraving in which the modes of *etching* and *cutting* with the graver are united, it muſt have been found neceſſary immediately upon the invention of etching; it was, however, firſt carried to perfection by G. Audran, and is now almoſt univerſally practiſed, whether the work is in ſtrokes or in dots.

Engraving in *dots*, the preſent faſhionable method, is a very old invention, and the only mode diſcovered by the Italians. Agoſtino de Muſis, commonly called *Auguſtine of Venice*, a pupil of Marc Antonio, uſed it in ſeveral of his earlieſt works, but confined it to the fleſh, as in the undated print of An Old Man ſeated upon a Bank, with a cottage in the back ground. He flouriſhed from 1509 to 1536. We alſo find it in a print of "A ſingle Figure ſtanding, holding a Cup and looking upwards," by Giulio Campagnola, who engraved about the year 1516. The back ground is executed with round dots, made apparently with a dry point. The figure is outlined with a ſtroke deeply engraved, and finiſhed with dots, in a manner greatly reſembling thoſe prints which Demarteau engraved at Paris in imitation of red chalk. The hair and beard are expreſſed by ſtrokes. Stephen de Laulne, a native of Germany, followed the ſteps of Campagnola; and many of his ſlight works are executed in dots only. John Boulanger, a French artiſt, who flouriſhed in the middle of the laſt century, and his contemporary Nicholas Van Plattenberg, improved greatly on this method, and practiſed it with much ſucceſs. It is only, however, of late, that it has been conſidered as an object worthy of general imitation. John Lutma executed this kind of work with a hammer and a ſmall punch or chiſſel.

The method of engraving in *mezzotinto* was invented about the middle of the 17th century; and the invention has generally been attributed to Prince Rupert, though it has alſo been aſſerted that he learnt the ſecret from another. See Mezzotinto.

Engraving in *aquatinta* is quite a recent invention, and ſeems at once to have been carried to perfection by Sandby and other living artiſts. See Aquatinta.

Engraving with the tool was the kind originally practiſed, and it is yet retained for many purpoſes. For though the manœuvre of etching be more eaſy, and other advantages attend it; yet where great regularity and exactneſs of the ſtroke or lines are required, the working with the graver is much more effectual: on which account it is more ſuitable to the preciſion neceſſary in the execution of portraits; as there every thing the moſt minute muſt be made out and expreſſed, according to the original ſubject, without any licenſe to the fancy of the deſigner in deviating from it, or varying the effect either by that maſterly negligence and ſimplicity in ſome parts, or thoſe bold ſallies of the imagination and hand in others, which give ſpirit and force to hiſtory painting.

The principal inſtruments uſed in engraving with the tool are, gravers, ſcrapers, a burniſher, an oil-ſtone, and a cuſhion for bearing the plates.

Gravers are made in ſeveral forms with reſpect to the points, ſome being ſquare, others lozenge; the ſquare graver for cutting broad and deep, and the lozenge for more delicate and fine ſtrokes and hatches. La Boſſe recommends, as the moſt generally uſeful, ſuch as are of a form betwixt the ſquare and lozenge: and he adviſes, that they ſhould be of a good length; ſmall towards the point, but ſtronger upwards, that they may have ſtrength enough to bear any ſtreſs there may be occaſion to lay upon them: for if they be too ſmall and mounted high, they will bend; which frequently cauſes their breaking, eſpecially if they be not employed for very ſmall ſubjects.

The burniſher is uſed to aſſiſt in the engraving on ſome occaſions, as well as to poliſh the plates. It is ſeven inches in length, and made of fine ſteel well poliſhed. The burniſher is formed at one end, and a ſcraper on the other, each about an inch and a half long from the point: betwixt them, about four inches of the inſtrument is made round, and ſerves as a handle; and is thicker in the middle than at the necks where the burniſher and ſcraper begin, which necks are only one quarter of an inch in diameter. The principal application of it in engraving, beſides its uſe in poliſhing the plates, is to take out any ſcratches or accidental defacings that may happen to the plates during the engraving; or to leſſen the effect of any parts that may be too ſtrongly marked in the work, and require to be taken down.

A cuſhion, as it is called, is likewiſe generally uſed for ſupporting the plate in ſuch a manner, that it may be turned every way with eaſe. It is a bag of leather filled with ſand, which ſhould be of the ſize that will beſt ſuit the plates it is intended to bear. They are round, and about nine inches over, and three inches in thickneſs.

The cuſhion, made as above directed, being laid on the table, the plate muſt be put upon it; and the graver being held in the hand in a proper manner, the point muſt be applied to the plate, and moved in the proper direction for producing the figures of the lines intended, obſerving, in forming ſtraight lines, to hold the plate ſteady on the cuſhion; and where they are to be finer, to preſs more lightly, uſing greater force where they are to be broader and deeper. In making circular or other curve lines, hold your hand and graver ſteadily; and as you work, turn your plate upon the cuſhion againſt your graver, otherwiſe it will be impoſſible for you to make any circular or curved line with that neatneſs and command of hand you by this means may. After part of the work is engraved, it is neceſſary to ſcrape it with the ſcraper or graver, paſſed in the moſt level direction over the plate to take off the roughneſs formed by the cutting of the graver; but great care muſt be taken not to incline the edge of the ſcraper or tool uſed, in ſuch a manner that may take the leaſt hold of the copper, as it would otherwiſe produce falſe ſtrokes or ſcratches in the engraving: and that the engraved work may be rendered more viſible, it may afterwards be rubbed over with a roll of felt dipped in oil. In uſing the graver, it is neceſſary to carry it as level as poſſible with the ſurface of the plate; for otherwiſe, if the fingers ſlip betwixt them, the line that will be produced, whether curve or ſtraight,

will become deeper and deeper in the progreſs of its formation; which entirely prevents ſtrokes being made at one cut, that will be fine at their extremities, and larger in the middle; and occaſions the neceſſity of retouching to bring them to that ſtate. For this reaſon, it is very neceſſary for thoſe who would learn to engrave in perfection, to endeavour, by frequent trials, to acquire the habit of making ſuch ſtrokes both ſtraight and curving, by lightening or ſinking the graver with the hand, according to the occaſion. If, after finiſhing the deſign, any ſcratches appear, or any part of the engraving be falſely executed, ſuch ſcratches, or faulty parts, muſt be taken out by the burniſher, and further poliſhed, if neceſſary, by the above mentioned roll.

The plate being thus engraved, it is proper to round off the edges, by uſing firſt a rough file, and afterwards a ſmoother; and to blunt the corners a little by the ſame means: after which, the burniſher ſhould be paſſed over the edges to give it a farther poliſh.

The dry point, or needle, which has been of late much uſed in engraving, is a tool like an etching point, which being drawn hard on the copper, cuts a ſtroke, and raiſes a burr; the burr is ſcraped off, and there remains a ſtroke more ſoft and delicate than can be produced in any other way.

In the conduct of the graver and dry point conſiſts all the art; for which there are no rules to be given; all depending on the habitude, diſpoſition, and genius, of the artiſt. However, beſides the explanations already given, ſome general obſervations and directions may not be improper. As the principles of engraving are the ſame with thoſe of painting, a perſon cannot expect to attain any conſiderable degree of perfection in this art who is not a good maſter of deſign; and therefore he ought to be well acquainted both with perſpective and architecture: for the former, by the proper gradations of ſtrong and faint colours, will enable him to throw backwards the figures and other objects of the picture or deſign which he propoſes to imitate; and the latter will teach him to preſerve the due proportion of its ſeveral orders, which the painter often entruſts to the diſcretion of the engraver. In order to preſerve equality and union in his works, the engraver ſhould always ſketch out the principal objects of his piece before he undertakes to finiſh them. In working, the ſtrokes of the graver ſhould never be croſſed too much in a lozenge manner, particularly in the repreſentation of fleſh, becauſe ſharp angles produce the unpleaſing effect of lattice-work, and take from the eye the repoſe which is agreeable to it in all kinds of pictureſque deſigns: we ſhould except the caſe of clouds, tempeſts, waves of the ſea, the ſkins of hairy animals, or the leaves of trees, where this method of croſſing may be admitted. But in avoiding the lozenge, it is not proper to get entirely into the ſquare, which would give too much of the hardneſs of ſtone. In conducting the ſtrokes, the action of the figures, and of all their parts, ſhould be conſidered; and it ſhould be obſerved how they advance towards, or recede from the eye; and the graver ſhould be guided according to the riſings or cavities of the muſcles or folds, making the ſtrokes wider and fainter in the light, and cloſer and firmer in the ſhades. Thus the figures will not appear jagged; and the hand ſhould be lightened in ſuch a manner, that the outlines may be formed and terminated without being cut too hard; however, though the ſtrokes break off where the muſcle begins, yet they ought always to have a certain connection with each other, ſo that the firſt ſtroke may often ſerve by its return to make the ſecond, which will ſhew the freedom of the engraver.

In engraving the fleſh, the effect may be produced in the lighter parts and middle tints by long pecks of the graver, rather than by light lines; or by round dots; or by dots a little lengthened by the graver; or, beſt of all, by a judicious mixture of theſe together.

In engraving the hair and the beard, the engraver ſhould begin his work by laying the principal grounds, and ſketching the chief ſhades in a careleſs manner, or with a few ſtrokes; and he may finiſh it at leiſure with finer and thinner ſtrokes to the extremities. When architecture or ſculpture is to be repreſented, except it be old and ruinous buildings, the work ought not to be made very black; becauſe, as edifices are commonly conſtructed either of ſtone or white marble, the colour, being reflected on all ſides, does not produce dark or brown ſhades as in other ſubſtances. White points muſt not be put in the pupils of the eyes of figures, as in engravings after paintings; nor muſt the hair or beard be repreſented as in nature, which makes the locks appear flowing in the air; becauſe in ſculpture there can be no ſuch appearances.

In engraving cloths of different kinds, linen ſhould be done with finer and cloſer lines than other ſorts, and be executed with ſingle ſtrokes. Woollen cloth ſhould be engraved wide, in proportion to the coarſeneſs or fineneſs of the ſtuff, and with only two ſtrokes; and when the ſtrokes are croſſed, the ſecond ſhould be ſmaller than the firſt, and the third than the ſecond. Shining ſtuffs, which are generally of ſilk or ſattin, and which produce flat and broken folds, ſhould be engraved more hard and more ſtraight than others, with one or two ſtrokes, as their colours are bright or brown; and between the firſt ſtrokes other ſmaller muſt be joined, which is called interlining. Velvet and pluſh are expreſſed in the ſame manner, and ſhould always be interlined. Metals, as armour, &c. are alſo repreſented by interlining, or by clear ſingle ſtrokes. In architecture, the ſtrokes which form the rounding object ſhould tend to the point of ſight; and when whole columns occur, it is proper to produce the effect as much as poſſible by perpendicular ſtrokes. If a groſs ſtroke is put, it ſhould be at right angles, and wider and thinner than the firſt ſtroke. In engraving mountains, the ſtrokes ought to be frequently diſcontinued and broken, for ſharp and craggy objects; and they ſhould be ſtraight, in the lozenge manner, and accompanied with long points or dots; and rocks ſhould be repreſented by croſs ſtrokes more ſquare and even. Objects that are diſtant towards the horizon ſhould be kept very tender, and ſlightly charged with black. Waters that are calm and ſtill are beſt repreſented by ſtrokes that are ſtraight, and parallel to the horizon, interlined with thoſe that are finer; omitting ſuch places as, in conſequence of gleams of light, exhibit the ſhining appearance of water; and the form of objects reflected from the water, at a ſmall diſtance upon it, or on the banks of the water, are expreſſed by the ſame ſtrokes, retouched more ſtrongly or faintly as occaſion may require, and even by ſome that are perpendicular. For agitated waters, as the waves of the ſea, the firſt ſtrokes ſhould follow the figure of the waves, and may be interlined, and the croſs ſtrokes ought to be very lozenge. In caſcades, the ſtrokes ſhould follow the fall, and be interlined. In engraving clouds, the graver ſhould ſport when they appear thick and agitated, in turning every way according to their form and their agitation. If the clouds are dark, ſo that two ſtrokes are neceſſary, they ſhould be croſſed more lozenge than the figures, and the ſecond ſtrokes ſhould be rather wider than the firſt. The flat clouds, that are loſt inſenſibly in the clear ſky, ſhould be made by ſtrokes parallel to the horizon, and a little waving; if ſecond ſtrokes are required, they ſhould be more or leſs lozenge; and when they are brought to the extremity, the hand ſhould be ſo lightened, that they may form no outline. The flat and clear ſky is repreſented by parallel and ſtraight ſtrokes, without the leaſt turning. In landſcapes, the trees, rocks, earth, and herbage, ſhould be etched as much as poſſible; nothing ſhould be left for the graver but perfecting, ſoftening, and ſtrengthening. The dry point produces an effect more delicate than the graver can, and may be

ufed to great advantage in linen, fkies, diftances, ice, and often in water, efpecially in fmall engravings. In moft things it is proper to etch the fhadows, only leaving the lighter tints for the dry point, graver, &c.

To imitate *chalk-drawings*, a mixture of varied and irregular dots are ufed, made more or lefs foft, fo as to refemble the grain produced by the chalks on paper. Every ftroke of the chalks on paper may be confidered as an infinite number of adjoining points, which are the fmall eminences of the grain of the paper touched by the chalk in paffing over it. When the copper-plate has been polifhed and varnifhed, or properly prepared, as in the common method of engraving, the drawing to be imitated may be counterproved on the varnifh of the plate. If this cannot be conveniently done, black lead pencil, or red chalk, muft be applied to varnifhed or oiled paper; and by means of this chalk or pencil, all the traces of the original will be tranfmitted to the varnifh. The outlines of the object muft be formed in the etching by points, whofe magnitude and diftance muft be determined by the quality of the ftrokes in the original drawing. The artift may be provided with pointed inftruments or needles of various fizes with fingle or double points. In forming the light and fhade, he fhould diftinguifh between thofe hatches which ferve to exprefs the perfpective of the object and thofe which form the ground of it. The principal hatches fhould be more ftrongly marked; the middle tints, if etched, fhould be marked lightly, or they may be left till the varnifh is taken off, and be perfected with a greater degree of foftnefs, by needles or the point of the graver, as the original may require. There is nothing peculiar in the method of applying the aquafortis in this kind of engraving; but it may be obferved, that it fhould not be left fo long as to corrode the lighter parts too much: if the light parts are fufficiently corroded, they may be ftopped out with turpentine varnifh and lamp-black mixed together, and the aquafortis may be applied again to the ftronger parts; for it will be no detriment to them, if the points which compofe the fhade burft into one another, provided the extreme be avoided. When the work of the aquafortis is finifhed, and the varnifh taken off the copper, it will be neceffary in the fofteft parts, fuch as the flefh, &c. to interftipple with proper points; as an effect will be thus produced more delicate than it is poffible to attain with the aquafortis only; and the ftrongeft fhades will require additional ftrength to be given them with fmall ftrokes of the graver. Drawings made with chalks of different colours may be imitated in this manner, if a plate be provided for every colour. This method of engraving is intended to form a kind of deception, fo that the connoiffeur may not be able, on the firft infpection, to diftinguifh between the orignal drawing and the engraving made in imitation of it; and it is extremely ufeful, as it ferves to multiply copies of drawings left by thofe mafters who excelled in the ufe of chalks, and thus to form and improve young artifts, who could not have accefs to the originals in the practice of drawing.

Engraving *upon Glafs*, or, more properly, *Etching* on glafs, is performed exactly by the fame procefs as in etching on copper, only employing the *fluoric* inftead of the nitrous acid. See Chemistry, page 425.

Engraving *on Precious Stones*, is the reprefenting of figures, or devices, in relievo or indented, on divers kinds of hard polifhed ftones. The art of engraving on precious ftones is one of thofe wherein the ancients excelled; there being divers antique agates, carnelians, and onyxes, which furpafs any thing of that kind the moderns have produced. Pyrgoteles among the Greeks, and Diofcorides under the firft emperors of Rome, are the moft eminent engravers we read of: the former was fo efteemed by Alexander, that he forbad any body elfe to engrave his head; and Auguftus's head, engraven by the latter, was deemed fo beautiful, that the fucceeding emperors chofe it for their feal.

All the polite arts having been buried under the ruins of the Roman empire, the art of engraving on ftones met with the fame fate. It was retrieved in Italy at the beginning of the 15th century, when one John of Florence, and after him Dominic of Milan, performed works of this kind no way to be defpifed. From that time, fuch fculptures became common enough in Europe, and particularly in Germany, whence great numbers were fent into other countries: but they came fhort of the beauty of thofe of the ancients, efpecially thofe on precious ftones; for, as to thofe on cryftal, the Germans, and, after their example, the French, &c. have fucceeded very well.

In this branch of engraving, they make ufe either of the diamond or of emery. The diamond, which is the hardeft of all ftones, is only cut by itfelf, or with its own matter. The firft thing to be done in this branch of engraving is, to cement two rough diamonds to the ends of two fticks big enough to hold them fteady in the hand, and to rub or grind them againft each other till they be brought to the form defired. The duft or powder that is rubbed off ferves afterwards to polifh them, which is performed with a kind of mill that turns a wheel of foft iron. The diamond is fixed in a brafs difh; and, thus applied to the wheel, is covered with diamond duft, mixed up with oil of olives; and when the diamond is to be cut facetwife, they apply firft one face, then another, to the wheel. Rubies, fapphires, and topazes, are cut and formed the fame way on a copper wheel, and polifhed with tripoli diluted in water. As to agates, amethyfts, emeralds, hyacinths, granites, rubies, and others of the fofter ftones, they are cut on a leaden wheel moiftened with emery and water, and polifhed with tripoli on a pewter wheel. Lapis-lazuli, opal, &c. are polifhed on a wooden wheel. To fafhion and engrave vafes of agate, cryftal, lapis-lazuli, or the like, they make ufe of a kind of lathe, like that ufed by pewterers, to hold the veffels, which are to be wrought with proper tools. The engraver's lathe generally holds the tools, which are turned by a wheel; and the veffel is held to them to be cut and engraved, either in relievo or otherwife; the tools being moiftened from time to time with diamond duft and oil, or at leaft emery and water. To engrave figures or devices on any of thefe ftones, when polifhed, fuch as medals, feals, &c. they ufe a little iron wheel, the ends of whofe axis are received within two pieces of iron, placed upright, as in the turner's lathe; and to be brought clofer, or fet further apart, at pleafure; at one end of the axis are fitted the proper tools, being kept tight by a fcrew. Laftly, The wheel is turned by the foot, and the ftone applied by the hand to the tool, and is fhifted and conducted as occafion requires.

The tools are generally of iron, and fometimes of brafs; their form is various, but it generally bears fome refemblance to chifels, gouges, &c. Some have fmall round heads, like buttons, others like ferrels, to take the pieces out, and others flat, &c. When the ftone has been engraven, it is polifhed on wheels of hair-brufhes and tripoli.

Engraving *on Steel* is chiefly employed in cutting feals, punches, matrices, and dies, proper for ftriking coins, medals, and counters. The method of engraving with the inftruments, &c. is the fame for coins as for medals and counters: all the difference confifts in their greater or lefs relievo; the relievo of coins being much lefs confiderable than that of medals, and that of counters ftill lefs than that of coins. Engravers in fteel commonly begin with punches, which are in relievo, and ferve for making the creux or cavities of the matrices and dies: though fometimes they begin with the creux or hollownefs; but then it is only when the intended work is to be cut very fhallow. The firft thing done, is that of defigning the figures;

the next is the moulding them in wax, of the ſize and depth they are to lie, and from this wax the punch is engraven. When the punch is finiſhed, they give it a very high temper, that it may the better bear the blows of the hammer with which it is ſtruck to give the impreſſion to the matrice. The ſteel is made hot to ſoften it, that it may the more readily take the impreſſion of the punch; and after ſtriking the punch on it in this ſtate, they proceed to touch up or finiſh the ſtrokes and lines, where by reaſon of their fineneſs or the too great relievo they are any thing defective, with ſteel gravers of different kinds, chiſels, flatters, &c. being the principal inſtruments uſed in graving on ſteel. The figure being thus finiſhed, they proceed to engrave the reſt of the medal, as the mouldings of the border, the engrailed ring, letters, &c. with little ſteel punches, well tempered, and very ſharp.

ENGUICHE, in heraldry, is ſaid of the great mouth of a hunting horn, when its rim is of a different colour from that of the horn itſelf.

ENHARMONIC, in muſic. The Greeks had three different ſpecies of muſic; the *diatonic*, the *chromatic*, and the *enharmonic*. This laſt was eſteemed by much the moſt agreeable and powerful of the three; but the difficulty of its execution rendered its duration ſhort, and latter artiſts were upbraided for having ſacrificed it to their indolence. It proceeded upon leſſer intervals than either the diatonic or chromatic; and as the chromatic ſemitone is ſtill leſs than the diatonic, the *enharmonic* intervals muſt have conſiſted of that ſemitone divided into parts more minute. In Rouſſeau's Muſical Dictionary (at the word *Enharmonique*), the reader may ſee how that interval was found in the tetrachords of the ancients. It is by no means eaſy for modern ears, inured to intervals ſo widely different, to imagine how a piece of muſic, whoſe tranſitions were formed either chiefly or ſolely upon ſuch minute diviſions, could have ſuch wonderful effects; yet the melody of ſpeech, which riſes or falls by intervals ſtill more minute than the enharmonic, when properly modulated and applied with taſte, has an aſtoniſhing power over the ſoul. As to the modern *enharmonic* ſyſtem, we may likewiſe refer the reader to the ſame work for an account of its nature and uſe; though he will find it accurately and clearly explained by D'Alembert.

ENHYDRUS, in natural hiſtory, a genus of ſiderochita or cruſtated ferruginous bodies, formed in large and in great part empty caſes, incloſing a ſmall quantity of an aqueous fluid. Of this genus there are only two ſpecies: 1. The thick-ſhelled enhydrus, with black, reddiſh-brown, and yellow cruſts. 2. The thinner-ſhelled kind, with yellowiſh-brown and purple cruſts; neither of which ferments with aquafortis or gives fire with ſteel.

ENIGMA. See ÆNIGMA.

ENIXUM, among chemiſts, a kind of natural ſalt, generated of an acid and an alkali. The ſal enixum of Paracelſus is the caput mortuum of ſpirits of nitre with oil of vitriol, or what remains in the retort after the diſtillation of this ſpirit; being of a white colour, and pleaſing acid taſte.

ENMANCHE, in heraldry, is when lines are drawn from the centre of the upper edge of the chief to the ſides, to about half the breadth of the chief; ſignifying ſleeved, or reſembling a ſleeve, from the French *manche*.

ENNEAGON, in geometry, a polygon with nine ſides. See POLYGON.

ENNEAHEDRIA, in natural hiſtory, a genus of columnar, cryſtalliform, and double-pointed ſpars, compoſed of a trigonal column, terminated at each end by a trigonal pyramid. Of this genus there are ſeveral ſpecies, diſtinguiſhed by the length or ſhortneſs of the column and pyramids, none of which give fire with ſteel, but all of them ferment with aquafortis. See SPAR.

ENNEANDRIA, in botany, from εννεα *nine*, and ανηρ a *man* or *huſband*, the name of the ninth claſs in Linnæus's ſexual ſyſtem, conſiſting of plants which have hermaphrodite flowers with nine ſtamina or male organs. See BOTANY, p. 40.

ENNIUS (Quintus), an ancient Latin poet, born at Rudii, a town in Calabria. He came firſt to Rome when M. Porcius Cato was queſtor, whom he had inſtructed in the Greek language in Sardinia; and by his genius and behaviour he gained the eſteem of the moſt eminent perſons in the city. According to Horace, Ennius never applied himſelf to writing till he had drunk freely of wine. Hence he contracted the gout, of which he died nine years B. C. He was interred in Scipio's ſepulchre; who had a great eſteem and friendſhip for him, and cauſed a ſtatue to be erected to him upon his monument. He endeavoured to introduce the treaſures of the Greek tongue among the Latins, and was the firſt among the Romans who made uſe of heroic verſes. He wrote the *Annals of Rome*; he tranſlated ſeveral tragedies from the Greek, and wrote others, beſide ſeveral comedies. We have only ſome fragments of his works, which were firſt collected by the two Stephens, and afterwards publiſhed at Naples, with a learned commentary, by Jerom Columna, in quarto, 1590; and reprinted at Amſterdam in 1707, in quarto, with additions by Heſſelius.

ENORMOUS, ſomething exceſſive or monſtrous, eſpecially in bulk. The word is formed of the privative *e*, and *norma*, "rule;" q. d. "void of, or contrary to, rule or meaſure;" *contra normam*. In the corrupt ages of Latinity, they uſed *innormis*, and *inormis*.

In the French juriſprudence, *læſio enormis*, "enormous damage," is that which exceeds half the value of the thing ſold.

ENS, among metaphyſicians, denotes entity, being, or exiſtence: this the ſchools call *ens reale*, and *ens poſitivum*; to diſtinguiſh it from their *ens rationis*, which is only an imaginary thing, or exiſts but in the imagination.

ENS, among chemiſts, imports the power, virtue, and efficacy, which certain ſubſtances exert upon our bodies.

ENS, in geography, a city of Germany, ſituated at the confluence of the Danube and the river Ens, about 80 miles ſouth of Vienna. E. lon. 14. 20. N. lat. 48. 16.

ENSATÆ, in botany, from *enſis*, "a ſword," the name of the ſixth order in Linnæus's natural method, conſiſting of plants with ſword-ſhaped leaves. It contains the following genera, viz. Antholyza, Calliſia, Commelina, Crocus, Eriocaulon, Ferraria, Gladiolus, Iris, Ixia, Moræa, Pontæderia, Siſyrinchium, Tradeſcantia, Wachendorffa, Xyris.

ENSEELED, in falconry, is ſaid of a hawk that has a thread drawn through her upper eye-lid, and made faſt under her beak, to take away the ſight.

ENSEMBLE, a French term, ſometimes uſed in our language; literally ſinifying *together*, or *one with another*: being formed from the Latin *in* and *ſimul*. In architecture, we ſay *the enſemble*, or *tout enſemble*, of a building; meaning the whole work, or compoſition, conſidered together, and not in parts; and ſometimes, alſo, the relative proportion of the parts to the whole. "All thoſe pieces of building make a fine *enſemble*." To judge well of a work, a ſtatue, or other piece of ſculpture, one muſt firſt examine whether the *enſemble* be good. The *tout enſemble* of a painting, is that harmony which reſults from the diſtribution of the ſeveral objects or figures whereof it is compoſed. "This picture is good, taking the parts ſeparately; but the *tout enſemble* is bad."

ENSIFORMIS CARTILAGO. See XIPHOIDES.

ENSIGN, in the military art, the banner or colours under which ſoldiers are ranged, according to the different companies

or parties they belong to. See **Flag, Colours, Standard,** &c. The Turkiſh enſigns are horſes' tails; thoſe of the Europeans are pieces of taffety, with various figures, colours, arms, and devices thereon. Xenophon tells us, that the enſign borne by the Perſians was a golden eagle on a white flag; the Corinthians bore the winged horſe, or Pegaſus, in theirs; the Athenians, an owl; the Meſſenians, the Greek letter M; the Lacedæmonians, the Λ. The Romans had a great diverſity of enſigns; the wolf, minotaur, horſe, boar, and at length the eagle, where they ſtopped: this was firſt aſſumed in the ſecond year of the conſulate of Marius. A military enſign on a medal of a Roman colony, denotes it a colony peopled with old ſoldiers.

Ensign is alſo the officer that carries the colours, being the loweſt commiſſioned officer in a company of foot, ſubordinate to the captain and lieutenant. It is a very honourable and proper poſt for a young gentleman at his firſt coming into the army: he is to carry the colours both in aſſault, day of battle, &c. and ſhould not quit them but with his life: he is always to carry them himſelf on his left ſhoulder: only on a march he may have them carried by a ſerjeant. If the enſign is killed, the captain is to carry the colours in his ſtead.

Naval Ensign, a large ſtandard or banner hoiſted on a long pole erected over the poop, and called the *enſign ſtaff*. The enſign is uſed to diſtinguiſh the ſhips of different nations from each other, as alſo to characteriſe the different ſquadrons of the navy. The Britiſh enſign in ſhips of war is known by a double croſs, viz. that of St. George and St. Andrew, formed upon a field which is either red, white, or blue.

ENSISHEIM, a town of France, in the department of the Upper Rhine, and late province of Alſace, ſeated on the river Ill, 10 miles S. W. of Briſach. E. lon. 7. 30. N. lat. 47. 58.

ENTABLATURE, or Entablement, in architecture, is that part of an order of a column which is over the capital, and comprehends the architrave, frieze, and corniche. See Architecture, page 284.

ENTABLER, in the manege, the fault of a horſe whoſe croupe goes before his ſhoulders in working upon volts; which may be prevented by taking hold of the right rein, keeping your right leg near, and removing your left leg as far from the horſe's ſhoulder as poſſible. This is always accompanied with another fault called *aculer*. See Aculer.

ENTAIL, in law, ſignifies *feetail*, or *fee entailed*; that is, abridged, curtailed, or limited, to certain conditions. See Fee, and Tail.

ENTE', in heraldry, a method of marſhalling, more frequent abroad than with us, and ſignifying grafted or ingrafted. We have, indeed, one inſtance of enté in the fourth grand quarter of his majeſty's royal enſign, whoſe blazon is Brunſwick and Lunenburg impaled with ancient Saxony, *enté en pointé*, "grafted in point."

ENTEROCELE, in ſurgery, a tumour formed by a prolapſion of the inteſtines through the rings of the abdomen and proceſſes of the peritonæum, into the ſcrotum. See Surgery.

ENTHUSIASM, an ecſtacy of the mind, whereby it is led to think and imagine things in a ſublime, ſurpriſing, yet probable manner. This is the enthuſiaſm felt in poetry, oratory, muſic, painting, ſculpture, &c. In a religious ſenſe, it implies a tranſport of the mind, whereby it fancies itſelf inſpired with ſome revelation, impulſe, &c. from heaven. Mr. Locke gives the following deſcription of enthuſiaſm. "In all ages, men in whom melancholy has mixed with devotion, or whoſe conceit of themſelves has raiſed them into an opinion of a great familiarity with God, and a nearer admittance to his favour than is afforded to others, have often flattered themſelves with a perſuaſion of an immediate intercourſe with the Deity, and frequent communications from the Divine Spirit. Their minds being thus prepared, whatever groundleſs opinion comes to ſettle itſelf ſtrongly upon their fancies, is an illumination from the Spirit of God. And whatſoever odd action they find in themſelves a ſtrong inclination to do, that impulſe is concluded to be a call or direction from heaven, and muſt be obeyed. It is a commiſſion from above, and they cannot err in executing it. This I take to be properly enthuſiaſm, which, though ariſing from the conceit of a warm and overweening brain, works, when it once gets footing, more powerfully on the perſuaſions and actions of men, than either reaſon or revelation, or both together; men being moſt forwardly obedient to the impulſes they receive from themſelves." Devotion, when it does not lie under the check of reaſon, is apt to degenerate into enthuſiaſm. When the mind finds itſelf inflamed with devotion, it is apt to think that it is not of its own kindling, but blown up with ſomething divine within it. If the mind indulges this thought too far, and humours the growing paſſion, it at laſt flings itſelf into imaginary raptures and ecſtacies; and when once it fancies itſelf under the influence of a divine impulſe, no wonder if it ſlights human ordinances, and refuſes to comply with the eſtabliſhed form of religion, as thinking itſelf directed by a much ſuperior guide.

ENTHUSIAST, a perſon poſſeſſed with enthuſiaſm. See the preceding article.

ENTHYMEME, in logic and rhetoric, an argument conſiſting only of two propoſitions, an antecedent, and a conſequent deduced from it. The word is Greek ενθυμημα, formed of the verb ενθυμεισθαι, "to think, conceive," a compound of εν and θυμος, "mind." The enthymeme is the moſt ſimple and elegant of all argumentations; being what a man, in arguing cloſely, commonly makes, without attending at all to the form. Thus, that verſe remaining of Ovid's tragedy, intitled *Medea*, contains an enthymeme; *Servare potui, perdere an poſſum rogas*: "I was able to ſave you; conſequently to have deſtroyed you." All the beauty would have been loſt, had all the propoſitions been expreſſed; the mind is diſpleaſed with a rehearſal of what is no ways neceſſary. Sometimes, alſo, the two propoſitions of an enthymeme are both included in a ſingle propoſition, which Ariſtotle calls an *enthymematical ſentence*, and gives this inſtance thereof: *Mortal, do not bear an immortal hatred.* The whole enthymeme would be, *Thou art mortal; let not, therefore, thy hatred be immortal.*

ENTITY, the ſame with Ens.

ENTOMOLOGY;

THAT part of the ſcience of zoology which treats excluſively of inſects.

Some natural hiſtorians conſider this claſs of animals the moſt imperfect of any, while others prefer them to the larger animals. One mark of their imperfection is ſaid to be, that many of them can live a long time, though deprived of thoſe organs

which are neceſſary to life in the higher ranks of nature. Many of them are furniſhed with lungs and an heart, like the nobler animals; yet the caterpillar continues to live, thought its heart and lungs, which is often the caſe, are entirely eaten away. It is not, however, from their conformation alone that inſects are inferior to other animals, but from their inſtincts alſo. It is true, that the ant and the bee preſent us with ſtriking inſtances of aſſiduity; yet even theſe are inferior to the marks of ſagacity diſplayed by the larger animals. A bee taken from the ſwarm is totally helpleſs and inactive, incapable of giving the ſmalleſt variations to its inſtincts. It has but one ſingle method of operating; and if put from that, it can turn to no other. In the purſuits of the hound, there is ſomething like choice; but in the labours of the bee, the whole appears like neceſſity and compulſion. All other animals are capable of ſome degree of education; their inſtincts may be ſuppreſſed or altered; the dog may be taught to fetch and carry, the bird to whiſtle a tune, and the ſerpent to dance: but the inſect has only one invariable method of operating; no arts can turn it from its inſtincts; and indeed its life is too ſhort for inſtruction, as a ſingle ſeaſon often terminates its exiſtence. Their amazing number is alſo an imperfection. It is a rule that obtains through all nature, that the nobler animals are ſlowly produced, and that nature acts with a kind of dignified economy; but the meaner births are laviſhed in profuſion, and thouſands are brought forth merely to ſupply the neceſſities of the more favourite part of the creation. Of all productions in nature, inſects are by far the moſt numerous. The vegetables which cover the ſurface of the earth bear no proportion to the multitudes of inſects; and though, at firſt ſight, herbs of the field ſeem to be the parts of organized nature produced in the greateſt abundance, yet, upon more minute inſpection, we find every plant ſupporting a mixture of ſcarce perceptible creatures, that fill up the compaſs of youth, vigour, and age, in the ſpace of a few days exiſtence. In Lapland, and ſome parts of America, the inſects are ſo numerous, that if a candle is lighted they ſwarm about it in ſuch multitudes, that it is inſtantly extinguiſhed by them; and in thoſe parts of the world, the miſerable inhabitants are forced to ſmear their bodies and faces with tar, or ſome other unctuous compoſition, to protect them from the ſtings of their minute opponents.

Swammerdam however argues for the perfection of inſects in the following manner. "After an attentive examination (ſays he) of the nature and anatomy of the ſmalleſt as well as the largeſt animals, I cannot help allowing the leaſt an equal, or perhaps a ſuperior, degree of dignity. If, while we diſſect with care the larger animals, we are filled with wonder at the elegant diſpoſition of their parts, to what an height is our aſtoniſhment raiſed, when we diſcover all theſe parts arranged, in the leaſt, in the ſame regular manner! Notwithſtanding the ſmallneſs of ants, nothing hinders our preferring them to the largeſt animals, if we conſider either their unwearied diligence, their wonderful powers, or their inimitable propenſity to labour. Their amazing love to their young is ſtill more unparalleled among the larger claſſes. They not only daily carry them to ſuch places as may afford them food, but if by accident they are killed, and even cut into pieces, they will with the utmoſt tenderneſs carry them away piecemeal in their arms. Who can ſhow ſuch an example among the larger animals which are dignified with the title of *perfect?* Who can find an inſtance in any other creature that can come in competition with this?"

On this diſpute it is only neceſſary to obſerve, that the wiſdom of the Creator is ſo conſpicuous in all his works, and ſuch ſurpriſing art is diſcovered in the mechaniſm of the body of every creature, that it is very difficult, if not impoſſible, to ſay where it is moſt, and where it is leaſt, to be perceived.

Thoſe who are deſirous of attaining a ſyſtematic knowledge of inſects, ought primarily to be ſolicitous about acquiring the terms made uſe of in the ſcience, that ſo he may be able rightly to denominate every part of an inſect. The ſtudent is firſt to know what an inſect is, leſt he miſtake hippocampi, and other amphibious animals, for them, as was formerly done; or confound them with the *vermes*, which Linnæus firſt diſtinguiſhed from inſects, and which differ as eſſentially from them as the claſs mammalia do from birds. Every inſect is furniſhed with a head, antennæ, and feet, of all which the vermes are deſtitute. All inſects have ſix or more feet; they reſpire through pores placed on the ſides of their bodies, and which are termed *ſpiracula:* their ſkin is extremely hard, and ſerves them inſtead of bones, of which they have internally none. From this definition, the acus marina is evidently no inſect. But the antennæ placed on the fore-part of the head conſtitute the principal diſtinction. Theſe are jointed and moveable in every part, in which they differ from the horns of other animals: they are organs conveying ſome kind of ſenſe; but we have no more idea of what this kind of ſenſe is, than a man has, who, without eyes, attempts to determine the particular action of the rays of light on the retina of the eye, or to explain the changes which from thence take place in the human mind. That they are the organs of ſome kind of ſenſe, is apparent from their perpetually moving them forward; yet the hard cruſt with which they are inveſted, and their ſhortneſs in flies and other inſects, would induce one to believe them not to be the organs of touch: Mr. Barbut ſuppoſes them to conſtitute or to contain the organs of hearing. That they are tubular, and filled with air and ſome kind of humour, appears from the antennæ of butterflies immerſed in water.—To come now to the terms of the art. A knowledge of the external parts of the body is firſt to be eſtabliſhed; which, after the method of anatomiſts, we may divide into head, trunk, abdomen, and extremities.

Sect. I. *Of the External Parts of the Body.*

I. CAPUT, the Head. It is aſſerted in the *Fundamenta Entomologiæ*, that this part in inſects is without brain. The difference between the brain and ſpinal marrow conſiſts in the former being a medullary part organized. We do not deny the exiſtence of a medullary thread in the heads of inſects, but we never could diſcover it to be organized: hence the hippoboſca equina, or horſe fly, will live, run, nay even copulate, after being deprived of its head; to ſay nothing of many others which are capable of living a long while under the ſame circumſtances.

Inſects not being apparently furniſhed with ears, they have been apprehended incapable of hearing; as we can no more conceive that ſenſe to exiſt without ears than viſion without eyes. That they are nevertheleſs ſuſceptible of any ſhrill or loud noiſe, as well as fiſhes, is indiſputable; but it has been ſuppoſed to be in a manner different from that of hearing. Mr. Barbut, however, ſuppoſes them to poſſeſs this ſenſe in a very diſtinct manner. Many inſects, he obſerves, are well known to be endowed with the power of uttering ſounds, ſuch as large beetles, the bee, waſp, common fly, gnat, &c. The ſphinx atropos ſqueaks, when hurt, nearly as loud as a mouſe. Now, if inſects are endowed with the power of uttering ſounds, it certainly muſt be for ſome purpoſe. As they vary their cry occaſionally, it muſt certainly be deſigned either to give notice of pleaſure or pain, or ſome affection in the creature who poſſeſſes it. "The knowledge of their ſounds (ſays our author) is undoubtedly confined to their tribe, and is a language intelligible to them only; ſaving when violence obliges the animal to exert the voice of nature in diſtreſs, craving compaſſion; then all animals underſtand the doleful cry. For inſtance, attack a bee or waſp near the hive or neſt, or a few of them: the conſe-

quence of that assault will be, the animal or animals, by a different tone of voice, will exprefs his or their disapprobation or pain; that found is known to the hive to be plaintive, and that their brother or brethren require their affiftance; and the offending party feldom efcapes with impunity. Now, if they had not the fenfe of hearing, they could not have known the danger their brother or brethren were in by the alteration of their tone."

A ftill more decifive proof occurred to his obfervation in a large fpider in St. James's Park. This creature had made a very large web on a wooden railing; and was, at the time of obfervation, on one of the rails at a confiderable diftance from the place where a large fly had entangled itfelf. Neverthelefs, the moment the fly was entangled, the fpider became fenfible of it; though, from the fituation of the rail, he could not poffibly have feen it. In this, however, Mr. Barbut might poffibly be deceived; becaufe the fpider was perhaps alarmed by the tremulous motion of the threads, occafioned by the fluttering of the fly; which he might well know how to diftinguifh from their vibration by the wind. The organ of hearing, in our author's opinion, is fituated in the antennæ; both from their fituation in the part of the head moft favourable to fuch organs, and their inward ftructure being moveable; the ears of the moft inferior animals being fo. He has never confidered the antennæ as either offenfive or defenfive, but has obferved them to have been endowed with an exquifite fenfe of feeling; that the animal appeared to be in agony when its antennæ were pinched; and that it takes care to avoid the touching any hard fubftance with them roughly. "This tendernefs in the organ of hearing (fays he) is common to all animals; and infects feem to be particularly tender in thefe parts by quickly withdrawing them from the touch."

This writer further obferves, that the antennæ of all infects are compofed of joints varying in fize, form, and number. Thofe who are chiefly confined to live under water have their antennæ in general fhorter than thofe who live on land. Some who roam at large in the air, have them long and flender. They are all hollow, and are rendered flexible by the joints, which are very vifible in the horns of the crab and lobfter. This hollownefs, in our author's opinion, is to receive the found communicated to the extremities of the antennæ by the repercuffion of the air affected by any noife, and convey it, by means of the joints, from one to another, till it arrives in that leffened degree of tone beft fuited to the timid nature of the animal. In this circumftance there may be many variations in point of perfection in thofe organs; the ftrength, utility, and degree of power in receiving found being proportioned to the neceffities of the animals, different in their nature and requifites. In moft animals, the entrance to the auricular organ is patulous; but in this cafe the animal would fuffer great inconvenience from fuch an organization, as the orifice would be fubject to impediments from dirt, &c.

Moft naturalifts are in doubt whether they have the fenfe of fmell, no organ being found in them adapted to that purpofe: and although it was evident they had a perception of agreeable and fetid effluvia, it was thought to be in a manner altogether unknown to us. Mr. Barbut is of opinion that the organs of fmell refide in the palpi or feelers. Many infects have four and fome fix, two of which are in general cheliform, in order to affift the infect in conveying its food to its mouth. It may be likewife obferved, that the palpi are in continual motion; the animal thrufting them into every kind of putrid or other matter, as a hog would do his nofe, fmelling and fearching after food. Infects which apparently do not poffefs palpi or fpiral tongues, have undoubtedly fome organ concealed within the mouth analogous to them in function and utility; the flefhy probofcis of the fly is thruft into every fubftance in which the animal expects to find food; and when it is extended, nearly in the middle are fituated, in our author's opinion, two upright palpi, which, no doubt, perform in their turn fome office, and perhaps that of fmell.

Many infects are without the tongue, nor do they make any found with their mouths; but for this purpofe fome ufe their feet, others their wings, and others fome elaftic inftrument with which they are naturally furnifhed.

EYES. Moft infects have two eyes; but the gyrinus has four, the fcorpion fix, the fpider eight, and the fcolopendra three. They have no eye-brows, but the external tunic of the eye is hard and tranfparent like a watch-glafs; their eyes have no external motion, unlefs it be in the crab. They confift for the moft part of one lens only; but in thofe of the butterfly, dipteræ, and many of the beetles, they are more numerous. Pugett difcovered 17,325 lenfes in the cornea of a butterfly, and Lieuwenhoek 800 in a fly.

ANTENNÆ. The number of thefe is generally two (unlefs four are allowed to fome kind of crabs), and placed on the forepart of the head: they are peculiar to infects; and are plainly diftinguifhable from the tentaculæ of the vermes, in being cruftaceous; and from the palpi of infects, which are more numerous, placed near the mouth, and are fometimes wanting. As the antennæ are of great moment in diftinguifhing the various kinds of infects, we fhall enumerate and explain the feveral different forms of them.

Setaceæ, are thofe which grow gradually taper towards the extremity—*Filiformes*, fuch as are of the fame thicknefs throughout—*Moniliformes*, are filiform, like the preceding, but confift of a feries of round knobs, like a necklace of beads—*Clavatæ*, fuch as gradually increafe in fize toward the extremity—*Capitatæ*, are *clavatæ*, but have the extremity fomewhat round—*Fiffiles*, are *capitatæ*; but have the capitulum, or knob, divided longitudinally into three or four parts, or laminæ, as in the fcarabæi—*Perfoliatæ*, are alfo *capitatæ*; but have the capitulum horizontally divided, as in the dermeftes—*Pectinatæ*, fo called from their fimilitude to a comb, though they more properly refemble a feather, as in the moths and elateres: this is moft obvious in the male—*Ariftatæ*, fuch as have a lateral hair, which is either naked or furnifhed with leffer hairs, as in the fly; *breviores*, thofe which are fhorter than the body; *longiores*, thofe which are longer than the body; *mediocres*, thofe which are of the fame length with the body; all three of which varieties are diftinguifhable in the cerambyces.

PALPI, or *Feelers*, refemble filiform, articulated, moveable antennæ. They are moft commonly four in number, fometimes fix; they are fufficiently diftinguifhed from antennæ, in being naked, fhort, and always placed at the mouth.

OS, the *Mouth*, is generally placed in the anterior part of the head, extending fomewhat downwards. In fome infects, it is placed under the breaft, as in the chermes, coccus, cancer (crab), and curculio.

ROSTRUM, or *Probofcis*, is the mouth drawn out to a rigid point: in many of the hemiptera clafs it is bent downward toward the breaft and belly, as in the cicada, nepa, notonecta, cimex (bug), aphis, and remarkably fo in fome curculiones.

MAXILLÆ, the *Jaws*, are two in number, fometimes four, and at other times more; they are placed horizontally; the inner edge of them in fome infects is ferrated or furnifhed with little teeth.

LINGUA, the *Tongue*, in fome infects is taper and fpiral, as in the butterfly; in others it is flefhy, refembling a probofcis, and tubular, as in the fly.

LABIUM *fuperius*, the *upper Lip*, is fituated above the jaws; as in the fcarabæus and gryllus.

STEMMATA, or *Crown*, are three fmooth hemifpheric dots, placed generally on the top of the head; as in moft of the hymenoptera, and others.

II. TRUNCUS, the TRUNK, is that part which comprehends the breaft or thorax: it is fituated between the head and

abdomen; and has the legs inferted into it, that its parts may be diftinctly determined. It is divided into *thorax*, *fcutellum*, and *fternum*.

Thorax, the *Cheft*, is the back part of the breaft; and is very various in its fhape. It is called *dentatus*, when its fides are armed with points; *fpinofus*, when its back is furnifhed with them, as in the cerambyx; and *marginatus*, when its margin is laterally dilated, as in the filpha and caffida.

Scutellum, or *Efcutcheon*, is the pofterior part of the thorax: it is frequently triangular; and appears to be divided from the thorax by an intervening future, as in moft of the coleoptera.

Sternum, the *Sternum*, is fituated on the inferior part of the thorax; it is pointed behind in the elateres, and bifid in fome of the dytifci.

III. ABDOMEN: the Abdomen is in moft infects diftinct from the thorax; it is the pofterior part of the body of the infect; and is compofed of a number of annular fegments, which ferve occafionally to lengthen or fhorten it, and to contain the organs of chylification, &c.

Spiracula, are little holes or pores, placed fingly on each fide of every fegment of the abdomen: through thefe the infect breathes; and if oil be applied fo as to ftop them up, it proves fatal to moft of them.

Tergum, the *Back*, is the fuperior part of the abdomen.

Venter, the *Belly*, is the inferior part.

Anus, is the pofterior part of the abdomen, perforated for the evacuation of the excrement. This part alfo frequently contains the organs of generation.

IV. ARTUS, the Limbs or Extremities, are the various inftruments of motion.

Pedes, the *Legs*, are generally fix. There is an exception to this, however, in the clafs Aptera, many of which have eight; as acari (mites), phalangii, moft of the aranei (fpiders), fcorpiones (fcorpions), and cancri (crabs). The onifcus has 14, and the iuli and fcolopendri ftill more.

The firft joint of the leg, which is generally thickeft, is called *femur*; the fecond, which is generally of the fame fize throughout, *tibia*; the third, which is jointed, is diftinguifhed by the name of *tarfus*; and the laft, which in moft infects is double, by that of *unguis*. The legs of infects, in general, are named from the various motions they produce: *curforii*, from that of running, which are the moft numerous; *faltatorii*, from that of leaping; *natatorii*, from that of fwimming, &c.—In the *faltatorii*, the thighs are remarkably large, by which means they are able to leap to a confiderable diftance, as in the gryllus, grafshopper, &c. In thofe of the *Natatorii*, the feet are flat, and edged with hairs, which anfwer the purpofe of oars in affifting them to fwim, as in the dytifcus.—*Mutici*, are fuch feet as have no claws.—*Chelæ*, or claws, are the fore-feet enlarged towards their extremities, each of which is furnifhed with two leffer claws, which act like a thumb and finger; as in the crab.

Alæ, *Wings*, the inftruments which enable the infect to fly. Thefe are membranous and undivided, except in the inftance of the phalænæ alucitæ, in which they are in part divided. Moft infects have four; the diptera clafs, and the coccus, however, have two only.

The wing is divided into its fuperior and inferior furfaces: its anterior part in a butterfly, is that towards the anterior margin, or next to the head; its pofterior part, that towards the anus; its exterior part, that towards the outer edge; and the interior, that next the abdomen.

They are called *Plicatiles*, when they are folded at the time the infect is at reft, as in the wafp: oppofite to thefe are the *planæ*, which are incapable of being folded—*Erectæ*, fuch as have their fuperior furfaces brought in contact when the infect is at reft; as in the ephemera, libellula puella and virgo, and papiliones (butterflies)—*Patentes*, which remain horizontally extended when the infect is at reft; as in the phalænæ geometræ, and moft of the libellulæ—*Incumbentes*, fuch as cover horizontally the fuperior part of the abdomen when the infect is at reft—*Deflexæ*, are incumbentes, but not horizontally, the outer edges declining toward the fides—*Reverfæ*, are deflexæ, with this addition, that the edge of the inferior wings projects from under the anterior part of the fuperior ones—*Dentatæ*, in which the edge is ferrated, or fcolloped—*Caudatæ*, in which one or more projections in the hinder wings are extended into proceffes—*Reticulatæ*, when the veffels of the wings put on the appearance of network, as in the hemerobius perla; the two anterior wings generally become fuperior, and the pofterior ones inferior, in moths, when their wings are clofed; but the anterior wings are called *primary*; and the inferior ones *fecondary*, in butterflies, as they cannot with propriety be called *inferior* when the wings are erect.

Colores, the colours; thefe are various and apparent: but according to their feveral fhapes, they take the different names of *punctæ*, dots; *maculæ*, fpots; *fafciæ*, bands, which frequently run acrofs and fometimes furround the edge of the wings; *ftrigæ*, ftreaks, which are very flender fafciæ; and *lineæ*, lines, which are longitudinally extended—*Ocellus*, is a round fpot, containing a leffer fpot of a different colour in its centre—*Stigmata*, another term lately introduced by Linnæus, fignifies the fpot, or anaftamofis, in the middle of the wing near the anterior margin; it is confpicuous in moft of the hymenoptera and neuroptera, and even in the coleoptera. The fingle or double kidney-fhaped fpot, fituated in the fame part of the anterior wings, and frequently occurring in the phalænæ paganæ, is diftinguifhed likewife by the name of *ftigma*.

Elytra (in the fingular number *elytron*). The upper wings, which are of a hard fubftance, in fome degree refembling leather, and which in moft infects are of a very hard texture, but in others flexible, are called *elytra*: their fuperior furface is generally convex, their inferior one concave. When the infect flies, they are extended; and fhut when it refts, clofing together, and forming a longitudinal future down the middle of the back, as in the coleoptera. They are of various fhapes. *Abbreviata*, when fhorter than the abdomen. *Truncata*, when fhorter than the abdomen, and terminating in a tranfverfe line. *Faftigiata*, when of equal or greater length than the abdomen, and terminating in a tranfverfe line. *Serrata*, when the exterior margin towards the apex is notched or ferrated, as in fome of the bupreftes. *Spinofa*, when their furface is covered with fharp points or prickles. *Scabra*, when their furface is fo uneven as to grate againft the fingers. *Striata*, when marked with flender longitudinal furrows. *Porcata*, when with elevated longitudinal fulci or ridges. *Sulcata*, when thefe ridges are concave. *Hemelytra*, when the fuperior wings are of a middle fubftance between leather and membrane; either totally fo, as in the grylli; or partially fo, as in the cimices, nepæ, and notonectæ: Thefe are commonly diftinguifhed by the name *hemiptera*.

Halteres, poifers (a term alfo introduced by Linnæus), are little heads placed on a ftalk or peduncle, moft frequently under a little arched fcale. They are found only in the clafs diptera, and appear to be nothing more than the rudiments of the hinder wings.

Cauda, the *Tail*, in moft infects is,—*Simplex*, fimple, capable of being extended, and again drawn back at pleafure. In the crab and fcorpion, however, it is—*Elongata*, elongated or lengthened out—*Setacea*, briftle-fhaped, or taper; as in the raphidea—*Trifeta*, confifting of three briftles; as in the ephemera—*Furcata*, being forked, as in the podura—*Forcipata*, refembling a pair of forceps; as in the forficula—*Foliofa*, re-

fembling a leaf; as in the blatta, grylli, and fome fpecies of cancri—*Telifera*, fuch as are armed with a dart or fting; as in the fcorpion and panorpa.

Aculeus, the fting, an inftrument with which they wound, and at the fame time inftil a poifon: with fuch the bee, wafp, fcorpion, &c. are furnifhed.

Explanation *of* Plate 13.

Fig. 1. Antennæ pectinatæ, or feathered; as in the *phalænæ*, moths.

2. Antennæ perfoliatæ, or perfoliated; as in the *dermeftes* and *dytifcus*.

3. ——— fissiles, or fiffile, divided into laminæ at the extremity, as in the *fcarabæi*, beetles.

4. ——— clavatæ, or club-fhaped, as in the *papilio*, butterfly.

5. moniliformes, like a necklace of beads; as in the *chryfomela*.

6. ———setaceæ, fetaceous, or briftle-fhaped; as in many of the *phalænæ*.

7. ——— aristatæ, furnifhed with a lateral hair, as in the *fly*.

8, 9. *a* Caput, the head. *b* Palpi, or feelers. *c* Antennæ, or horns. *d* Oculi, the eyes. *e* Thorax. *f* Scutellum, or efcutcheon. *g* Pectus, or breaft. *h* Sternum, or breaft-bone. *i* Abdomen, and its fegments. *k* Anus. *l* Elytra, or fhells. *m* Membranous wings. *n* Pedes, or feet, which are natatorii.

10. *o* Femur, or thigh. *p* Tibia, or leg. *q* Tarfus, or foot. *r* Unguis, or claw.

11. *a* The anterior part of the wing. *b* The pofterior part. *c* The exterior part. *d* The interior part. *e* The margin. *f* The difk, or middle. *g* Oculus, or eye.

12, 13, 14, 15, Reprefent the infect in its egg, caterpillar, pupa, and perfect ftate.

Sect. II. *Of the Sexes of Infects.*

In infects the fame difference of fex exifts as in other animals, and they even appear more difpofed to increafe their fpecies than other animals; many of them, when become perfect, feeming to be created for no other purpofe but to propagate their fpecies. Thus the filk-worm, when it arrives at its perfect or moth-ftate, is capable of eating, and can hardly fly; it endeavours only to propagate its fpecies; after which the male immediately dies, and, as foon as fhe has depofited her eggs, the female alfo expires.

The males and females of many infects are with difficulty diftinguifhed; whilft in fome, they differ fo widely, that an unfkilful perfon might eafily take the male and female of the fame infect for different fpecies; as for inftance, in the phalæna humuli, piniaria, ruffula; each fex of which differs in colour. This unlikenefs is ftill more apparent in fome infects, in which the male has wings and the female none; as in the coccus, lampyris, phalæna antiqua, brumata, lichenella. And as moft infects remain a long while in copulation, as we may fee in the tipula and filk-worm, the winged males fly with the winglefs females, and carry them about from one place to another; as in the phalæna antiqua. It is, however, no certain rule, that when one infect of the fame fpecies is found to have wings, and the other to be without, the former muft neceffarily be the male, and the latter the female. The aphides, for inftance, are an exception; and befides thefe, individuals of both fexes, and of the fame fpecies, are found without wings, as the carabi majores, tenebriones, meloes, cimices. The gryllus pedeftris is likewife deftitute of wings; and might have paffed for a gryllus in its pupa ftate, had it not been feen in copulation; for it is well known that no infect can propagate its fpecies till it arrives at its laft or perfect ftate.

"Pleraque infectorum genitalia fua intra anum habent abfcondita, et penes folitarios, fed nonnulla penem habent bifidum: Cancri autem et Aranei geminos, quemadmodum nonnulla amphibia, et quod mirandum in loco alieno, ut Cancer, fub bafi caudæ. *Araneus mas* palpos habet clavatos, qui penes funt, juxta os utrinque unicum, quæ clavæ fexum nec fpeciem diftinguunt; et fœmina vulvas fuas habet in abdomine juxta pectus. Huic vero fi unquam vere dixeris, "*Res plena timoris amor:* fi enim procus in aufpicato accefferit, fœmina ipfum devorat; quod etiam fit, fi non ftatim fe retraxerit. Libellula fœmina genitale fuum fub apice gerit caudæ, et mas fub pectore; adeo ut cum mas collum fœminæ forcipe caudæ arripit, illa caudam fub pectore ejus adplicit, ficque peculiari ratione connexæ volitent."

Befides thofe of male and female, a third fex exifts in fome infects which we call *neuter:* As thefe have not the diftinguifhing parts of either fex, they may be confidered as eunuchs or infertile. We know of no inftance of this kind in any other clafs of animals, nor in vegetables, except in the clafs Syngenefia, and in the Opulus. This kind of fex is only found among thofe infects which form themfelves into focieties, as bees, wafps, and ants: and here thefe kind of eunuchs are real flaves, as on them lies the whole bufinefs of the economy; while thofe of the other fex are idle, only employing themfelves in the increafe of the family. See the article Bees. Among *Ants*, the neuters form a hill in the fhape of a cone, that the water may run off it, and place thofe which are in the pupa ftate on that fide of it which is leaft expofed to the heat of the fun. At a confiderable diftance from thefe are found the habitations of the males and females, to whom the moft ready obedience is yielded by the neuters, till a new offspring fucceeds, and then they oblige them to quit their habitations. But thofe ants which live entirely under ground, provide better for themfelves in this refpect; for a little before their nuptials they quit their habitation of their own accord, and, after fwarming in the manner of bees, copulate in the air; and each retiring to fome new habitation founds a new race.

No *hermaphrodites* have as yet been difcovered among infects. There is fomething very fingular, however, in the propagation of the aphides. A female aphis once impregnated, can produce young, which will continue to produce others without any frefh impregnation, even to the fifth progeny; afterwards a new impregnation muft take place. See Aphis.

The male infects, like male hawks, are always fmaller than the females.

In the propagation of their fpecies they are remarkably careful; fo that it is with the greateft difficulty the flies are kept from depofiting their eggs on frefh meat, the cabbage butterfly from laying them on cabbage, and other infects from depofiting them in the feveral places peculiar to each. The fcarabæus pilularius and carnifex are deferving of our attention, as they afford a mutual affiftance to each other: for when the female has laid her eggs in a little ball of dung, the males with their feet, which are axiform, affift the female to roll it to fome fuitable place; as Ariftotle and Pliny formerly, and Loefling has fince remarked.

A fact not a little wonderful is, that in the coccus and onifcus, the female has no fooner brought forth her young, than fhe is devoured by it; and that the fphex fhould be able fo readily to kill the caterpillar of a moth, then bury it in the earth, and there depofit her eggs in it. Nor can we without admiration behold the fame fpecies of aphis, which was viviparous in the fummer, become oviparous in the autumn.

Almoſt innumerable examples might be brought of the ſingularities in the eggs of inſects: we ſhall, however, only mention thoſe of the hemerobius, which are depoſited on a footſtalk; thoſe of the phalæna neuſtria, which are placed regularly in a ring round the branch of ſome tree; and the compound eggs of the blatta or cock roach.

SECT. III. *Of the Metamorphoſes of Inſects.*

EXCEPT thoſe of the aptera claſs, there are no inſects but what are continually undergoing ſome transformation. They change firſt from the (ovum) egg, into the (larva) caterpillar or maggot; then into the (pupa) chryſalis; and laſtly into the (imago) fly or perfect ſtate. During each of thoſe changes, their appearance differs moſt eſſentially. The inſect, as ſoon as it came out of the egg, was by former entomologiſts called *eruca*; but as this is ſynonymous with the botanic name *ſiſymbrium*, it was changed by Linnæus for the term

Larva; a name expreſſive of the inſect's being, in this ſtate, as it were maſked, having its true appearance concealed. Under this maſk or ſkin the entire inſect, ſuch as it afterwards appears when perfect, lies concealed, inveloped only in its tender wings, and putting on a ſoft and pulpy appearance; inſomuch that Swammerdam was able to demonſtrate the butterfly with its wings to exiſt in a caterpillar, though it bore but a faint reſemblance to its future perfection. The inſect, therefore, in this ſtate, undergoes no other alteration but the change of its ſkin. The larvæ are, for the moſt part, larger than the inſect, when perfect, and are very voracious. The caterpillar of the cabbage-butterfly eats double what it would ſeem to require from its ſize; its growth, however, is not adequate to its voracity.

Pupa. The inſect in this ſtate was formerly called *chryſalis*, or *aurelia*: but as the appearance of gilding is confined to a few butterflies only, the term of *pupa* has been adopted in its ſtead; becauſe the lepidoptera, eſpecially, reſemble an infant in ſwaddling-clothes; and in this ſtate none, except thoſe of the hemiptera claſs, take any nouriſhment.

Imago, is the third ſtate. This name is given by Linnæus to the third change, in which the inſect appears in its proper ſhape and colours; and as it undergoes no more transformations, it is called *perfect*. In this ſtate it flies, is capable of propagating its ſpecies, and receives its true antennæ; which before, in moſt inſects, were ſcarce apparent.

As the ſhape of the pupa is different in different claſſes of inſects, it aſſumes different names; thus it is called

Coarctata, when it is round, and as it were turned, without the leaſt reſemblance of the ſtructure of the inſect; as in the diptera.

Obtecta, when it conſiſts as it were of two parts, one of which ſurrounds the head and thorax, and the other the abdomen.

Incompleta, when they have wings and feet, but are not capable of moving them: as in moſt of the hymenoptera.

Semicompleta, in which they walk or run, but have only the rudiments of wings.

Completa, in which they immediately obtain the perfect form of the inſect, without undergoing any more change: as in thoſe of the aptera claſs, except only the flea. The bed-bug alſo belongs to this claſs.

The ſpider undergoes frequent transformations, though only in the colour of its ſkin. The cruſtaceous inſects, as crabs, lobſters, &c. yearly caſt their ſhells, or their growth would otherwiſe be impeded—The ſcolopendri, when young, have fewer feet than when they are full grown—All inſects, as ſoon as they undergo the third change, are arrived at their full growth; nor do we find any difference in the ſize of the ſame ſpecies of inſect in the ſame countries, unleſs, during its caterpillar ſtate, it has not had a ſufficiency of proper food.

SECT. IV. *Of the Claſſification of Inſects.*

THE inſect tribe being endowed with the various powers of creeping, flying, and ſwimming, there is ſcarce any place, however remote and obſcure, in which they are not to be found. The great confuſion which appeared to the ancients to ariſe from their number, made them never dream of reducing them to any ſyſtem. Swammerdam, that indefatigable inquirer into nature, obſerved that their metamorphoſes were divided by nature into ſeveral ſtates or orders. Their external appearance alſo carried with it ſome mark of diſtinction: ſo that entomologiſts called all thoſe of the coleoptera claſs *Scarabæi* (beetles); thoſe of the lepidoptera *Papiliones*; and thoſe of the gymnoptera claſs that had two wings only, *Muſcæ* (flies); thoſe of the ſame claſs that had four wings, were called *Apes* (bees). No farther progreſs was made in the ſyſtematic part of this ſcience till the time of Linnæus. He was the firſt that undertook to determine the genera, and aſſign them their proper characters, in the *Syſtema Naturæ*; and thus reduced this ſcience to a ſyſtematic form. This ſyſtem, in ſubſequent editions, was conſiderably enriched and amended by him, inſomuch that the ſcience of inſects now ſhines forth in its full luſtre. He it was who firſt inſtituted natural orders, and reduced them into genera by expreſſive names; determined an infinite number of ſpecies in the *Fauna Suecica* and *Muſeum Reginæ*; collected with incredible pains the ſynonymous names of the various authors who had written on them; and, laſtly, added their deſcriptions, and the places in which they were to be found. So that the ſyſtem of this illuſtrious author will lead any perſon, without the aſſiſtance of a maſter, for the moſt part, eaſily to aſcertain the name of any inſect he may meet with. Before his time ſcarce any more than 200 inſects were known; whereas, in the laſt edition of his ſyſtem, he has determined the names of nearly 3000 diſtinct ſpecies; though this is not the ſixth part of the number that is now known.

ORDERS. The claſs of *inſects* is divided by Linnæus into ſeven orders. 1. The *Coleoptera* (from κωλεος *a ſheath*, and πτερον *a wing)*, are ſuch inſects as have cruſtaceous elytra or ſhells, which ſhut together, and form a longitudinal ſuture down the back of the inſect; as the beetle *(bupreſtis ignita)*, fig. 16. plate 13. 2. *Hemiptera* (from ημισυ *half*, and πτερον *a wing)*, have their upper wings uſually half cruſtaceous and half membranaceous, not divided by a longitudinal ſuture, but incumbent on each other; as the cimex, fig. 17. 3. *Lepidoptera* (from λεπις *a ſcale*, and πτερον *a wing*), are inſects having four wings, covered with fine ſcales in the form of powder or meal; as in the butterfly *(papilio antiopa)*, fig. 18. 4. *Neuroptera*, from νευρον *a nerve*, and πτερον *a wing)*, have four membranous tranſparent naked wings, generally like network: as in the *panorpa coa*, fig. 19. 5. *Hymenoptera* (from υμην *a membrane*, and πτερον *a wing)*, are inſects with four membranous wings; tail furniſhed with a ſting; as in the *tenthredo*, fig. 20. 6. *Diptera* (from δυω *two*, and πτερον *a wing)*, are ſuch as have only two wings, and poiſers; as in the fly *(muſca)*, fig. 21. 7. *Aptera* (from α *without*, and πτερον *a wing)*, inſects having no wings. This laſt diviſion contains ſcorpions, ſpiders, crabs, lobſters, &c. See ARANEA, CANCER, &c.

GENERA. It is not neceſſary to inſert here the characters of all the different genera which may be found in Linnæus's Syſt. Nat. It will be ſufficient to enumerate ſome new genera mentioned by ſubſequent ſyſtematic writers; ſo that, by being acquainted with the ſubtile diſtinctions on which they are built, the ſtudent may avoid running into confuſion. It is among the moderns only that genera of this kind are to be met with, and

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new names given them. To remove this difficulty, we ſhall firſt enumerate thoſe names adopted by authors, which are ſynonymous with thoſe of Linnæus.

New GENERA *of Authors ſynonymous with thoſe of Linnæus.*

In this account we ſhall diſtinguiſh the names of other authors by italics. Thus Lucanus has been named *Platyceros*—Hiſter, *Attelabus*—Byrrhus, *Anthrenus ciſtela*—Mylabris, *Laria* Scop. —Attelabus, *Clerus*—Silpha, *Peltis*—Bruchus, *Mylabris*—Ptinus, *Byrrhus*—Chryſomela, *Galericula*—Hiſpa, *Crioſeris*—Cantharis, *Cicindela*—Bupreſtis, *Cucujus*—Carabus, *Bupreſtis*—Myrmeleon, *Formica-leo*—Sirex, *Uroceros.*

New GENERA *of Authors.*

Copris; Scarabæus abſque ſcutello—*Boſtricius*; Dermeſtes capecinus—*Ciſtela*; Byrrhus pilula—*Rhinomancer*; Attelabus roſtro producto fere curculionis—*Anthribus*; Silpha—*Bruchus*; Ptinus Fur ob ſpinas thoracis—*Melolontha*; Chryſomela cylindrica—*Altica*; Chryſomela ſaltatoria—*Diaperis*; Chryſomela fungorum—*Pyrochora*; Cantharis—*Telephorus*; Cantharis—*Cantharis*; Meloë alata—*Cerocoma*: Meloë ſhafferi—*Notaxis*; Meloë monoceros—*Prionus*; Cerambyx thoracis margine denticulato—*Stenocoris*; Leptura thorace ſpinoſa—*Hydrophilus*; Dytiſcus antennis clavatis—*Mylabris*; Necydalis minor—*Acridium*; Gryllus muticus—*Locuſta*; Gryllus tettigonia—*Tettigonia*; Cicada—*Corixa*; Notonecta—*Naucoceris*; Nepa—*Perla*; Hemerobius cauda biſecta—*Libelluloides*; Myrmeleon antennis capitatis—*Crabro*; Tenthredo antennis clavatis—*Pterophorus*; Phalæna alucita—*Bibio*; Tipula thorace ſpinoſo—*Stomoxoides*; Aſilus bucca inflata—*Stratiomymus*; Muſca—*Nemotelus*; Muſca —*Volucella*; Muſca.

Theſe genera appear to be in a great meaſure like thoſe which were introduced into botany by the followers of Rivinus. Paying too little regard to nature, they diſunited natural genera, on account of the moſt trifling diſtinctions. This made their continuance in the ſcience of very ſhort duration. Our buſineſs here is not to ſuppoſe, but to examine, what nature will allow of, and what ſhe will not. Knowledge of this kind, built on opinion only, will not ſtand. We are therefore to look into the ſcience with great accuracy; and the larva of the inſect, its manner of changing, and other things of moment, are to be known, before we preſume to form a new genus.

Coining of new names, and changing of one old one for another, has been the ſource of the greateſt confuſion. Thus, in order to reduce the cicindela and carabus to the ſame genus, *bupreſtis* has been adopted for the generic name; but as that genus had long ago received a very different application, it was changed for that of *cucujus*. Again, that the officinal cantharides might be ranged among the cerambyces, the cantharides have been removed from the genus of meloë (to which they naturally belong), and referred to the genus of cicindela, obtaining thus a new name. And ſo of many others. Thus alſo, to mention no more, how needleſs and raſh was it to ſeparate the acridium and locuſta from the genus of gryllus, the crabro from the tenthredines, and the mylabris from the necydalis!

TRIVIAL NAMES. The trivial names placed under their reſpective genera will occaſion little or no controverſy; they are current like money, and of the ſame utility as the proper names of men, Peter or Paul, &c. Inſects living on vegetables ſhould receive their names from the particular plants on which they moſtly feed, as that method is preferable to all others. Thus the names of the *phalæna mori*, &c. are excellent; and when we are able to give ſuch to inſects, the old ones are to be diſcarded. But we are to be cautious of not being too haſty in our judgment in this reſpect; as inſects, when they cannot get their favourite food, will often eat other plants. Thus the ſilk-worm, for want of mulberry leaves, will eat thoſe of lettuce, though it will not be ſo well nouriſhed by them.

Various other inſtances of the invention of trivial names will be met with in the *Syſtema Naturæ*, particularly among the butterflies and moths. To prevent confuſion from the great number of ſpecies which conſtitute the genus of phalæna, they are diſtributed into ſections, and diſtinguiſhed by the terms of *bombyces, noctuæ, geometræ, tortrices, pyralides, tineæ*, and *alucitæ*. The bombyces, and noctuæ, which are ſo much alike, that the females of the bombyces are with great difficulty diſtinguiſhed from the noctuæ, are named in a promiſcuous manner.

All thoſe of the geometræ have their names terminating in *aria* and *ata*, according as their antennæ are ſetaceous or pectinated. The tortrices, in *aria*; the pyralides, in *alis*; the tineæ, in *ella*; and the alucitæ, in *dactyla*: ſo that it is evident from the termination itſelf to what ſection the inſect is to be referred. It were to be wiſhed that ſimilar inſtitutions could be formed throughout the whole ſcience, as here the name itſelf ſerves to diſtinguiſh the inſect.

Butterflies are divided into ſections, by the names of *Equites, Heliconii, Danai, Nymphales*, and *Plebeii*. In ſuch a multitude of butterflies, the greateſt part of which are foreign and extra European, and to whoſe food and manner of life we are utter ſtrangers, it was impoſſible to give ſignificant trivial names. Linnæus, therefore, by way of ſimile, has taken the names of the *Equites* from the Trojan hiſtory. Theſe conſiſt, as it were, of two troops or bodies; of which one contains the ſable, and as it were mourning nobles, having red or bloody ſpots at the baſis of their wings. Theſe receive names from the Trojan nobles; and as Priam was king of Troy, the moſt ſplendid among theſe bear his name. The other body, ornamented with a variety of gay colours, are diſtinguiſhed by the names of the Grecian heroes; and as in both armies there were kings as well as officers of an inferior rank, thoſe elegant butterflies, whoſe hinder wings reſembled tails, were diſtinguiſhed by ſome royal name. Thus when Paris is mentioned (knowing from hiſtory that he was a Trojan, and of royal blood), we find him among thoſe of the firſt ſection; that is, thoſe of a ſable colour, ſpotted in the breaſt with red, and having their hinder-wings reſembling tails. When Agamemnon is named, we remember him to be a noble Greek, and find him among thoſe nobles which have variegated and ſwallow-tailed wings. But when Nereus is ſpoken of, we readily know him to belong to the laſt ſection, having wings but no tails.

The ſecond claſs, which contains the *Heliconii*, derive their names from the muſes, as Urania. The names of the ſons and daughters of Danaus are beſtowed on the third ſection. And as theſe ſpecies are ſubdivided into two other ſections, viz. the white and parti-coloured, the metaphor is ſo conducted, that the white ones preſerve the names of the daughters of Danaus, and the parti-coloured ones thoſe of the ſons of Egyptus: ſo that it is evident from the name itſelf to what ſection the butterfly is to be referred.

The names of the fourth ſection, *Nymphales*, are taken from various nymphs of antiquity; and thoſe of the fifth ſection, *Plebeii*, are ſelected from different men among the ancients whoſe names are worthy of remembrance: ſo that by this means a knowledge of the ancients may be interſperſed, and this agreeable ſcience be made doubly pleaſing. Thoſe, therefore, who may find new lepidoptera, and give them new names, will do well to follow this method, unleſs it be apparent what food the inſect chiefly prefers for its ſubſiſtence.

ENTREPAS, in the manege, a broken pace or going, that is neither walk nor trot, but has ſomewhat of an amble. This is a pace or gait of ſuch horſes as have no reins or back, and go upon their ſhoulders; or, of ſuch as are ſpoiled in their limbs.

ENTRING-LADDERS, in a ſhip, are of two ſorts; one uſed by the veſſel's ſides, in a harbour, or in fair weather, for perſons to go in and out of the ſhip: the other is made of ropes, with ſmall ſtaves for ſteps; and is hung out of the gallery to enter into the boat, or to come aboard the ſhip, when the ſea runs ſo high that they durſt not bring the boat to the ſhip's ſide for fear of ſtaving it.

ENTROCHUS, in natural hiſtory, a genus of extraneous foſſils, uſually of about an inch in length, and made up of a number of round joints, which when ſeparate and looſe are called *trochitæ*: they are compoſed of the ſame kind of plated ſpar with the foſſil ſhells of the echini, which is uſually of a blueiſh-grey colour, and very bright where freſh-broken; they are all ſtriated from the centre to the circumference, and have a cavity in the middle. See Plate 2. The entrochi are found of all ſizes, from that of a pin's head to a finger's length, and the thickneſs of one's middle finger; and are plainly of marine origin, having often ſea-ſhells adhering to them. They ſeem to be the petrified arms of that ſingular ſpecies of the ſea ſtar-fiſh, called *ſtella arboreſcens*.

ENTRY, in law, ſignifies taking poſſeſſion of lands or tenements, where a perſon has a right ſo to do.

Bill of ENTRY, in commerce. See BILL. In making entries inwards, it is uſual for merchants to include all the goods they have on board the ſame ſhip in one bill, though ſometimes they may happen to be upwards of 20 ſeveral kinds: and in caſe the goods are ſhort entered, additional or poſt entries are now allowed; though formerly the goods, ſo entered, were forfeited. As to bills of entry outwards, or including goods to be exported, upon delivering them, and paying the cuſtoms, you will receive a ſmall piece of parchment called a *cocket*, which teſtifies your payment thereof, and all duties for ſuch goods. If ſeveral ſorts of goods are exported at once, of which ſome are free, and others pay cuſtoms; the exporter muſt have two cockets, and therefore muſt make two entries; one for the goods that pay, and the other for the goods that do not pay cuſtom. Entries of goods, on which a drawback is allowed, muſt likewiſe contain the name of the ſhip in which the goods were imported, the importer's name, and time of entry inwards. The entry being thus made, and an oath taken that the cuſtoms for thoſe goods were paid as the law directs, you muſt carry it to the collector and comptroller, or their deputies; who, after examining their books, will grant a warrant, which muſt be given to the ſurveyor, ſearcher, or land-waiter, for them to certify the quantity of goods; after which the certificate muſt be brought back to the collector and comptroller, or their deputies, and oath made that the ſaid goods are really ſhipped, and not landed again in any part of Great Britain.

ENVELOPE, in fortification, a work of earth, ſometimes in form of a ſimple parapet, and at others like a ſmall rampart with a parapet: it is raiſed ſometimes on the ditch, and ſometimes beyond it.

ENVIRONNE, in heraldry, ſignifies ſurrounded with other things: thus, they ſay, a lion environné with ſo many bezants. See BEZANT.

ENUMERATION, in rhetoric, a part of peroration; in which the orator, collecting the ſcattered heads of what has been delivered throughout the whole, makes a brief and artful relation or recapitulation thereof.

ENVOY, a perſon deputed to negotiate ſome affair with any foreign prince or ſtate. Thoſe ſent from the courts of Britain, France, Spain, &c. to any petty prince or ſtate, ſuch as the princes of Germany, the republics of Venice, Genoa, &c. go in quality of envoys, not ambaſſadors; and ſuch a character only do thoſe perſons bear, who go from any of the principal courts of Europe to another, when the affair they go upon is not very ſolemn or important. There are envoys ordinary and extraordinary, as well as ambaſſadors; they are equally under the protection of the law of nations, and enjoy all the privileges of ambaſſadors; only differing from them in this, that the ſame ceremonies are not performed to them.

ENVY, in ethics; pain felt, and maliguity conceived at the ſight of excellence or happineſs in another. See EMULATION.

EON, or ÆON. See ÆON.

EONIANS, in church hiſtory, the followers of Eon, a wild fanatic of the province of Bretagne, in the 12th century, whoſe brain was diſordered. He concluded from the reſemblance between *eum*, in the form for exorciſing malignant ſpirits, viz. *Per eum, qui venturus eſt judicare vivos & mortuos*, and his own name Eon, that he was the ſon of God, and ordained to judge the quick and the dead. Eon, however, was ſolemnly condemned by the council at Rheims in 1148, at which Pope Eugenius III. preſided, and ended his days in a miſerable priſon. He left behind him a number of followers and adherents, whom perſecution and death ſo weakly and cruelly employed could not perſuade to abandon his cauſe, or to renounce an abſurdity which, ſays Moſheim, one would think could never have gained credit but in ſuch a place as Bedlam.

EORIA, in mythology, a feaſt celebrated by the Athenians in honour of Erigonus, who, by way of puniſhment, for their not avenging the death of his father Icarus, engaged the gods to inflict the curſe on their daughters, that they ſhould love men who never returned their paſſion. The feaſt was inſtituted by the order of Apollo.

EOSTRE, in mythology, a Saxon goddeſs to whom they ſacrificed in the month of April, called the month of *Eoſtra*; and thence the name *Eaſter*, which the Saxons retained after their converſion to Chriſtianity, applying it to the feſtival celebrated in commemoration of our Saviour's reſurrection.

EPACRIS, in botany; a genus of the monogynia order, belonging to the pentandria claſs of plants. The calyx is a five-parted perianthium; the corolla monopetalous and tubular; the ſtamina five very ſhort filaments; the pericarpium a roundiſh, depreſſed, quinquelocular, quinquevalvular, gaping capſule; the ſeeds are numerous and very ſmall.

EPACTS, in chronology, the exceſſes of the ſolar month above the lunar ſynodical month, and of the ſolar year above the lunar year of twelve ſynodical months; or of ſeveral ſolar months above as many ſynodical months, and ſeveral ſolar years above as many dozen of ſynodical months. The epacts, then, are either *annual* or *menſtrual*. Menſtrual epacts are the exceſſes of the civil or calendar month above the lunar month. Suppoſe, *e. g.* it were new moon on the firſt day of January; ſince the lunar month is 29 days 12 h. 44′ 3″, and the month of January contains 31 days, the menſtrual epact is 1 day 11 h. 15′ 57″. Annual epacts are the exceſſes of the ſolar year above lunar. Hence, as the Julian ſolar year is 365 days 6 h. and the Julian lunar year 354 days 8 h. 48′ 38″, the annual epact will be 10 days 21 h. 11′ 22″; that is, nearly 11 days. Conſequently the epact of 2 years is 22 days; of 3 years, 33 days; or rather 3, ſince 30 days make an *emboliſmic* or intercalary month. Thus the epact of 4 years is 14 days, and ſo of the reſt; and thus, every 19th year, the epact becomes 30 or 0; conſequently the 20th year the epact is 11 again; and ſo the cycle of epacts expires with the golden number, or lunar cycle of 19 years, and begins with the ſame, as in the following table:

Gold. Numb.	Epacts.	Gold. Numb.	Epacts.	Gold. Numb.	Epacts.
1	XI	7	XVII	13	XXIII
2	XXII	8	XXVIII	14	IV
3	III	9	IX	15	XV
4	XIV	10	XX	16	XXVI
5	XXV	11	I	17	VIII
6	VI	12	XII	18	XIX
				19	XXX

Again, as the new moons are the fame, that is, as they fall on the fame day every 19 years, fo the difference between the lunar and folar years is the fame every 19 years. And becaufe the faid difference is always to be added to the lunar year, in order to adjuft or make it equal to the folar year; hence the faid difference refpectively belonging to each year of the moon's cycle is called the *epact of the faid year*, that is, the number to be added to the faid year, to make it equal to the folar year; the word being formed from the Greek επαγω, *induco, intercalo*.

Upon this mutual refpect between the cycle of the moon and the cycle of the epacts, is founded this rule for finding the Julian epact, belonging to any year of the moon's cycle. Multiply the year given of the moon's cycle into 11; and if the product be lefs than 30, it is the epact fought; if the product be greater divide it by 30, and the remainder of the dividend is the epact. For inftance, I would know the epact for the year 1712, which is the third year of the moon's cycle. Wherefore 3 is the epact for 1712; for $11 \times 3 = 33$, and 33 being divided by 30, there is left 3 of the dividend for the epact. But the difference of the Julian and Gregorian years being equal to the excefs of the folar above the lunar year, or 11 days, it happens that the Gregorian epact for one year is the fame with the Julian epact for the preceding year.

EPAMINONDAS, a celebrated Theban, the fon of Polymnus, and one of the greateft captains of antiquity. He learned philofophy and mufic under Lyfis, a Pythagorean philofopher; and was from his infancy inured to all the exercifes of body and mind. He was learned, generous, well-fkilled in war, brave, modeft, and prudent; and had fuch a regard for truth, that he would not tell a falfehood even in jeft. He ferved firft under the Lacedemonians; faved the life of Pelopidas their chief, who received in a battle feven or eight wounds; and contracted a ftrict friendfhip with that general, which lafted till his death. At his perfuafions, Pelopidas delivered the city of Thebes from the yoke of the Spartans, who had rendered themfelves mafters of Cadmea, which occafioned a bloody war between the two nations. Epaminondas was made general of the Thebans; on which he gained the celebrated battle of Leuctra, in which Cleombrotus, the valiant king of Sparta, was killed. He then ravaged the enemy's country, and caufed the city of Meffina to be rebuilt and peopled. At length, the command of the army was given to another, becaufe Epaminondas had kept his troops in the field four months longer than he had been ordered by the people; but, inftead of retiring in difguft, he now ferved as a common foldier, and diftinguifhed himfelf by fo many brave actions, that the Thebans, afhamed of having undefervedly deprived him of the command, reftored him to his poft, in order to carry the war into Theffaly, where his arms were always victorious. A war breaking out between the Elians and the inhabitants of Mantinea, the Thebans took the part of the former. Epaminondas then refolved to endeavour to furprife Sparta and Mantinea; but not fucceeding, he gave the enemy battle, in which he received a mortal wound with a javelin, the bearded iron remaining in the wound. Knowing that it could not be drawn out without occafioning immediate death, he would not fuffer it to be touched, but continued to give his orders: and on his being told, that the enemy were entirely defeated, "I have lived long enough (he cried), fince I die without being conquered;" and at the fame time he plucked the javelin from his wound, and expired, 363 B. C.

EPANALEPSIS. See ORATORY.

EPANODOS. *Ibid.*

EPANORTHOSIS. *Ibid.*

EPARER, in the manege, fignifies the flinging of a horfe, or his yerking and ftriking with his hind-legs.

EPAULEMENT, in fortification, a work raifed to cover fidewife, is either of earth, gabions, or fafcines loaded with earth. The epaulements of the places of arms for the cavalry, at the entrance of the trenches, are generally of fafcines mixed with earth.

EPAULETTES, are a kind of fhoulder-knots worn by officers in the army. They are of various figures according to the cuftom of each regiment. They are fometimes made of embroidery; but more commonly of lace.

EPENTHESIS, in grammar, the interpofition or infertion of a letter or fyllable in the middle of a word; as *alituum*, for *alitum*; *relligio*, for *religio*; *induperator*, for *imperator*, &c.

EPEUS, of the line of Endymion, the inventor of the battering ram, an engine of great fervice in fieges to make a breach. He is thought to have built the Trojan horfe, and to have founded the city Metaphontum.

EPHA, or EPHAH, in Jewifh antiquity, a meafure for things dry, equal to 3 pecks and 3 pints.

EPHEBÆUM, in antiquity, the place where the ephebi or youth exercifed; or, as fome fay, where thofe who defigned to exercife met, and agreed what kind of exercife they fhould contend in, and what fhould be the victor's reward.

EPHEBI, among the Athenians, a defignation given to their young men when they arrived at 18 years of age, at which time they had their names entered in a public regifter.

EPHEDRA, in botany, a genus of the monadelphia order, belonging to the diœcia clafs of plants; and in the natural method ranking under the 51ft order, *Coniferæ*. The male calyx is bifid; there is no corolla, but feven ftamina; four antheræ inferior; three fuperior. The female calyx is bipartite, and five-fold, upon one another; there is no corolla; there are two piftils, and two feeds covered by the calyx, refembling a berry.

EPHEMERA, from ημερα, "a day;" a diary fever, or a fever of one day's continuance only. In this cafe, fuch a heat as attends an excefs of wine, a pulfe fomewhat full and quick, but foft and regular, a flight head-ach, a naufea, and reftleffnefs, are all the fymptoms, and which terminate without any fenfible evacuation. If it continue unto the third day, it is not a diary fever; and if the conftitution is very irritable, an hectic is to be dreaded.

EPHEMERA, the *Day-fly*, in zoology, a genus belonging to the order of neuroptera. It has no teeth or palpæ; there are two large protuberances above the eyes; the wings are erect, the two hind ones being largeft; and the tail is briftly. Thefe flies take their name from the fhortnefs of their life, and are diftinguifhed into feveral fpecies. Some live feveral days, others do not take flight till the fetting of the fun, and live not to fee the rifing of that luminary. Some exift but one hour, others but half that time; in which fhort period they comply with the call of nature. With refpect to thofe that live feveral days, Mr. Barbut obferves there is a peculiarity incident to themfelves alone. They have to caft off one flough more, an operation which fometimes takes 24 hours to complete. To bring this about, they cling faft to a tree. The ephemeræ, before they flutter in air, have in fome manner been fifhes. They remain in the ftates of larva and chryfalis (fee pl. 2.) for one, two, or three years. The chryfalis only differs from the larva

by there being obſervable on its back, caſes for wings. Both have on their ſides ſmall fringes of hair, which, when put into motion, ſerve them as fins. Nothing can be more curious than the plying of thoſe little oars in the water. Their abdomen is terminated, as well as in their ſtate of flies, by three threads. Theſe larvæ ſcoop themſelves out dwellings in the banks of rivers; and they are ſmall tubes made like ſiphons, the one ſerving for an entrance, the other affording them an outlet. The banks of ſome rivers are often perforated with them. When the waters decreaſe, they dig freſh holes lower down, in order to enjoy their element the water. The ſeaſon and hour when the chryſalids of the different ſpecies of the ephemeræ turn into flies, maintain a kind of regularity. The heat, the riſe or fall of the waters, accelerate, however, or poſtpone their final diſplay. The ephemera of the Rhine appear in the air two hours before ſunſet. Theſe flies are hatched almoſt all at the ſame inſtant in ſuch numbers as to darken the air. The moſt early of thoſe on the Marne and Seine in France do not begin to fly till two hours after the ſetting of the ſun, towards the middle of Auguſt. They are ſeen fluttering and ſporting on the brink of their tomb. The glare of light attracts them, round which they perform a thouſand circles with amazing regularity. Their coming together for the purpoſe of generation can only be ſurmiſed, the ſhortneſs of their life requiring that all its functions ſhould be proportionable to their duration. Some naturaliſts have been of opinion, that the males impregnate the eggs after the manner of fiſhes. The females, by the help of the threads of their tail and the flapping of their wings, ſupport themſelves on the ſurface of the water, and in that almoſt upright ſituation drop their eggs in cluſters. One ſingle female will lay 700 or 800 eggs, which ſink to the bottom. The larvæ that eſcape from the voraciouſneſs of the fiſhes, ſet about the conſtruction of habitations to ſhelter them from every kind of danger. When the flies have propagated, they are ſeen to die and fall by heaps. The land and water are ſtrewed with them to a conſiderable thickneſs. The fiſhermen conſider theſe multitudes of deſtroyed inſects as manna for the fiſhes.

EPHEMERIDES, in aſtronomy, tables calculated by aſtronomers, ſhowing the preſent ſtate of the heavens for every day at noon; that is, the places wherein all the planets are found at that time. It is from theſe tables that the eclipſes, conjunctions, and aſpects of the planets, are determined; horoſcopes or celeſtial ſchemes conſtructed, &c. We have ephemerides of Origan, Kepler, Argoli, Heckerus, Mezzaracchis, Wing, De la Hire, Parker, &c. S. Caſſini has calculated ephemerides of the ſidera medicæa or ſatellites of Jupiter, which are of much uſe in determining the longitude.

In England, the Nautical Almanac, or Aſtronomical Ephemeris, publiſhed annually by anticipation, under the direction of the commiſſioners of longitude, is the moſt conſiderable. In France, celeſtial ephemerides have been publiſhed by M. Deſplaces every ten years, from 1715 to 1745: they were afterwards continued by the Abbé Caille, with many additions; of which an account may be ſeen in the Hiſtory of the Academy of Sciences for 1743. The Academy of Sciences have likewiſe publiſhed annually, from the beginning of the preſent century, a kind of ephemeris, under the title of *Connoiſſance des Tems*. Theſe publications however have been interrupted by the revolutionary ſtruggles in that country.

EPHESUS, an ancient and celebrated town of Turkey in Aſia, in that part of Natolia anciently called Ionia. It is now called Ajaſalouc, and has ſtill many remains of its ancient ſplendour. There is nothing to be ſeen about it but heaps of marble, overturned walls, columns, capitals, and pieces of ſtatues, heaped one upon another. The fortreſs, which is upon an eminence, ſeems to be the work of the Greek emperors. The eaſtern gate has three baſſo-relievos, taken from ſome ancient monuments: that in the middle was conſtructed by the Romans. The moſt remarkable ſtructure of all was the temple of Diana, which the ancient Chriſtians had turned into a church; but it is now ſo entirely ruined, that it is no eaſy matter to find the ground-plot: however, there are ſome ruins of the walls, and of five or ſix marble columns, all of a piece, 40 feet in length, and ſeven in diameter. It is ſeated near a gulf of the ſame name, and has ſtill a good harbour, 40 miles S. of Smyrna. E. long. 27. 33. N. lat. 37. 48.

EPHETÆ, from ἐφίημι, "I ſend forth," in antiquity, a ſort of magiſtrates among the Athenians, inſtituted by king Demophoon, to take cognizance of murder, man-ſlaughter, and chance-medley. Their number was 100, whereof 50 were Athenians, and 50 Argians: they were not admitted to the poſt till upwards of 50 years of age. Draco new modelled it, excluded the Argians from it, and made it to conſiſt of 51 Athenians, each above 50 years of age: Ubbo Emmius de Rep. Athen. ſays, he transferred to them part of the juriſdiction of the Areopagites. See AREOPAGUS.

EPHOD, in Jewiſh antiquity; one part of the prieſtly habit; being a kind of girdle, which, brought from behind the neck over the two ſhoulders, and hanging down before, was put acroſs the ſtomach, then carried round the waiſt, and made uſe of as a girdle to the tunic. There were two ſorts of ephods, one of plain linen for the prieſts, and the other embroidered for the high prieſt.

EPHORI, in Grecian antiquity, magiſtrates eſtabliſhed in ancient Sparta to balance the regal power. The authority of the ephori was very great. They ſometimes expelled and even put to death the kings, and aboliſhed or ſuſpended the power of the other magiſtrates, calling them to account at pleaſure. There were five of them, others ſay nine. They preſided in the public ſhows and feſtivals. They were entruſted with the public treaſure; made war and peace; and were ſo abſolute, that Ariſtotle makes their government equal to the prerogative of a monarchy. They were eſtabliſhed by Lycurgus, according to the generality of authors: though this is denied by others, who date their origin 130 years after the time of that legiſlator. Thus Plutarch, in his Life of Cleomenes, aſcribes their inſtitution to Theopompus king of Sparta; which is alſo confirmed by the authority of Ariſtotle.

EPHORUS, an orator and hiſtorian of Cumæ in Æolia, about 352 years before Chriſt. He was diſciple to Iſocrates, by whoſe advice he wrote a hiſtory which gave an account of all the actions and battles that had happened between the Greeks and barbarians for 750 years. It was greatly eſteemed by the ancients; but is now loſt.

EPHRATA, a ſmall town of Pennſylvania in America, and the principal ſettlement of the religious ſect called *Dunkards* or *Tunkers*. See TUNKERS.

EPHREM (Syrus), an ancient Chriſtian writer, in the fourth century, deacon of Edeſſa, was born at Niſibe, in Syria. He was greatly eſteemed by St. Baſil, St. Gregory Nyſſen, and other great men. He wrote againſt the opinions of Sabellius, Arius, Apollonarius, the Manichees, &c. and acquired ſuch reputation by his virtue and his works, that he was called the *doctor and the prophet of the Syrians*. He died in 378. The beſt editions of his works are, that of Oxford, in 1708, in folio, and that of Rome, from 1732 to 1736, in Syriac, Greek, and Latin, 6 vols. folio.

EPHYDOR, in antiquity, an officer in the Athenian courts of juſtice, who was to provide the plaintiff and defendant with equal water hour-glaſſes. When the glaſs was run out, they were not permitted to ſpeak any farther; and, therefore, we find them very careful not to loſe or miſpend one drop of their water. Whilſt the laws quoted by them were reciting, or if any other buſineſs happened to intervene, they gave orders that the glaſs ſhould be ſtopped.

EPIBATÆ, Επιβάται, among the Greeks, marines or ſol-

diers who ſerved on board the ſhips of war. They were armed in the ſame manner as the land-forces, only that more of them wore full or heavy armour.

EPIBATERION, a poetical compoſition, in uſe among the ancient Greeks. When any perſon of condition and quality returned home after a long abſence or journey into another country, he called together his friends and fellow-citizens, and made them a ſpeech, or rehearſed them a copy of verſes, wherein he returned ſolemn thanks to the immortal gods for his happy return; and ended with an addreſs by way of compliment to his fellow-citizens. Theſe verſes made what the Greeks call ἐπιβατήριον, *epibaterium*, of ἐπιβαίνω, "I go abroad." At going away they had another, called *apobaterium*.

EPIBATERIUM, in botany: a genus of the hexandria order, belonging to the monœcia claſs of plants. In the male flowers the calyx is a double perianthium, the outward one with ſix leaves, very ſmall; the inner one three-leaved, and three times larger than the former, with egg-ſhaped leaves. The corolla has ſix petals ſmaller than the interior calyx and roundiſh. The ſtamina are ſix capillary filaments, crooked, and as long as the petals; the antheræ are roundiſh. The female flowers are on the ſame plant. The calyx and corolla are as in the male. The pericarpium conſiſts of three roundiſh, monoſpermous plums; the ſeed a kidney-ſhaped compreſſed nut, ſomewhat furrowed.

EPIC, or HEROIC, *Poem*, a poem expreſſed in narration, formed upon a ſtory partly real and partly feigned; repreſenting, in a ſublime ſtyle, ſome ſignal and fortunate action, diſtinguiſhed by a variety of great events, to form the morals, and affect the mind with the love of heroic virtue. We may diſtinguiſh three parts of the definition, namely, the matter, the form, and the end. The matter includes the action of the fable, under which are ranged the incidents, epiſodes, characters, morals, and machinery. The form comprehends the way or manner of the narration, whether by the poet himſelf, or by any perſons introduced, whoſe diſcourſes are related: to this branch likewiſe belong the moving of the paſſions, the deſcriptions, diſcourſes, ſentiments, thoughts, ſtyle, and verſification; and beſides theſe, the ſimilies, tropes, figures, and, in ſhort, all the ornaments and decorations of the poem. The end is to improve our morals and increaſe our virtue. See POETRY.

EPICEDION, formed of ἐπὶ *upon*, and κῆδος *funeral*, in the Greek and Latin poetry, a poem, or poetical compoſition, on the death of a perſon. At the obſequies of any man of figure, there were three kinds of diſcourſes uſually made; that rehearſed at his *buſtum* or funeral pile, was called *nenia*; that engraven on his tomb, *epitaph*; and that ſpoken in the ceremony of his funeral, *epicedion*. We have two beautiful epicedions in Virgil, that of Euryalus and that of Pallas.

EPICEDIUM, in ancient poetry, a poem rehearſed during the funeral ſolemnity of perſons of diſtinction.

EPICHARMUS, an ancient poet and philoſopher, born in Sicily, was a ſcholar of Pythagoras. He is ſaid to have introduced comedy at Syracuſe in the reign of Hiero. Horace commends Plautus for imitating him, in following the chace of the intrigue ſo cloſely as not to give the readers or ſpectators time to trouble themſelves with doubts concerning the diſcovery. He wrote likewiſe treatiſes concerning philoſophy and medicine; but none of his works have been preſerved. He died aged 90, according to Laertius, who has preſerved four verſes inſcribed on his ſtatue.

EPICHIROTONIA, among the Athenians. It was ordained by Solon, that once every year the laws ſhould be carefully reviſed and examined; and if any of them were found unſuitable to the preſent ſtate of affairs, they ſhould be repealed. This was called ἐπιχειροτονία τῶν νόμων, from the manner of giving their ſuffrages by *holding up their hands*. See a farther account of this cuſtom in Pott. Archæol. Græc. lib. 1. cap. 26. tom. i. p. 142.

EPICŒNE, in grammar, a term applied to nouns, which, under the ſame gender and termination, mark indifferently the male and female ſpecies. Such in Latin is *aquila*, *veſpertilio*, &c. which ſignify equally a male or female eagle or bat. Grammarians diſtinguiſh between *epicœne* and *common*. A noun is ſaid to be common of two kinds, when it may be joined either with a maſculine or a feminine article; and epicœne, when it is always joined to ſome one of the two articles, and yet ſignifies both genders.

EPICTETUS, a celebrated Stoic philoſopher, born at Hierapolis in Phrygia, in the firſt century, was the ſlave of Epaphroditus, a freedman and one of Nero's guard. Domitian baniſhing all philoſophers from Rome, about the year 94, Epictetus retired to Nicopolis in Epirus, where he died in a very advanced age; and after his death, the earthen lamp he made uſe of ſold for 3000 drachmas. He was a man of great modeſty; which was eminent in his own practice, as well as in his recommendation to others: Hence he uſed to ſay, "That there is no need of adorning a man's houſe with rich hangings or paintings, ſince the moſt graceful furniture is temperance and modeſty, which are laſting ornaments, and will never be the worſe for wearing." Of all the ancient philoſophers, he ſeems to have made the neareſt approaches to the Chriſtian morality, and to have had the moſt juſt ideas of God and providence. He always poſſeſſed a cool and ſerene mind, unruffled by paſſion; and was uſed to ſay, that the whole of moral philoſophy was included in theſe words, *ſupport* and *abſtain*. One day, his maſter Epaphroditus ſtrove in a frolic to wrench his leg; when Epictetus ſaid, with a ſmile, and free from any emotion, "If you go on, you will certainly break my leg." But the former redoubling his effort, and ſtriking it with all his ſtrength, he at laſt broke the bone; when all the return Epictetus made was, "Did not I tell you, Sir, you would break my leg?" No man was more expert at reducing the rigour of the maxims of the Stoics into practice. He conformed himſelf ſtrictly, both in his diſcourſe and behaviour, to the manners of Socrates and Zeno. He waged continual war with fancy and fortune; and it is an excellence peculiar to himſelf, that he admitted all the ſeverity of the Stoics without their ſourneſs, and reformed Stoiciſm as well as profeſſed it; and beſides his vindicating the immortality of the ſoul as ſtrenuouſly as Socrates or any Stoic of them all, he declared openly againſt ſelf-murder, the lawfulneſs of which was maintained by the reſt of the ſect. Arrian, his diſciple, wrote a long account of his life and death, which is loſt; and preſerved four books of his diſcourſes and his Enchiridion, of which there have been ſeveral editions in Greek and Latin; and, in 1758, a tranſlation of them into Engliſh was publiſhed by the learned and ingenious Miſs Carter.

EPICUREAN PHILOSOPHY, the doctrine or ſyſtem of philoſophy maintained by Epicurus and his followers. His philoſophy conſiſted of three parts; canonical, phyſical, and ethereal. The firſt was about the canons or rules of judging. The cenſure which Tully paſſes upon him for his deſpiſing logic, will hold true only with regard to the logic of the Stoics, which he could not approve of, as being too full of nicety and quirk. Epicurus was not acquainted with the analytical method of diviſion and argumentation, nor was he ſo curious in modes and formation as the Stoics. Soundneſs and ſimplicity of ſenſe, aſſiſted with ſome natural reflections, was all his art. His ſearch after truth proceeded only by the ſenſes; to the evidence of which he gave ſo great a certainty, that he conſidered them as an infallible rule of truth, and termed them the *firſt natural light of mankind*.

In the ſecond part of this philoſophy he laid down atoms, ſpace, and gravity, as the firſt principles of all things: he did

not deny the exiſtence of God, but thought it beneath his majeſty to concern himſelf with human affairs; he held him a bleſſed immortal Being, having no affairs of his own to take care of, and above meddling with thoſe of others.

As to his ethics, he made the ſupreme good of man to conſiſt in pleaſure, and conſequently ſupreme evil in pain. Nature itſelf, ſays he, teaches us this truth; and prompts us from our birth to procure whatever gives us pleaſure, and avoid what gives us pain. To this end he propoſed a remedy againſt the ſharpneſs of pain: this was to divert the mind from it, by turning our whole attention upon the pleaſures we have formerly enjoyed. He held that the wiſe man muſt be happy, as long as he is wiſe: the pain, not depriving him of his wiſdom, cannot deprive him of his happineſs.

There is nothing that has a fairer ſhow of honeſty than the moral doctrine of Epicurus. Gaſſendus pretends, that the pleaſure in which this philoſopher has fixed the ſovereign good, was nothing elſe but the higheſt tranquillity of mind, in conjunction with the moſt perfect health of body: but Tully, Horace, and Plutarch, as well as almoſt all the fathers of the church, give us a very different repreſentation: indeed the nature of this pleaſure, in which the chief happineſs is ſuppoſed to be ſeated, is a grand problem in the morals of Epicurus. Hence there were two kinds of Epicureans, the rigid and the remiſs: the firſt were thoſe who underſtood Epicurus's notion of pleaſure in the beſt ſenſe, and placed all their happineſs in the pure pleaſures of the mind, reſulting from the practice of virtue: the looſe or remiſs Epicureans, taking the words of that philoſopher in a groſs ſenſe, placed all their happineſs in bodily pleaſures or debauchery.

EPICURUS, the greateſt philoſopher of his age, was born at Gargettium in Attica, about 340 B. C. in the 109th Olympiad. He ſettled at Athens in a fine garden he had bought; where he lived with his friends in great tranquillity, and educated a great number of diſciples. They lived all in common with their maſter. The reſpect which his followers paid to his memory is admirable: his ſchool was never divided: but his doctrine was followed as an oracle. He wrote a great many books, and valued himſelf upon making no quotations. He raiſed the atomical ſyſtem to a great reputation, though he was not the inventor of it, but had only made ſome change in that of Democritus. As to his doctrine concerning the ſupreme good or happineſs, it was very liable to be miſrepreſented, and ſome ill effects proceeded from thence, which diſcredited his ſect. He was charged with perverting the worſhip of the gods, and inciting men to debauchery; but he did not forget himſelf on this occaſion: he publiſhed his opinions to the whole world; he wrote ſome books of devotion; recommended the veneration of the gods, ſobriety, and chaſtity; and it is certain that he lived in an exemplary manner, and conformably to the rules of philoſophical wiſdom and frugality. Timocritus, a deſerter of his ſect, ſpoke very ſcandalouſly of him. Gaſſendus has given us all he could collect from the ancients concerning the perſon and doctrine of this philoſopher; who died of a ſuppreſſion of urine, aged 72.

EPICYCLE, in the ancient aſtronomy, a little circle whoſe centre is in the circumference of a greater circle: or it is a ſmall orb or ſphere, which being fixed in the deferent of a planet, is carried along with it; and yet, by his own peculiar motion, carries the planet faſtened to it round its proper centre. It was by means of epicycles that Ptolemy and his followers ſolved the various phenomena of the planets, but more eſpecially their ſtations and retrogradations.

EPICYCLOID, in geometry, a curve generated by the revolution of the periphery of a circle, along the convex or concave ſide of the periphery of another circle.

EPICYEMA, among the ancient phyſicians, denotes a ſuperfetation; or falſe conception ſuppoſed to happen after the birth of a regular fetus.

EPIDEMIA, in Grecian antiquity, feſtivals kept in honour of Apollo and Diana, at the ſtated ſeaſons when thoſe deities, who could not be preſent every where, were ſuppoſed to viſit different places, in order to receive the vows of their adorers.

EPIDEMIC, among phyſicians, denotes thoſe diſeaſes which at certain times are popular, attacking great numbers at or near the ſame time.

EPIDENDRUM, in botany; a genus of the diandria order, belonging to the gynandria claſs of plants; and in the natural method ranking under the ſeventh order, *Orchideæ*. The nectarium is turbinated, oblique, and reflexed. This is the plant which produces the fruit called *vanilla*, and which is uſed in the making of chocolate. It is a native of Mexico, and alſo of ſome parts of the Eaſt Indies. It is a paraſitic plant; the leaves of which greatly reſemble the vine, and are about 18 inches long and three inches broad. The flowers are of a white colour intermixed with ſtripes of red and yellow. When theſe fall off, they are quickly ſucceeded by the pods, which at firſt are green, but afterwards, as they ripen, become yellow, and are gathered for uſe. The pods of the beſt vanilla are long, ſlender, and well filled with ſeeds. If opened when freſh, the cavity of the pod is found to contain a humid ſubſtance that is black, oily, and balſamic, of ſuch a ſtrong ſmell, that it frequently cauſes headachs, and even a ſort of temporary intoxication. The ſeaſon for gathering the pods begins about the latter end of September, and laſts till the end of December. They are dried in the ſhade; and when dry and fit for keeping, they are rubbed externally with a little oil of cocoa or calba, to render them ſupple, or preſerve them the better, and to prevent them from becoming too dry or brittle. The uſe of this fruit is only for perfuming chocolate. In New Spain it is reckoned unwholeſome; and therefore never uſed: but in England and other countries of Europe, it is a conſtant ingredient; and perhaps its noxious qualities may be corrected by the ſea-air. In thoſe countries where they grow, the plants are very eaſily propagated by cuttings. In this country they require to be kept in a ſtove, and alſo to be placed near ſome American tree, round which they may climb for their ſupport.

EPIDERMIS, in anatomy, the cuticle or ſcarf-ſkin. See ANATOMY, page 185. The word is formed of the Greek επι *on, over*, and δερμα *ſkin*.

EPIDICASIA, among the Athenians. Daughters inheriting their parent's eſtate were obliged to marry their neareſt relation; which gave occaſion to perſons of the ſame family to go to law with one another, each pretending to be more nearly allied to the heireſs than the reſt. The ſuit was called επιδικασιας δικη: and the virgin, about whom the relations conteſted, επιδικος.

EPIDIDYMIS, in anatomy, a little round body, on the back of each teſticle; called alſo *paraſtata*. See ANATOMY, p. 208.

EPIGÆA, in botany; a genus of the monogynia order, belonging to the decandria claſs of plants; and in the natural method ranking under the 18th order, *Bicornes*.

EPIDOTÆ, certain deities who preſided over the growth of children. They were worſhipped by the Lacedemonians, and chiefly invoked by thoſe who were perſecuted by the ghoſts of the dead, &c.

EPIGASTRIC REGION, a part or ſubdiviſion of the abdomen. See ANATOMY, page 185.

EPIGLOTTIS, in anatomy, one of the cartilages of the larynx or wind-pipe. See ANATOMY, page 192.

EPIGONI, the ſons and deſcendants of the Grecian heroes who were killed in the firſt Theban war. The war of the Epi-

goni is famous in ancient hiſtory. The deſcendants of the veteran Macedonians, who ſerved under Alexander the Great, and who had children by Aſiatic women, were alſo called *Epigoni*.

EPIGRAM, in poetry, a ſhort poem in verſe, treating only of one thing, and ending with ſome lively, ingenious, and natural thought or point. The word is formed of επιγραμμα *inſcription*, of επιγραφειν *to inſcribe* or *write upon*. Epigrams then, originally, ſignify inſcriptions, and they derive their origin from thoſe inſcriptions placed by the ancients on their tombs, ſtatues, temples, triumphal arches, &c. Theſe, at firſt, were only ſimple monograms: afterwards, increaſing their length, they made them in verſe, to be the more eaſily retained. Herodotus and others have tranſmitted to us ſeveral of them. Such little poems retained the name of epigrams, even after the deſign of their firſt inſtitution was varied, and people began to uſe them for the relation of little facts and incidents, the characterizing of perſons, &c. The point or turn is a quality much inſiſted on by the critics, who require the epigram conſtantly to cloſe with ſomething poignant and unexpected, to which all the reſt of the compoſition is only preparatory; while others, on the contrary, exclude the point, and require the thought to be equally diffuſed throughout the poem, without laying the whole ſtreſs on the cloſe: the former is uſually Martial's practice, and the latter that of Catullus.

The Greek epigrams have ſcarce any thing of the point or briſkneſs of the Latin ones: thoſe collected in the Anthology, have moſt of them a remarkable air of eaſe and ſimplicity, attended with ſomething juſt and witty; ſuch as we find in a ſenſible peaſant, or a child that has wit. They have nothing that bites, but ſomething that tickles. Though they want the ſalt of Martial, yet to a good taſte they are not inſipid; except a few of them, which are quite flat and ſpiritleſs. However, the general faintneſs and delicacy of the pleaſantry in them, has given occaſion for a Greek epigram, or *epigram à la Greque*, to denote, among the French, an epigram void of ſalt or ſharpneſs.

The epigram admits of great variety of ſubjects: ſome are made to praiſe, and others to ſatirize; which laſt are much the eaſieſt, ill-nature ſerving inſtead of point and wit. Boileau's epigrams are all ſatires on one or another; thoſe of des Reaux are made in honour of his friends; and thoſe of Mad. Scudery are ſo many elogies. The epigram being only a ſingle thought, it would be ridiculous to expreſs it in a great number of verſes.

EPIGRAPHE, among antiquarians, denotes the inſcription of a building, pointing out the time when, the perſons by whom, the uſes, and the like, for which it was erected.

EPILEPSY, in medicine, the ſame with what is otherwiſe called the *falling-ſickneſs*, from the patient's falling ſuddenly to the ground. See MEDICINE.

EPILOBIUM, the WILLOW-HERB, in botany; a genus of the monogynia order, belonging to the octandria claſs of plants; and in the natural method ranking under the 17th order, *Calycanthemæ*. The calyx is quadrifid; the petals four; the capſule oblong inferior; the ſeeds pappous or downy. There are ſeven ſpecies, all of them natives of Britain. They grow in marſhes, or under hedges in moiſt and ſhady places; having bloſſoms generally of a red colour, and ſometimes of conſiderable beauty. The moſt remarkable is the hirſutum, commonly called *codlins and cream*. The top-ſhoots of this plant have a very delicate fragrancy; but ſo tranſitory, that before they have been gathered five minutes, it is no longer perceptible. Horſes, ſheep, and goats eat this plant; cows are not fond of it; ſwine refuſe it. An infuſion of the leaves of another ſpecies, the anguſtifolium, or roſebay willow-herb, has an intoxicating quality, as the inhabitants of Kamtſchatka have learned. Theſe people alſo eat the white young ſhoots which creep under the ground, and have a ſort of ale brewed from the dried pith of it. The down of the ſeeds has been lately manufactured by mixing it with cotton or beaver's hair.

EPILOGUE, in oratory, the end or concluſion of a diſcourſe, ordinarily containing a recapitulation of the principal ſubjects delivered.

EPILOGUE, in dramatic poetry, a ſpeech addreſſed to the audience, after the play is over, by one of the principal actors therein; uſually containing ſome reflections on certain incidents in the play, eſpecially thoſe in the part of the perſon that ſpeaks it; and having ſomewhat of pleaſantry, intended to compoſe the paſſions raiſed in the courſe of the repreſentation. This practice is ridiculed by the *Spectator*; and compared to a merry jig upon the organ after a good ſermon, to wipe away any impreſſions that might have been made thereby, and ſend the people away juſt as wiſe as they came.

EPIMEDIUM, BARREN-WORT, in botany; a genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 24th order, *Corydales*. There are four nectaria, cup-ſhaped, and lying on the petals. The corolla is tetrapetalous, the calyx dropping off. The ſeed-veſſel is a pod. There is only one ſpecies, *viz.* the alpinum. It is a low herbaceous plant, with a creeping root, having many ſtalks about nine inches high, each of which has three flowers compoſed of four leaves placed in the form of a croſs. They are of a reddiſh colour, with yellow ſtripes on the border.

EPIMENIDES, an ancient poet and philoſopher, was born at Gnoſſus in Crete. Many ſtories are related of him, too wonderful to merit attention; however, his reputation was ſo great over all Greece, that he was there eſteemed a favourite of the gods. Having eſſentially ſerved the Athenians by putting a ſtop to a dreadful plague that raged in the country; and, of all the preſents offered him, accepted only a little branch of the ſacred olive preſerved in their citadel, he returned to Crete; where he died ſoon after, aged 157 years; or as the Cretans, conſiſtently with their character, pretended, 299. He was a great poet, and wrote 5000 verſes on "the genealogy of the gods," 6500 "on the building of the ſhip Argos and Jaſon's expedition to Colchis," and 4000 "concerning Minos and Rhadamanthus." He wrote alſo in proſe, "Concerning ſacrifices and the commonwealth of Crete." St. Jerom likewiſe mentions his "book of oracles and reſponſes." The Lacedemonians procured his body, and preſerved it among them by the advice of an oracle; and Plutarch tells us, that he was reckoned the ſeventh wiſe man by thoſe who refuſed to admit Periander into the number.

EPIMETHEUS, a ſon of Japetus and Clymene, one of the Oceanides, who inconſiderately married Pandora, by whom he had Pyrrha, the wife of Deucalion. He had the curioſity to open the box which Pandora had brought with her, and from thence iſſued a train of evils, which from that moment have never ceaſed to afflict the human race. Hope was the only one which remained at the bottom of the box, not having a ſufficient time to eſcape, and it is ſhe alone which comforts men under misfortunes. Epimetheus was changed into a monkey by the gods, and ſent into the iſland of Pithecuſa.

EPIPHANY, a Chriſtian feſtival, otherwiſe called the *Manifeſtation of Chriſt to the Gentiles*, obſerved on the ſixth of January, in honour of the appearance of our Saviour to the three magi or wiſe men, who came to adore him and bring him preſents. The feaſt of epiphany was not originally a diſtinct feſtival; but made a part of that of the nativity of Chriſt, which being celebrated 12 days, the firſt and laſt of which were high or chief days of ſolemnity, either of theſe might properly be called *epiphany*, as that word ſignifies the appearance of Chriſt in the world. The word in the original Greek, επιφανια, ſignifies *appearance* or *apparition*; and was applied, as ſome critics

will have it, to this feaſt, on account of the ſtar which appeared to the magi.

EPIPHONEMA. See ORATORY.

EPIPHORA, in medicine, a preternatural defluxion of the eyes, when they continually diſcharge a ſharp ſerous humour, which excoriates the cheeks.

EPIPHYSIS, in anatomy. See ANATOMY, p. 162.

EPIPLOCELE, in ſurgery, is a kind of hernia or rupture, in which a portion of the omentum falls into the ſcrotum.

EPIPLOOMPHALON, in ſurgery, a hernia umbilicalis, proceeding from the omentum falling into a ſac projecting from the region of the umbilicus or navel.

EPIPLOON. See OMENTUM.

EPIRUS, a diſtrict of ancient Greece, bounded on the eaſt by Etolia, on the weſt by the Adriatic, on the north by Theſſaly and Macedon, and on the ſouth by the Ionian ſea. This country was anciently governed by its own princes, in which ſtate it made a very conſiderable figure.

EPISCOPACY, that form of church-government, in which dioceſan biſhops are eſtabliſhed as diſtinct from and ſuperior to prieſts or preſbyters. It has been much controverted whether the diſtinction be of divine or human right; whether it was ſettled in the apoſtolic age or afterwards. See BISHOP. This controverſy commenced ſoon after the Reformation; and has been agitated with great warmth between the *Epiſcopalians* on the one ſide, and the *Preſbyterians* and *Independents* on the other. Among the Proteſtant churches *abroad*, thoſe which were reformed by *Luther* and his aſſociates are in general *epiſcopal*; whilſt ſuch as follow the doctrines of *Calvin* have for the moſt part thrown off the order of biſhops as one of the corruptions of popery. In *England*, however, the controverſy has been conſidered as of greater importance than on the *Continent*: for it has there been ſtrenuouſly maintained by one party, that the *epiſcopal order* is eſſential to the conſtitution of the church; and by others, that it is a pernicious encroachment on the rights of men, for which there is no authority in ſcripture.

EPISCOPALIANS, in church-hiſtory, an appellation given to thoſe who prefer the epiſcopal government and diſcipline to all others. By the teſt act, none but Epiſcopalians, or members of the church of England, are qualified to enjoy any office civil or military.

EPISODE, in poetry, a ſeparate incident, ſtory, or action, which a poet invents, and connects with his principal action, that his work may abound with a greater diverſity of events; though, in a more limited ſenſe, all the particular incidents whereof the action or narration is compounded, are called *epiſodes*. See POETRY.

EPISPASTIC, in medicine, a topical remedy, which being applied to the external parts of the body, ſtimulates or bliſters them.

EPISTATES, in the Athenian government, was the preſident of the proedri. See PROEDRI.

EPISTEMONARCH, in the ancient Greek church, an officer of great dignity, who had the care of every thing relating to faith, in the quality of cenſor. His office anſwered pretty nearly to that of maſter of the ſacred palace at Rome.

EPISTLE, denotes the ſame with a miſſive letter; but is now chiefly uſed in ſpeaking of ancient writings, as the epiſtles of St. Paul, epiſtles of Cicero, epiſtles of Pliny, &c.

EPISTLES *and Goſpels*, in the liturgy of the church of England, are ſelect portions of ſcripture, taken out of the writings of the evangeliſts and apoſtles, and appointed to be read, in the communion-ſervice, on Sundays and holidays. They are thought to have been ſelected by St. Jerom, and by him put into the lectionary.

EPISTOLARY COMPOSITION. See LETTER; and the article POETRY.

EPISTROPHE. See ORATORY.

EPISTYLE, in the ancient architecture, a term uſed by the Greeks for what we call *architrave*, viz. a maſſive piece of ſtone or wood, laid immediately over the capital of a column.

EPITAPH, from επι *upon*, and ταφος *ſepulchre*, a monumental inſcription, in honour or memory of a perſon deceaſed. It has been diſputed whether the ancient Jews inſcribed epitaphs on the monuments of their dead; but be this as it will, epitaphs, it is certain, of very ancient date, are found amongſt them. The Athenians, by way of epitaph, put only the name of the dead, with the epithet χρηστος, ſignifying "good," or ηρως "hero," and the word χαιρε, ſignifying their good wiſhes: The name of the deceaſed's father and his tribe were frequently added. The Lacedemonians allowed epitaphs to none but thoſe who had died in battle. The Romans inſcribed their epitaphs to the *manes*, *diis manibus*; and frequently introduced the dead by way of proſopopœia, ſpeaking to the living. Of this we have a fine inſtance, worthy of the Auguſtan age, wherein the dead wife thus beſpeaks her ſurviving huſband:

Immatura peri; ſed tu, felicior, annos
Vive tuos, conjux optime, vive meos.

The epitaphs of the preſent day are generally little elſe than fulſome compliments which were never merited, characters which human nature in its beſt ſtate could ſcarce lay claim to, and expreſſions of reſpect which were never paid in the life-time of the deceaſed. Hence the proverb with great propriety took its riſe, "He *lies* like an epitaph."

EPITAPH, is alſo applied to certain elogies, either in proſe or in verſe, compoſed without any intent to be engraven on tombs; as, That of Alexander,

Sufficit huic tumulus, cui non ſufficeret orbis;

and that of Newton,

Iſaacum Newton,
Quem immortalem
Teſtantur Tempus, Natura, Cœlum,
Mortalem hoc Marmor
Fatetur.

EPITASIS, in ancient poetry, the ſecond part or diviſion of a dramatic poem, wherein the plot, entered upon in the firſt part or *protaſis*, was carried on, heightened, and worked up, till it arrived at its ſtate or height, called *cataſtaſis*.

EPITASIS, in medicine, the increaſe of a diſeaſe or beginning of a paroxyſm, particularly in a fever.

EPITHALAMIUM, in poetry, a nuptial ſong or compoſition in praiſe of the bride and bridegroom, praying for their proſperity, for a happy offspring, &c. Epithalamia were ſung amongſt the Jews, at the door of the bride, by her friends and companions, the evening before the marriage. Pſalm xlv. is an epithalamium. Among the Greeks the epithalamium was ſung as ſoon as the married couple were gone to bed, and attended with ſhouts and ſtamping of the feet to drown the cries of the bride. They returned in the morning, and with the ſame ſong, a little altered, ſaluted them again. The evening ſong was called επιθαλαμια κοιμητικα, the morning ſalute was called επιθαλαμια εγερτικα. This was the practice amongſt the Romans alſo, but their epithalamia were often obſcene.

EPITHEM, in pharmacy, a name heretofore given to a kind of fomentation of a ſpirituous or aromatic kind, applied externally to the regions of the heart, liver, &c.

EPITHET, in poetry, and rhetoric, an adjective expreſſing ſome quality of a ſubſtantive to which it is joined; or ſuch an adjective as is annexed to ſubſtantives by way of ornament and illuſtration, not to make up an eſſential part of the deſcription.

Nothing, fays Ariftotle, tires the reader more than too great a redundancy of epithets, or epithets placed improperly; and yet nothing is fo effential in poetry as a proper ufe of them. The writings of the beft poets are full of them.

EPITOME, in literary hiftory, the fame with ABRIDGMENT.

EPITRITUS, in profody, a foot confifting of three long fyllables and one fhort. Of thefe, grammarians reckon four kinds: the firft confifting of an iambus and fpondee, as fălūtāntēs; the fecond, of a trocheus and fpondee, as cōncĭtātī; the third, of a fpondee and an iambus, as cōmmūnĭcāns; and the fourth, of a fpondee and trocheus as īncāntārĕ. See the articles SPONDEUS, TROCHEUS, &c.

EPITROPE. See ORATORY.

EPITROPUS, a kind of judge, or rather an arbitrator, which the Greek Chriftians under the dominion of the Turks elect in the feveral cities, to terminate the differences that arife among them, and avoid carrying them before the Turkifh magiftrates. See ARBITRATOR. Anciently the Greeks ufed the term επιτροπος in the fame fenfe as the Latins did *procurator*, viz. for a commiffioner or intendant. Thus the commiffioners of provifions in the Perfian army are called by Herodotus and Xenophon *epitropi*. In the New Teftament, επιτροπος denotes the fteward of a houfehold, rendered in the vulgate, *procurator*.

EPIZEUXIS. See ORATORY.

EPOCHA, in chronology, a term or fixed point of time whence the fucceeding years are numbered or counted. See ÆRA.

EPODE, in lyric poetry, the third or laft part of the ode, the ancient ode being divided into ftrophe, antiftrophe, and epode. See ODE, &c. The epode was fung by the priefts, ftanding ftill before the altar, after all the turns and returns of the ftrophe and antiftrophe, and was not confined to any precife number or kind of verfes. The epode is now a general name for all kinds of little verfes that follow one or more great ones, of what kind foever they be: and in this fenfe, a pentameter is an epode after an hexameter. And as every little verfe, which, being put after another, clofes the period, is called *epode*; hence the fixth book of Horace's odes is intitled *liber epodon*, "book of epodes," becaufe the verfes are all alternately long and fhort, and the fhort ones generally, though not always, clofe the fenfe of the long one.

EPOPOEIA, in poetry, the hiftory, action, or fable, which makes the fubject of an epic poem. The word is derived from the Greek επος *carmen*, "verfe;" and ποιεω *facio*, "I make." In the common ufe of the word, however, *epopœia* is the fame with *epos*, or epic poem itfelf. See the article POETRY.

EPOPS, or HOOPOE. See UPUPA.

EPSOM, a town of Surry, about 16 miles fouth-weft from London, long famous for its mineral waters. Thefe were difcovered in 1618; and though not in fuch repute as formerly, yet they are not impaired in virtue, and the falt obtained from them is a very ufeful purgative. On the neighbouring downs are annually horfe-races; but the inns, fhops, and bowling-greens are not near fo much frequented as formerly. The market is on Friday; fair, July 25. The town is about one mile and an half in femicircle, from the church to the palace at Durdans, which was burned down fome years fince, but has been rebuilt. It was once inhabited by his prefent majefty's father. In Hudfon's lane here, was Epfom-Court, an ancient Saxon feat, long fince converted into a farm.

EPULARES, in antiquity, an epithet given to thofe who were admitted to the facred *epulæ* or entertainments, it being unlawful for any to be prefent at them who were not pure and chafte.

EPULO, in antiquity, the name of a minifter of facrifice among the Romans. The pontifices, not being able to attend all the facrifices performed at Rome to fo many gods as were adored by that people, appointed three minifters, whom they called *epulones*, becaufe they conferred on them the care and management of the *epula*, feafts in the folemn games and feftivals. To them belonged the ordering and ferving the facred banquet, offered on fuch occafions to Jupiter, &c. They wore a gown bordered with purple like the pontifices. Their number was at length augmented from three to feven, and afterwards by Cæfar to ten. Their firft eftablifhment was in the year of Rome 558, under the confulate of L. Furius Purpureo, and M. Claudius Marcellus.

EPULUM, in antiquity, a holy feaft prepared for the gods in times of public danger. The feaft was fumptuous, and the gods were formally invited and attended; for the ftatues were brought on rich beds furnifhed with foft pillows, called *pulvinaria*. Thus accommodated, their godfhips were placed on their couches at the moft honourable part of the table. The care of the *epula* belonged to the *epulones*, and the gods were plentifully ferved with the richeft dainties, as if they were able to eat; but the *epulones* performed that function for them, and doubtlefs were competent proxies! No wonder that Pliny folicited Trajan to be admitted of their order.

EPULUM is alfo ufed to fignify any folemn feaft; fo we meet with *epulum ferale*, "a funeral entertainment."

EQUAL, a term of relation between two or more things of the fame magnitude, quantity, or quality. Thus, mathematicians fpeak of *equal* lines, angles, figures, circles, ratios, folids, &c.

EQUALITY, in a political fenfe, is a term much ufed in thefe days, though not generally underftood. All men are upon an equality with regard to their rights. Their right to have their perfons and their property (whether it be lefs or more) protected by the government under which they live, cannot be difputed. Neither can the right *to do any thing that is not injurious to another*, which is the only true definition of *liberty*, be called in queftion, let the party exercifing it be ever fo poor. But it is a dangerous error to fuppofe, that an equality of property is meant by the term; for that is to fuppofe, what is not the fact, that all men are equal in merit and in talents.

EQUANIMITY, in ethics, denotes that even and calm frame of mind and temper, under good or bad fortune, whereby a man appears to be neither puffed up nor overjoyed with profperity, nor difpirited, foured, or rendered uneafy by adverfity.

EQUATIONS, in algebra. See ALGEBRA, page 107.

EQUATION *of Time*, in aftronomy and chronology, the reduction of the apparent time or motion of the fun, to equable, mean, or true time. See ASTRONOMY, p. 397.

EQUATOR, in aftronomy and geography, a great circle of the fphere, equally diftant from the two poles of the world, or having the fame poles with thofe of the world. It is called the *equator*, becaufe, when the fun is in it, the days and nights are *equal*; whence alfo it is called the *equinoctial*; and when drawn on maps and planifpheres, the *equinoctial line*, or fimply the *line*. Every point of the equator is a quadrant's diftance from the poles of the world; whence it follows, that the equator divides the fphere into two hemifpheres, in one of which is the northern, and in the other the fouthern pole.

EQUERY, or ECURY, a grand ftable or lodge for horfes, furnifhed with all requifite conveniencies; as ftalls, manger, rack, &c. The word is formed from the French *efcurie*, which fignifies the fame thing. Some again derive *efcurie* from the Latin *fcuria*, which not only denotes a place for beafts to be put up in, but alfo a grange or barn. But a more probable derivation is from *equile* "a ftable for horfes," of *equus* "horfe." Some hold that the word *ftable*, in propriety, relates only to

bullocks, cows, ſheep, hogs, &c. and *equery*, to horſes, mules, &c. A *ſimple equery* is that provided for one row of horſes ; a *double equery* that provided for two, with a paſſage in the middle, or two paſſages ; the horſes being placed head to head, as in the little equery at Verſailles. Under equery are ſometimes alſo comprehended the lodgings and apartments of the equerries, grooms, pages, &c. Equery is alſo an officer who has the care and management of the horſes of a king or prince.

EQUERIES, or Equerries, popularly called *Querries*, are particularly uſed among us for officers of the king's ſtables, under the maſter of the horſe, ſeven in number, who, when his majeſty goes abroad, ride in the leading coach, are in waiting one at a time monthly, and have a table with the gentlemen-uſhers during the time, and a ſalary of 300l. a year each. They uſed to ride on horſeback by the coach-ſide when the king travelled ; but that being more expenſive to them than neceſſary to the ſovereign, has been diſcontinued.

Equeries *of the Crown Stable* have that appellation, as being employed in managing and breaking the ſaddle-horſes, and preparing them for the king's riding. Theſe are two in number ; the firſt having an annual ſalary of 256l. and the ſecond 200l. whereof one is, or always ſhould be, in cloſe waiting at court ; and when his majeſty rides, holds the ſtirrup, while the maſter of the horſe, or one of the equeries in his abſence, aſſiſts in mounting him ; and when his majeſty rides, they uſually attend him.

EQUES, in antiquity. See Equestrian *Order*, and Equites.

Eques *Auratus*, is uſed to ſignify a knight-bachelor, called *auratus*, q. d. *gilt*, becauſe anciently none but knights might gild or beautify their armour or other habiliments of war with gold. In law this term is not uſed, but inſtead of it *miles*, and ſometimes *chevalier*.

EQUESTRIA, among the Romans, a place in the theatre where the equites or knights ſat.

EQUESTRIAN, *Equeſtris*, a term chiefly uſed in the phraſe *equeſtrian ſtatue*, which ſignifies a ſtatue repreſenting a perſon mounted on horſeback. The word is formed of the Latin *eques*, " knight, horſeman," of *equus*, " horſe."

Equestrian *Games*, among the Romans, horſe-races, of which there were five kinds, the *prodromus* or *plain horſe-race*, the *chariot-race*, the *decurſory-race* about funeral piles, the *ludi ſeviroles*, and the *ludi neptunales*.

Equestrian *Order*, among the Romans, ſignified their knights or equites ; as alſo their troopers or horſemen in the field ; the firſt of which orders ſtood in contradiſtinction to the ſenators ; as the laſt did to the foot, military, or infantry. Each of theſe diſtinctions was introduced into the ſtate by Romulus.

EQUIANGULAR, in geometry, an epithet given to figures whoſe angles are all equal : ſuch are a ſquare, an equilateral triangle, &c.

EQUIDISTANT, an appellation given to things placed at equal diſtances from ſome fixed point or place to which they are referred.

EQUILATERAL, in general, ſomething that hath equal ſides ; as an equilateral triangle.

EQUILIBRIUM, in mechanics, is when the two ends of a lever or balance hang ſo exactly even and level, that neither will aſcend or deſcend, but both keep in a poſition parallel to the horizon ; which is occaſioned by their being both charged with an equal weight.

EQUIMULTIPLES, in arithmetic and geometry, are numbers or quantities multiplied by one and the ſame number or quantity. Hence, equimultiples are always in the ſame ratio to each other as the ſimple quantities before multiplication : thus, if 6 and 8 are multiplied by 4, the equimultiples 24 and 32 will be to each other as 6 to 8.

EQUINOCTIAL, in aſtronomy, a great and immoveable circle of the ſphere, under which the equator moves in its diurnal motion. The equinoctial or equinoctial line is ordinarily confounded with the equator : but there is a difference ; the equator being moveable, and the equinoctial immoveable ; and the equator being drawn about the convex ſurface of the ſphere, but the equinoctial on the concave ſurface of the magnus orbis. Whenever the ſun in his progreſs through the ecliptic comes to this circle, it makes equal days and nights all around the globe ; as then riſing due eaſt and ſetting due weſt, which he never does at any other time of the year. And hence the denomination from *æquus* and *nox*, " night," *quia æquat diem nocti*. The equinoctial then is the circle which the ſun deſcribes, or appears to deſcribe, at the time of the equinoxes ; that is, when the length of the day is every where equal to that of night, which happens twice a year. See Equinox.

Equinoctial, in geography. See Equator. The ſhadows of thoſe who live under this circle are caſt to the ſouthward of them for one half of the year, and to the northward of them during the other half ; and twice in a year, viz. at the equinoxes, the ſun at noon caſts no ſhadow, being in their zenith. From this circle is the declination or latitude of places accounted in the degrees of the meridian.

Equinoctial *Points*, are the two points wherein the equator and ecliptic interſect each other : the one being in the firſt point of Aries, is called the *vernal point* or *equinox* ; and the other in the firſt point of Libra, the *autumnal point* or *equinox*.

Equinoctial *Dial*, is that whoſe plane lies parallel to the equinoctial. See Dial.

EQUINOX, in aſtronomy, the time when the ſun enters one of the equinoctial points. The equinoxes happen when the ſun is in the equinoctial circle ; when of conſequence the days are equal to the nights throughout the world, which is the caſe twice a year, viz. about the 20th of March and the 23d of September, the firſt of which is the vernal and the ſecond the autumnal equinox. It is found by obſervation, that the equinoctial points, and all the other points of the ecliptic, are continually moving backward, or *in antecedentia*, that is, weſtward. This retrograde motion of the equinoctial points is that famous and difficult phenomenon called the *preceſſion of the equinoxes*. See Astronomy, p. 391.

EQUIPAGE, in the military art, denotes all ſorts of utenſils, artillery, &c. neceſſary for commencing and proſecuting with alacrity any military operations. Camp and field equipage conſiſts of tents, kitchen-furniture, ſaddle-horſes, baggage, waggons, bat-horſes, &c.

To EQUIP, in naval language, a term borrowed from the French marine, and frequently applied to the buſineſs of fitting a ſhip for ſea, or arming her for war.

EQUIPOLLENCE, in logic, is when there is an equivalence between any two or more terms or propoſitions, *i. e.* when they ſignify one and the ſame thing, though they expreſs it differently. Such propoſitions, &c. are ſaid to be *equipollent*.

EQUIRIA, in antiquity, a feſtival inſtituted by Romulus, and celebrated on the 27th of February, in honour of Mars, at which there were horſe-races.

EQUISETUM, Horse-tail ; a genus of the order of filices, belonging to the cryptogamia claſs of plants ; and in the natural method ranking under the 51ſt order, *Coniferæ*. There is a ſpike of peltated or ſhielded fructifications opening at the baſe. There are ſeven ſpecies ; of which the moſt remarkable are, 1. The *ſylvaticum*, or wood horſe-tail. It grows in woods and moiſt ſhady places in many parts of England and Scotland. The ſtalk riſes from 12 to 18 inches high, angular, and rough

to the touch; the angles being edged with ſharp *ſpiculæ*, ſcarce viſible without a microſcope. The leaves grow verticillate, 12 or more in a whorl, and theſe whorls are about an inch diſtant from one another. The leaves are very ſlender, nearly quadrangular, about five inches long, pendent, and beſet with ſeveral other ſecondary whorls, ſo that it reſembles a pine tree in miniature. Horſes are very fond of this plant, and in ſome parts of Sweden it is collected to ſerve them as winter food. 2. The *arvenſe*, common or corn horſe-tail, grows in wet meadows and corn-fields. The moſt remarkable property of this is, that its ſeeds, when viewed by a microſcope, are ſeen to leap about as if they were animated. It is a troubleſome plant in paſtures; and diſagreeable to cows, being never touched by them unleſs they are compelled by hunger, and then it brings on an incurable diarrhœa. It does not ſeem to affect horſes or ſheep. 3. The *paluſtre*, marſh horſe-tail, or paddock pipe, is frequent in marſhes and ditches. It is not ſo rough as the former, but is likewiſe prejudicial to cattle. 4. The *fluviatile*, or great river horſe-tail, is frequent in ſhady marſhes, and on the brinks of ſtagnant waters. It is the largeſt of all the ſpecies, growing ſometimes to the height of a yard, and near an inch in diameter. Haller tells us, that this kind of equiſetum was eaten by the Romans; and Linnæus affirms, that oxen and rein deer are fond of it, but that horſes refuſe it. 5. The *hyemale*, rough horſe-tail, ſhave-graſs, or Dutch ruſhes. This is much uſed by the white-ſmiths and cabinet-makers, under the name of *Dutch ruſhes*, for poliſhing their metals and wood. All the other ſpecies will anſwer this purpoſe in ſome degree, but the laſt better than any of the reſt. In Northumberland the dairy-maids ſcour and clean their milk-pails with it. Some imagine, that if cows are fed with this ſpecies, their teeth will fall out.

EQUITES, amongſt the Romans, were perſons of the ſecond degree of nobility, immediately ſucceeding the ſenators in point of rank. The *equites* or knights were required to be poſſeſſed of 400 *ſeſtertia* before they could be admitted into that order; and when the knights were ſo reduced as to fall ſhort of the preſcribed revenue, they were expunged out of the equeſtrian liſt. The equeſtrian revenue juſt mentioned amounted to about 10,000 crowns. Part of the ceremony whereby the honour of knighthood was conferred amongſt the Romans was the giving of a horſe; for every *eques* or knight had a horſe kept at the public charge, he received alſo the ſtipend of an horſeman to ſerve in the wars, and wore a ring which was given him by the ſtate. The *equites* compoſed a large body of men, and conſtituted the Roman cavalry; for there was always a ſufficient number of them in the city, and nothing but a review was requiſite to fit them for ſervice. The knights at laſt grew too powerful, were a balance for the ſenate and people, neglected the exerciſes of war, and betook themſelves to civil employments. The *equites* were liable to be puniſhed by the cenſors, and to ſuffer degradation. They were degraded by taking from them the horſe which was kept for each of them at the public charge; this was called *equum adimere*.

EQUITY, in a general ſenſe, the virtue of treating all other men according to reaſon and juſtice, or as we would gladly be treated ourſelves when we underſtand aright what is our due. See JUSTICE.

EQUITY, in juriſprudence, is defined a correction or qualification of the law, generally made in that part wherein it faileth or is too ſevere. It likewiſe ſignifies the extenſion of the words of the law to caſes unexpreſſed, yet having the ſame reaſon; ſo that where one thing is enacted by ſtatute, all other things are enacted that are of the like degree. For example, the ſtatute of *Glouc.* gives action of waſte againſt him that holds lands for life or years; and by the equity thereof, a man ſhall have action of waſte againſt a tenant that holds but for one year, or one half-year, which is without the words of the act, but within the meaning of it; and the words that enact the one, by *equity* enact the other. So that equity is of two kinds. The one abridges and takes from the letter of the law: the other enlarges and adds to it; and ſtatutes may be conſtrued according to equity, eſpecially where they give remedy for wrong, or are for expedition of juſtice. Equity ſeems to be the interpoſing *law of reaſon*, exerciſed by the lord chancellor in extraordinary matters to do equal juſtice; and, by ſupplying the defects of the law, gives remedy in all caſes. See CHANCERY.

EQUITY, in mythology, ſometimes confounded with *Juſtice*, a goddeſs among the Greeks and Romans, repreſented with a ſword in one hand and a balance in the other.

EQUIVALENT, is underſtood of ſomething that is equal in value, force, or effect, to another. Equivalence is of various kinds, in propoſitions, in terms, and in things.

EQUIVALENT *Propoſitions*. See EQUIPOLLENCE.

EQUIVALENT *Terms* are where ſeveral words that differ in ſound have yet one and the ſame ſignification; as *every body was there*, and *nobody was abſent*, *nihil non*, and *omne*.

EQUIVALENT *Things*, are either *moral*, *phyſical*, or *ſtatical*. *Moral*, as when we ſay that the commanding or adviſing a murder is a guilt equivalent to that of the murder. *Phyſical*, as when a man who has the ſtrength of two men is ſaid to be equivalent to two men. *Statical*, whereby a leſs weight becomes of equal force with a greater, by having its diſtance from the centre increaſed.

EQUIVOCAL TERMS or WORDS, among logicians, are thoſe which have a doubtful or double meaning. According to Mr. Locke, the doubtfulneſs and uncertainty of words has its cauſe more in the ideas themſelves, than in any incapacity of the words to ſignify them; and might be avoided, would people always uſe the ſame term to denote the ſame idea or collection of ideas: but, adds he, it is hard to find a diſcourſe on any ſubject where this is the caſe; a practice which can only be imputed to folly or great diſhoneſty; ſince a man, in making up his accounts, might with as much fairneſs uſe the numeral characters ſometimes for one, ſometimes for another collection of units.

EQUIVOCATION, the uſing a term or expreſſion that has a double ſignification. Equivocations are expedients to ſave telling the truth, and yet without telling a falſity. The fathers are great patrons of equivocations and mental reſervations, holding that the uſe of ſuch ſhifts and ambiguities is in many caſes allowable.

EQUULEUS, or ECCULEUS, in antiquity, a kind of rack uſed for extorting a confeſſion, at firſt chiefly practiſed on ſlaves, but afterwards made uſe of againſt the Chriſtians. The equuleus was made of wood, having holes at certain diſtances, with a ſcrew, by which the criminal was ſtretched to the third, ſometimes to the fourth, or fifth holes, his arms and legs being faſtened on the equuleus with cords; and thus was hoiſted aloft, and extended in ſuch a manner, that all his bones were diſlocated. In this ſtate red-hot plates were applied to his body, and he was goaded in the ſides with an inſtrument called *ungula*.

EQUULEUS, EQUICULUS, and *Equus Minor*, the horſe's head, in aſtronomy, a conſtellation of the northern hemiſphere, whoſe ſtars in Ptolomy's catalogue are 4, in Tycho's 4, in Hevelius's 6, and in Mr. Flamſteed's 10.

EQUUS, in zoology. See BARB.

ERA, in chronology. See ÆRA; and CHRONOLOGY, p. 520.

ERANARCHA, a public officer among the ancient Greeks, whoſe buſineſs was to preſide over and direct the alms and proviſions made for the poor. Cornelius Nepos, in his life of Epaminondas, deſcribes his office thus: When any perſon was reduced to poverty, taken captive, or had a daughter to mar-

ry, which he could not effect for want of money, &c. the eranarcha called an aſſembly of friends and neighbours, and taxed each according to his means and eſtate, to contribute towards his relief.

ERANTHEMUM, in botany; a genus of the monogynia order, belonging to the diandria claſs of plants; and in the natural method ranking with thoſe of which the order is doubtful. The corolla is quinquefid, with the tube filiform; the antheræ without the tube; the ſtigma ſimple.

ERASISTRATUS, a celebrated phyſician, grandſon to the philoſopher Ariſtotle. He diſcovered by the motion of the pulſe the love which Antiochus had conceived for his mother-in-law Stratonice, and was rewarded with 100 talents for the cure by the father of Antiochus. He was a great enemy to bleeding and violent phyſic.

ERASMUS (Deſiderius), born at Rotterdam in 1467. He loſt his father and mother at 14 years of age; and was committed to the care of certain guardians, who would force him to be an eccleſiaſtic, which he refuſed for a long time. However, he was obliged to aſſume the religious habit among the canons regular in the monaſtery of Stein near Tergou; but afterwards obtained a diſpenſation from his vows. He was the moſt learned man of the age in which he lived; and contributed, by his example and his writings, to the reſtoration of learning in the ſeveral countries in which he occaſionally reſided, viz. Italy, Switzerland, Holland, France, and England: with the laſt, he was moſt ſatisfied; and found the greateſt encouragement from Henry VIII. Sir Thomas More, and all the learned Engliſhmen of thoſe days. He publiſhed a great many books; and died at Baſil in 1536. He was buried honourably, and his memory is ſtill held in veneration. He had, however, many enemies; and as he did not embrace the reformation, and yet cenſured many things in popery, he hath been treated injuriouſly both by Catholics and Proteſtants. The works of Eraſmus in 10 vols. folio were publiſhed at Leyden in 1706, in a very handſome manner, under the care of M. Le Clerc. Dr. Jortin publiſhed his life in one vol. 4to. 1758.

ERASTIANS, a religious ſect or faction which aroſe in England during the time of the civil wars in 1647, thus called from their leader Thomas Eraſtus, whoſe diſtinguiſhing doctrine it was, that the church had no right to diſcipline, that is, no regular power to excommunicate, exclude, cenſure, abſolve, decree, or the like.

ERATO, from εραω *I love*, in mythology, the name of one of the nine muſes who preſided over love-poetry. To this muſe ſome have aſcribed the invention of the lyre and lute; and ſhe is repreſented with a garland of myrtles and roſes, holding a lyre in one hand and a bow in the other, and at her ſide a Cupid with his torch. There is alſo a Nereid of the ſame name.

ERATOSTHENES, a Cyrenæan philoſopher, hiſtorian, and poet; called for his learning *Plato Minor*. He was keeper of the famous library at Alexandria; and was greatly in favour with Ptolemy Euergetes, by whoſe order he wrote a hiſtory of the Theban kings of Egypt, which ſucceſſion was entirely omitted by Manetho. He thus fixed the Egyptian chronology, and his authority is by many preferred to that of Manetho. He wrote many other things, a catalogue of which is to be ſeen in Fabricius, Voſſius, &c. but his only piece now remaining entire, is a deſcription and fabulous account of the ſtars. He ſtarved himſelf in old age through grief for the dimneſs of his ſight, about the 10th or 12th year of Ptolemy Epiphanes, 194 B. C.

ERATOSTRATUS, an Epheſian who burnt the famous temple of Diana the ſame night that Alexander the Great was born. This burning, as ſome writers have obſerved, was not prevented or ſeen by the goddeſs of the place, who was then preſent at the labours of Olympias, and at the birth of the conqueror of Perſia. Eratoſtratus did this villany merely to eternize his name by ſo uncommon an action.

EREBUS, Ερεβο, from ערב *night*, in mythology, a term denoting darkneſs. According to Heſiod, Erebus was the ſon of Chaos and the night, and the father of the day. This was alſo the name of part of the *inferi* among the ancients: they had a peculiar expiation for thoſe who were detained in Erebus. Erebus was properly the gloomy region, and diſtinguiſhed both from Tartarus the place of torment, and Elyſium the region of bliſs: according to the account given of it by Virgil, it forms the third grand diviſion of the inviſible world beyond the Styx, and comprehends ſeveral particular diſtricts, as the *limbus infantum*, or receptacle for infants; the *limbus* for thoſe who have been put to death without cauſe; that for thoſe who have deſtroyed themſelves; the fields of mourning, full of dark groves and woods, inhabited by thoſe who died for love; and beyond theſe, an open champaign country for departed warriors.

ERECTION, in a general ſenſe, the art of raiſing or elevating any thing; as the erection of a perpendicular, &c. It is alſo uſed in a figurative ſenſe; as the erection of a biſhopric, marquiſate, &c.

Erection is particularly uſed by medical writers for the ſtate of the penis when ſwelled and diſtended by the action of the muſcles called *erectores*. See Anatomy, p. 109. There is alſo an erection of the clitoris which is performed by muſcles for that purpoſe.

EREMIT. See Hermit.

ERFORT, a town of Germany, capital of Upper Thuringia, with a univerſity. It was formerly imperial, but is now ſubject to the elector of Mentz. It is a large place, but thinly peopled; defended by two ſtrong forts, and ſurrounded by ditches full of water. A fire happened here in 1736, which burnt down 180 houſes, and ſeveral churches. It is ſeated on the river Gere. 30 miles E. S. E of Mulhauſen. E. lon. 11. 23. N. lat. 51. 0. Its territory comprehends 73 villages, and the inhabitants are at ſo ſmall a diſtance from 26 towns, that they can go to each and return the ſame day. With regard to religion, the principal magiſtrate is ſometimes a Proteſtant, and ſometimes a Papiſt; but the greater part of the burghers are Proteſtants. There are three fine libraries, one of which belongs to the Papiſts, another to the univerſity, and a third to the Proteſtant miniſters.

ERGASTULUM, among the Romans, was a priſon, workhouſe, or houſe of correction, where ſlaves by the private authority of their maſters were confined and kept for their offences to hard labour. The Greeks had a place of confinement of this ſort called Σωφρονιϛηριον.

ERGOT, in farriery, is a ſtub, like a piece of ſoft horn, about the bigneſs of a cheſnut, placed behind and below the paſtern joint, and commonly hid under the tuft of the fetlock.

ERICA, heath, in botany; a genus of the monogynia order, belonging to the octandria claſs of plants; and in the natural method ranking under the 18th order, *Bicornes*. The calyx is tetraphyllous; the corolla quadrifid; the filaments inſerted into the receptacle; the antheræ bifid; the capſule quadrilocular. Of this there are four ſpecies, natives of Britain; which are ſo well known, that no deſcription need be given of them. In the Highlands of Scotland this plant is made ſubſervient to a great variety of purpoſes. The poorer inhabitants make walls for their cottages with alternate layers of heath and a kind of mortar made of black earth and ſtraw. The woody roots of the heath are placed in the centre; the tops externally and internally. They make their beds of it, by placing the roots downwards; and the tops only being uppermoſt, they are ſufficiently ſoft to ſleep upon. Cabbins are alſo thatched with it. In the iſland of Ilay, ale is frequently made by brewing

one part of malt and two of the tops of young heath; fometimes adding hops. Boethius relates, that this liquor was much ufed by the Picts. Woollen cloth boiled in alum water, and afterwards in a ftrong decoction of heath-tops, comes out of a fine orange colour. The ftalks and tops will tan leather. Befoms, and faggots to burn in ovens, are alfo made of this plant. It is alfo ufed for filling up drains that are to be covered over. Sheep and goats will fometimes eat the tender fhoots, but they are not fond of them. Cattle not accuftomed to feed on heath, give bloody milk; but they are foon relieved by drinking plentifully of water. Horfes will eat the tops. Bees extract a great deal of honey from the flowers; and, where heath abounds, the honey has a reddifh caft. There are many exotic fpecies with which our green-houfe collections are enriched and adorned, as the triflora, tubiflora, auftralis, &c.

Eridanus, in aftronomy, a conftellation of the fouthern hemifphere, in form of a river. The ftars in the conftellation Eridanus, in Ptolemy's catalogue, are 34; in Tycho's, 19; and in the Britifh catalogue, 84.

ERIE, a vaft lake to the weftward of Pennfylvania, in North America, fituated between 80° and 87° W. long. and between 41° and 42° N. lat.

ERIGENA, or Scotus, (John), a famous fcholaftic divine, born about the beginning of the ninth century; but where, is a matter of difpute among authors. Bale and Pitts fay he was born at St. David's in Wales; Dempfter, Mackenzie, and Henry, that he was born at Ayr in Scotland; which they infer from his names *Eregina* and *Scotus*, by the latter of which he was generally diftinguifhed by his cotemporary writers. But Du Pin and Sir James Ware affert that he was by birth an Irifhman; Ireland being in thofe days called *Scotia*, and by the natives *Erin*. They agree, however, in relating that he travelled to Athens, where he acquired a competent knowledge of the Greek and other oriental languages; and that he afterwards refided many years in the court of Charles the Bald, king of France, who, on account of his fingular abilities, treated him as his intimate friend and companion. He flept frequently in the royal apartment; and was conftantly admitted to the king's table. "We may judge (fays a modern hiftorian) of the freedom which he ufed with Charles, by the following repartee. As the king and Scotus were fitting one day at table, oppofite to each other, after dinner, drinking a cheerful glafs, the philofopher having faid fomething that was not quite agreeable to the rules of French politenefs, the king in a merry humour afked him, Pray what is between a *Scot* and a *fot?* To which he anfwered, "Nothing but the table." See *Henry's Hiftory of Great Britain*, vol. i. p. 344. who quotes this ftory from *Hovedeni Annal. ad an.* 86. Quer. What language were they talking when this *bon mot* was uttered?

During his refidence with Charles, he wrote feveral books of fcholaftic divinity; which, though abfurd enough, were at that time not fufficiently fo to fecure him from the imputation of heterodoxy; and on that account the pope commanded Charles the Bald to fend him to Rome; but the king had too great a regard for his companion to truft him with his holinefs. One of the chief controverfies in which Scotus was engaged, and with which the pope was much offended, was concerning the real prefence and blood of Chrift in the wafer. His opinion of this weighty matter is expreffed in thefe few words: "What we receive corporally is not the body of our Lord; but that which feeds the foul and is only perceived by faith." John Scotus is fuppofed to have died about the year 874; but whether in France or England, is uncertain, and of little importance. Some have related, that he was invited to England by king Alfred: but in this they confound him with John, abbot of Etheling, who was affaffinated in 895: and to this miftake the various accounts concerning this author are to be attributed. Regardlefs of his hiftory, he appears from his writings to have been a man of parts, and, in point of learning, fuperior to any of his cotemporaries. He wrote, 1. *De divifione naturæ*, lib. v. 2. *De prædeftinatione Dei.* 3. *Excerpta de differentiis & focietatibus Græci Latinique verbi.* 4. *De corpore et fanguine Domini.* 5. *Ambigua S. Maximi feu fcholia ejus in difficiles locos S. Gregorii Nazianzeni, Latine verfa.* 6. *Opera S. Dionyfii quatuor in Latinum ling. converfa.* All publifhed. 7. *De vifione Dei*, and feveral other works, in manufcript, preferved in different libraries.

ERIGERON, flea-bane, in botany; a genus of the polygamia fuperflua order, belonging to the fyngenefia clafs of plants; and in the natural method ranking under the 49th order, *Compofitæ*. The receptacle is naked; the pappus hairy; the florets of the radius are linear, and very narrow. There are five fpecies; of which the moft remarkable is the vifcofum, or male flea-bane of Theophraftus, and greater flea-bane of Diofcorides. It is a native of the fouth of France and Italy; and hath a perennial root, from whence arife many upright ftalks near three feet high. The leaves in warm weather fweat out a clammy juice; the flowers are produced fingle upon pretty long footftalks, are of a yellow colour, and have an agreeable odour. The plants are eafily propagated by feeds; and thrive beft in a dry foil and funny afpect.

ERIGONE, in fabulous hiftory, daughter to Icarius, died of grief for her father's death, was tranflated into heaven, and makes the fign Virgo.

ERINACEUS, or hedgehog, in zoology; a genus of quadrupeds belonging to the order of feræ, the characters of which are thefe: They have two fore-teeth in the upper jaw, at a confiderable diftance from one another, and two in the under jaw, lefs diftant; and they have two recumbent dog-teeth, one on each fide. The hedge-hog has a very uncommon method of defending himfelf from the attacks of other animals: being poffeffed of little ftrength or agility, he does not attempt to fly from or affail his enemies; but erects his briftles, and rolls himfelf up like a ball, expofing no part of his body that is not furnifhed with fharp weapons of defence; he will not unfold himfelf, unlefs thrown into water: the more he is frightened or haraffed, the clofer he fhuts himfelf up; and frequently difcharges his urine, which has a very fetid and loathfome fmell. While in this ftate, moft dogs, inftead of biting him, ftand off and bark, not daring to feize him; or, if they attempt it once, their mouths are fo pricked with his briftles, that they cannot be prevailed upon to attempt it a fecond time. Both the male and female are covered with briftles from the head to the tail. Thefe briftles are of great ufe in defending them from other animals; but muft be very inconvenient when they incline to copulate. This operation they cannot perform in the manner of other quadrupeds; but do it face to face, either ftanding on end, or the female lying on her back. The females come in feafon in the fpring, and produce their young in the beginning of fummer. They commonly bring forth three or four, and fometimes five at a time. The young ones are of a whitifh colour, and only the points of the briftles appear above the fkin. It is impoffible to tame them: the mother and her young have frequently been confined together, and furnifhed with plenty of provifions; but, inftead of nourifhing them, fhe uniformly devoured them one after another. Males and females have likewife been kept in one apartment, where they lived, but never copulated. Hedge-hogs feed upon fallen fruits, fome roots, and infects: they are very fond of flefh-meat, whether raw or roafted. They frequent woods, and live under the trunks of old trees, in the chinks of rocks, or under large ftones. Naturalifts allege, that they go into gardens, mount the trees, and come down with pears, apples, or plums, ftuck upon their briftles. But this is a miftake: although kept in a garden, they never attempt to

climb trees, or ftick even fallen fruit upon their briftles, but lay hold of their food with the mouth. They never come out of their holes in the day, but go about in queft of food during the night. They eat but little, and can live very long without taking any nourifhment. They do not lay up any ftore of provifions in harveft; fuch an inftinct would be ufelefs, as they fleep all the winter. They lie under the undeferved reproach of fucking cattle and hurting their udders; but the fmallnefs of their mouths renders that impoffible. There are three fpecies, viz. 1. The *europæus*, or common hedgehog, with round ears, and crefted noftrils. See Plate 12. It is about nine inches long; the upper part of the body is totally covered with fharp prickles, and the under part is covered with hair. The hedgehog, even when ftanding on his legs, has a very ugly afpect. His body is an oblong mafs, convex above, terminated on the fore-part by a very fharp muzzle, and mounted on four fhort legs, of which nothing appears but the feet, and the tail is not difcernible. His ears are broad, round, and fhort; and his eyes are fmall and protuberant. The length of his body from the point of the muzzle to the anus is about nine inches. 2. The *inauris*, or white hedge-hog, has no external ears. It is a native of America. 3. The *malaccenfis* has hanging ears, and is a native of Afia.

ERINGO, in botany. See Eryngium.

ERINUS, in botany; a genus of the angiofpermia order, belonging to the didynamia clafs of plants; and in the natural method ranking under the 40th order, *Perfonatæ*. The calyx is pentaphyllous; the limb of the corolla quinquefid and equal; with its lobes emarginated, and the upper lip very fhort and reflexed; the capfule bilocular. There are fix fpecies, none of them natives of Britain. They grow from two inches to four feet in height, and are adorned with flowers of a white or purple colour. They are propagated by feeds, but in this country generally require to be kept in a ftove.

ERIOCAULON, in botany; a genus of the trigynia order, belonging to the triandria clafs of plants; and in the natural method ranking with the fixth order, *Enfatæ*. The common calyx is an imbricated capitulum or knob; there are three equal petals; and the ftamina are on the germen.

ERIOCEPHALUS, in botany; a genus of the polygamia neceffaria order, belonging to the fyngenefia clafs of plants; and in the natural method ranking under the 49th order, *Compofitæ*. The receptacle is fomewhat villous; there is no pappus; the calyx is decaphyllous and equal; the radius has five florets.

ERIOPHORUM, in botany; a genus of the monogynia order, belonging to the triandria clafs of plants; and in the natural method ranking under the third order, *Calamariæ*. The glumes are paleaceous and imbricated all round; there is no corolla; and only one feed furnifhed with a very long down.

ERITHALIS, in botany; a genus of the monogynia order, belonging to the pentandria clafs of plants; and in the natural method ranking with thofe of which the order is doubtful. The corolla is quinquepartite; the calyx urceolated or bladder-like, the berry decemlocular inferior.

ERIVAN, a large town of Afia, capital of Perfian Armenia, with an Armenian patriarch. It is defended by a fortrefs, in which is the governor's palace, and by a caftle, which is feated on the river Zuengui, near a lake of its own name. The Meidan is an open fquare, 400 paces over, wherein are very fine trees. The baths and caravanfaries have likewife their beauties, but the churches of the Chriftians are fmall, and half under ground. The lake is very deep, and 60 miles in circumference. It is 105 miles N. W. of Aftrabad. E. lon. 44. 10. N. lat. 40. 20.

ERIPHYLE, in fabulous hiftory, a fifter of Adraftus king of Argos, who married Amphiaraus. She was daughter of Talaus and Lifimache. When her hufband concealed himfelf that he might not accompany the Argives in their expedition againft Thebes, where he knew he was to perifh, Eriphyle fuffered herfelf to be bribed by Polynices with a golden necklace which had been formerly given to Hermione by the goddefs Venus, and fhe difcovered where Amphiaraus was. This treachery of Eriphyle compelled him to go to the war; but before he departed, he charged his fon Alcmæon to murder his mother as foon as he was informed of his death. Amphiaraus perifhed in the expedition; and his death was no fooner known than his laft injunctions were obeyed, and Eriphyle was murdered by the hands of her fon.

ERIS, the goddefs of difcord among the Greeks. She is the fame as the *Difcordia* of the Latins.

ERISICHTHON, in fabulous hiftory, a Theffalian, fon of Triops, who derided Ceres and cut down her groves. This impiety irritated the goddefs, who afflicted him with continual hunger. He fquandered all his poffeffions to gratify the cravings of his appetite, and at laft he devoured his own limbs for want of food. Some fay that his daughter had the power of transforming herfelf into whatever animal fhe pleafed, and that fhe made ufe of that artifice to maintain her father, who fold her; after which fhe affumed another fhape, and became again his property.

ERMIN, in zoology. See Mustela.

Ermin, or *Ermine*, in heraldry, denotes a white field or fur, powdered or interfperfed with black fpots, called *powdering*. It is fuppofed to reprefent the fkin of an animal of the fame denomination: fee Mustela. There is however no animal whofe fkin naturally correfponds to the herald's ermin. The animal is milk white, and fo far is it from having fpots, that tradition reports, that it will rather die or be taken than fully its whitenefs. Whence its fymbolical ufe. But white fkins having for many ages been ufed for the linings of the robes of magiftrates and great men; the furriers at length, to add to their beauty, ufed to few bits of the black tails of thofe creatures upon the white fkins, to render them the more confpicuous. Which alteration was introduced into armoury. The fable fpots in ermin are not of any determinate number, but they may be more or lefs at the pleafure of the painter or furrier.

Ermin, an order of knights, inftituted in 1450 by Francis I. duke of Bretagne, and formerly fubfifting in France. The collar of this order was of gold, compofed of ears of corn in faltier; at the end of which hung the ermin, with this infcription, *a ma vie*. But the order expired when the dukedom of Bretagne was annexed to the crown of France.

Ermines, in heraldry, the reverfe of ermine, i. e. white fpots on a black field.

ERMINITES, in heraldry, fhould fignify little ermines, but it is otherwife; for it fignifies a white field powdered with black, only that every fuch fpot hath a little red hair on each. Erminites alfo fignify a yellow field powdered with black, which the French exprefs much better by *or femée d'ermine de fable*.

ERMINOIS, in heraldry, fignifies the field or, and the fpots black.

EROORO, in ornithology. See Alcedo, of which it is a fpecies.

EROS, of ἔρως "love," in mythology, one of two chiefs over all the other Cupids, being the caufe of love. See Anteros.

EROTIA, a feftival in honour of Eros the god of love. It was celebrated by the Thefpians every fifth year with fports and games, when muficians and others contended. If any quarrels or feditions had arifen among the people, it was then ufual to offer facrifices and prayers to the god, that he would totally remove them.

EROTIC (derived from ἐρως "love;" whence ἐρωτικος), is applied to any thing which has a relation to the paſſion of love. In medicine we find the phraſe *delirium eroticum* uſed for a kind of melancholy contracted through exceſs of love.

EROSION, among ſurgeons, denotes much the ſame with CORROSION, only in a ſtronger degree.

EROTESIS. See ORATORY.

ERPENIUS (Thomas), in Dutch, THOMAS of ERPE; a celebrated profeſſor of the Arabic language, was born at Gorcum in Holland, in 1584, and educated at Leyden. He applied himſelf to the oriental languages at the perſuaſion of Joſeph Scaliger; and afterwards travelled into England, France, Italy, and Germany, and every where obtained the eſteem of the learned. On his return to Holland, he was made profeſſor of Arabic in the univerſity of Leyden, and died there in 1624. He publiſhed a great many excellent works, which ſpread his reputation through the whole learned world. It is ſaid, that the king of Morocco admired ſo greatly the letters Erpenius wrote to him in Arabic in the name of the United Provinces, that he could not ceaſe reading them, and ſhowing them to thoſe who ſpoke that language naturally.

ERRATIC, in general, ſomething that wanders, or is not regular: hence it is the planets are called *erratic ſtars*.

ERRHINES, in pharmacy, medicines which when ſnuffed up the noſe promote a diſcharge of mucus from that part.

Among the milder kinds we may reckon marjoram, thyme, hyſſop, ſavory, marum, ſyriacum, the tops of origanum, flowers of lilies of the valley, and gum benzoin, &c. Violent errhines are, euphorbium, the powder of white hellebore, turbith mineral, pepper, &c. and, in a milder degree, ſeveral ſorts of ſnuffs. Errhines are ſuppoſed to be of ſervice in oppreſſive pains of the head, lethargic diſorders, &c. and they act chiefly by inflaming the mucous membrane of the noſe.

ERROR, in philoſophy, a miſtake of our judgment, giving aſſent to that which is not true. Mr. Locke reduces the cauſes of error to theſe four; firſt, want of proofs; ſecondly, want of ability to uſe them; thirdly, want of will to uſe them; and, fourthly, wrong meaſures of probability.

He obſerves upon the firſt of theſe cauſes of error, that the greateſt part of mankind want conveniencies and opportunities of making experiments and obſervations themſelves, or of collecting the teſtimony of others, being prevented by the neceſſity of their condition. Upon the ſecond of theſe cauſes, he obſerves, that there are many, who, from the ſtate of their condition, might beſtow time in collecting proofs, but yet are not able to carry a train of conſequences in their heads, nor weigh exactly the preponderancy of contrary proofs and teſtimonies, merely from the difference in men's underſtandings, apprehenſions, and reaſonings. Thirdly, he remarks, that though ſome have opportunities and leiſure enough, and want neither parts, learning, nor other helps, that they never come to the knowledge of ſeveral truths within their reach, either upon account of their attachment to pleaſure or buſineſs; or otherwiſe becauſe of their lazineſs or averſion to ſtudy. The fourth cauſe of error, viz. wrong meaſures of probability, he imputes, 1. To the practice of taking for principles, propoſitions that are not in themſelves certain and evident, but, on the contrary, doubtful and falſe. 2. To received hypotheſes. 3. To predominant paſſions or inclinations. And, 4. To authority, or the giving up our aſſent to the common received opinions either of our friends or party, neighbours or country.

The cauſes of error in philoſophy, or the reaſons why all former philoſophers have through ſo many ages erred, according to Lord Bacon, are theſe following. 1. Want of time ſuited to learning. 2. The little labour beſtowed upon natural philoſophy. 3. Few entirely addicted to natural philoſophy. 4. The end of the ſciences wrong fixed. 5. A wrong way choſen. 6. The neglect of experiments. 7. Regard to antiquity and authority. 8. Admiration of the works in uſe. 9. The artifice of teachers and writers in the ſciences. 10. Oſtentatious promiſes of the moderns. 11. Want of propoſing worthy taſks. 12. Superſtition and zeal being oppoſite to natural philoſophy, as thinking philoſophy dangerous, on account of the ſchool-theology; from the opinion that deep natural inquiries might ſubvert religion. 13. Schools and academies proving unfavourable to philoſophy. 14. Want of rewards. And, 15. Deſpair, and the ſuppoſition of impoſſibility.

ERROR *Loci*, a term introduced into medicine by Boerhaave, from the opinion that the veſſels were of different ſizes for the circulation of blood, ſerum, and lymph; and that when the larger-ſized globules were forced into the leſſer veſſels by an error of place, they became obſtructed. But this opinion is now exploded.

ERUCA, in general, denotes caterpillars of all kinds. The caterpillar ſtate is that through which every butterfly muſt paſs before it arrives at its perfection and beauty: and, in the ſame manner, all the known winged animals, except only the puceron, paſs through a reptile ſtate: none of them, except this, being produced in their winged form. The change from caterpillar to butterfly was long eſteemed a ſort of metamorphoſis; a real change of one animal into another: but this is by no means the caſe. The egg of a butterfly produces a butterfly, with all lineaments of its parent; only theſe are not diſcloſed at firſt, but for the greater part of the animal's life they are covered with a ſort of caſe or muſcular coat, in which are legs for walking, which only ſuit it in this ſtate; but its mouth takes in nouriſhment, which is conveyed to the included animal; and after a proper time this covering is thrown off, and the butterfly, which all the while might be diſcovered in it by an accurate obſerver with the help of a microſcope, appears in its proper form. Before it paſſes into this ſtate, however, there requires a ſtate of reſt for the wings to harden, and the ſeveral other parts to acquire their proper firmneſs; this is tranſacted in a time of perfect reſt, when the animal lies in what is called the *nymph* or *chryſalis* ſtate, in appearance only a lump of inanimate matter. There is a ſettled and determined time for each of theſe changes in every ſpecies: but in the ſeveral different kinds, the periods are very different.

There is no ſign of ſex in the animal while in the caterpillar ſtate: the propagation of the ſpecies is the buſineſs of the creature in its ultimate perfection; and till that, theſe parts are never excluded: one female butterfly, when ſhe has been impregnated by the male, will produce 300 or 400 eggs, or even more. There is no way of knowing the ſexes of theſe little creatures by viewing the parts; but the whole figure and manner of the animal makes the difference. The females are always larger than the males; they are alſo more ſlow in their motions; and ſome of them have no wings, or, at the moſt, only very ſmall ones. The males, however, have a ſort of beards, more beautiful than the antennæ or horns of the females: the female is much ſtronger as well as bigger than the male; and not unfrequently, in caſe of danger or diſturbance, ſhe flies away with him in time of copulation. On diſſecting the female, her uterus affords an aſtoniſhing ſight. The number of eggs in the tubes is amazing: but theſe have not all the ſame figure; and, in ſome ſpecies, as the ſilk-worm, &c. the eggs are of a beautiful blue; if any yellowiſh ones are ſeen among them, they are judged to be defective.

The care of all the butterfly tribe to lodge their eggs in ſafety is ſurpriſing. Thoſe whoſe eggs are to be hatched in a few weeks, and who are to live in the caterpillar ſtate during part of the remaining ſummer, always lay them on the leaves of ſuch plants as will afford a proper nouriſhment; but, on the contrary, thoſe whoſe eggs are to remain unhatched till the fol-

lowing ſpring, always lay them on the branches of trees and ſhrubs, and uſually are careful to ſelect ſuch places as are leaſt expoſed to the rigour of the enſuing ſeaſon, and frequently cover them from it in an artful manner. Some make a general coat of a hairy matter over them, taking the hairs from their own bodies for that purpoſe; others hide themſelves in hollow places in trees, and in other ſheltered cells, and there live in a kind of torpid ſtate during the whole winter, that they may depoſit their eggs in the ſucceeding ſpring, at a time when there will be no ſeverities of weather for them to combat. The day butterflies only do this, and of theſe but a very few ſpecies; but the night ones, or phalænæ, all without exception, lay their eggs as ſoon as they have been in copulation with the male, and die immediately afterwards.

It is well known, that the common and natural food of theſe creatures is the leaves and verdure of vegetables; yet, as weak and harmleſs as they ſeem, they will many of them deſtroy their fellows whenever they get an opportunity. M. Reaumur gives us an inſtance of this in 20 caterpillars of the oak, which he kept in a box with a ſufficient quantity of their natural food; yet their numbers daily decreaſed, till at laſt there remained only one. This is, however, only the caſe in ſome few ſpecies, the generality of theſe animals being very peaceable, many ſpecies living together in the ſame place without moleſting one another. Theſe ſpecies, however, though freed from ſuch dangers, are expoſed to others of a much more terrible kind; the worms or maggots of ſeveral ſorts of flies are frequently found about them, ſome preying upon their outſide, others lodged within them under the ſkin, but both kinds eating the poor defenceleſs creature up alive. Thoſe which feed on the outſides are eaſily diſcovered, the others are more hid; and frequently the caterpillar, which ſeems very hearty and vigorous, and very fleſhy, ſhall be found, upon opening, to be a mere ſkin, the internal parts being found to be all eaten away, and all the food that he ſwallows ſerving only to feed a vaſt number of worms, or maggots, which crawl about at liberty within him. Theſe devouring worms are of many different ſpecies; ſome being of the gregarious, ſome of the ſolitary kinds, and ſome ſpinning webs of their own ſilk to transform themſelves in; others undergoing that change without any ſuch covering. The beautiful cabbage-caterpillar is one of thoſe unhappy kinds which frequently are infeſted with the gregarious kinds, large numbers of which ſpin themſelves webs one after another, and afterwards come out in the ſhape of the parent-fly to whoſe eggs they owed their origin.

Theſe inteſtine enemies are a ſure prevention of the butterfly's appearing at its proper time; and as many of the former naturaliſts, who knew what butterfly to expect from a peculiar ſpecies of caterpillar which they preſerved, often ſaw a parcel of flies come out in the place of it, they having no idea that the fly had laid its eggs in the fleſh of the poor creature, ſuppoſed that this was one of its natural transformations, and that certain ſpecies of caterpillars ſometimes produced butterflies, ſometimes ſmall flies. Theſe, and many other deſtroyers, among which the birds are to be reckoned in the principal place, ſerve a noble purpoſe in preventing the too great number of theſe miſchievous animals. Their uſual habitation being the leaves and flowers of plants, they are, in their feeding, much expoſed to all thoſe deſtroyers: yet nature has taken care to preſerve a great number, by making many of them ſo exactly of the colour of the leaves they feed on, that they are not eaſily diſtinguiſhed from them; and by giving others a caution of keeping on the under part of the leaves, and being by that means out of ſight. But ſome ſpecies are much leſs expoſed, and of much more miſchief to the plants they feed on, by devouring more eſſential parts of them. Of theſe ſome eat the roots, and others the interior part of the trunk, deſtroying the veſſels that imbibe, and thoſe that diſtribute the juices. Theſe are different from the common caterpillars, in that their ſkin is much leſs rough and hard; and theſe are ſecure from our obſervation, and in general from their great deſtroyers the birds. They are not, however, abſolutely ſafe from the common dangers of the other ſpecies; for there is a kind of worms that find their food and habitation even in the bodies of theſe. The root-caterpillars, and thoſe which live within the branches of plants, are much more eaſily found out. The roots of ſcrophularia, and the ſtalks of lettuces, and ſome other plants, afford caterpillars which ſeem all of the ſame ſpecies. Thoſe found in the lettuces are extremely plentiful ſome years, and deſtroy vaſt quantities of that plant. Theſe uſually have their firſt habitation in the ſtalk, near the root.

Nothing is more ſurpriſing in inſects than their induſtry; and in this the caterpillars yield to no kind, not to mention their ſilk, the ſpinning of which is one great proof of it. The ſheaths and caſes which ſome of theſe inſects build for the paſſing their transformations under, are, by ſome, made of the ſilk, with their own hair, mixed with pieces of bark, leaves, and other parts of trees, with paper, and other materials; and the ſtructure of theſe is well worthy our attention. Yet there are others whoſe workmanſhip, in this article, far exceeds theſe. There is one which builds in wood, and is able to give its caſe a hardneſs greater than that of the wood itſelf in its natural ſtate. This is the ſtrange horned caterpillar of the willow, which is one of thoſe that eat their *exuviæ*. This creature has extremely ſharp teeth, and with theſe it cuts the wood into a number of ſmall fragments: theſe fragments it afterwards unites together into a caſe, of what ſhape it pleaſes, by means of a peculiar ſilk; which is no other than a tough and viſcous juice, which hardens as it dries, and is a ſtrong and firm cement. The ſolidity of the caſe being thus provided for, we are to conſider, that the caterpillar incloſed in it is to become a butterfly; and the wonder is, in what manner a creature of this helpleſs kind, which has neither legs to dig nor teeth to gnaw with, is to make its way out of ſo firm and ſtrong a lodgment as this in which it is hatched. It has been ſuppoſed by ſome, that the butterfly, as ſoon as hatched, diſcharged a liquor which ſoftened the viſcous matter that holds the caſe together, and ſo its ſeveral fragments falling to pieces, the way out lies open. This is evidently the truth of the caſe; though thoſe who ſuppoſed it, did it by mere conjecture: for, on a ſtrict examination, this liquor is always to be found in the animal, and is of the moſt proper kind for ſuch a ſervice. Reaumur judged, from the effects, that this liquor muſt be of a ſingular nature, and very different from the generality of animal fluids: and in diſſecting this creature in the caterpillar ſtate, there will always be found near the mouth, and under the œſophagus, a bladder of the bigneſs of a ſmall pea, full of a limpid liquor, of a very quick and penetrating ſmell, and which, upon divers trials, proves to be a very powerful acid; and among other properties, which it has in common with other acids, it ſenſibly ſoftens the glue of the caſe, on a common application. It is evident that this liquor, beſides its uſe to the caterpillar, remains with it in the chryſalis ſtate, and is the very thing that gives it a power of diſſolving the ſtructure of the caſe, and making its way through in a proper manner at the neceſſary time. Boerhaave adopted the opinion, that there are no true acids in animals, except in the ſtomach or inteſtines; but this familar inſtance proves the contrary.

Another very curious and myſterious artifice, is that by which ſome ſpecies of caterpillars, when the time of their changing into the chryſalis ſtate is coming on, make themſelves lodgments in the leaves of the trees, by rolling them up in ſuch a manner as to make themſelves a ſort of hollow cylindric caſe, proportioned to the thickneſs of their body, well defended againſt the

injuries of the air, and carefully fecured for their ftate of tranquillity. Befides thefe caterpillars, which in this manner roll up the leaves of plants, there are other fpecies which only bend them once; and others which, by means of thin threads, connect many leaves together to make them a cafe. All this is a very furprifing work, but all much inferior to this method of rolling. The different fpecies of caterpillars have different inclinations, not only in their fpinning and their choice of food, but even in their manners and behaviour one to another. Some never part company from the time of their being hatched to their laft change; but live and feed together, and undergo together their laft change into the chryfalis ftate. Others feparate one from another as foon as able to crawl about, and each feeks its fortune fingle; and there are others which regularly live to a certain time of their lives in community, and then feparate, each to fhift for itfelf, and never to meet again in that ftate. *Reaumur, Hift. Infect.* vol. ii. *paffim.*

Caterpillars are very deftructive to gardens, particularly thofe of two fpecies. The one, that which afterwards becomes the common white butterfly. This is of a yellowifh colour, fpotted with black; and infefts the leaves of cabbages, cauliflowers, and the Indian crefs, of which it eats off all the tender parts, leaving only the fibres entire; fo that whole plantations are often feen deftroyed by them in autumn, efpecially fuch as are near large buildings, or are crowded with trees. There is no remedy againft this evil but the pulling the creatures off before they are fpread from their nefts, and watching the butterflies, which are daily, in the hot weather, depofiting their eggs on thefe plants. Thefe, however, feed principally on the outfide of the leaves of the plants, and are therefore the eafier taken off; but the other kind lies near the centre, and therefore is with much more difficulty difcovered. This is much larger; and the fkin is very tough, and of a brown colour. It is called by the gardeners a *grub*, and is extremely pernicious. The eggs which produce it are ufually depofited in the very heart or centre of the plant, particularly in cabbages; and the creature, when formed, and grown to fome fize, eats its way through all the blades, and leaves its dung in great quantity behind it, which fpoils the cabbage. This infect alfo burrows under the furface of the ground, and makes fad havock among young plants, by eating off their tender fhanks, and drawing them into its holes. This mifchief is chiefly done in the night; but wherever a plant is feen thus deftroyed, if the earth be ftirred with a finger an inch deep, the creature will be certainly found, and this is the only way of deftroying them. *Miller.*

When thefe animals attack fruit-trees, the beft prefervative is to boil together a quantity of rue, wormwood, and the common tobacco, of each equal parts, in common water; to make the liquor very ftrong, and fprinkle it on the leaves and young branches every night and morning, during the time when the fruit is ripening. See farther the article CATERPILLAR.

Dr. Hawkefworth has given an account of a kind of fmall green caterpillar, which the voyagers to the South fea found in great numbers on the true Weft Indian mangroves. Their bodies were thick fet with hairs, and they were ranged on the leaves fide by fide like files of foldiers, to the number of 20 or 30 together. When they touched them, they found that the hairs on their bodies had the quality of a nettle, and gave them a much more acute though lefs durable pain.

ERUCÆ *Aquaticæ, Water Caterpillars.* It may feem incredible, that there is any fuch thing as a caterpillar whofe habitation is under water; but experience and obfervation prove, that there are fuch, and that they feed on the water plants as regularly as the common kinds do on thofe at land. Thefe are not named at random like many of the aquatic animals of the larger kinds, as the fea-wolf, the fea-horfe, &c. which might as well be called any thing elfe as *wolves* and *horfes*; but they are properly what they are called, and do not refpire in the manner of the fifh-tribe, but by their ftigmata as other caterpillars. M. Reaumur, in his obfervations, met with two fpecies of thefe; the one upon the potamogiton or pond-weed, the other upon the lenticula or duck-meat. Thefe are both very induftrious animals; but the firft being much the largeft, its operations are more eafily diftinguifhed. This, though truly an aquatic animal, fwims but badly, and does not at all love to wet itfelf. The parent butterfly lays her egg on the leaf of a certain plant; and as foon as the young caterpillar is hatched, it gnaws out a piece of the leaf, of a roundifh fhape. This it carries to another part of the fame leaf, and lays it in fuch a manner, that there may be a hollow between, in which it may lodge. It then faftens down this piece to the larger leaf with filk of its own fpinning; only leaving certain holes at which it can put out its head, and get to gnaw any of the leaves that are near. It eafily gets out, though the aperture be naturally fmall, fince a little force from its body bends up the upper leaf and down the lower, both being flexile; and when the creature is out, it has a fort of down that defends it from being wetted, and the natural elafticity of the leaves and of the filk joins the aperture up again, fo that no water can get in. The leaves of this kind of plant are alfo naturally very flippery, and not eafily wetted by water. It foon happens that this habitation becomes too fmall for the animal, in which cafe it makes juft fuch another; and after that, at times, feveral others; each being only made fit for it at the fize it is then of. The changes of this creature into the chryfalis and butterfly ftates are in the common method. The butterfly gets out of a chryfalis which was placed on the furface of the water; the lightnefs of the animal eafily fuftains it on the water till its wings are dried, and then it leaves that element, never to return to it again.

ERUCÆ *Sylveftres, Wood-caterpillars*; the name of a fort of caterpillars which do not live, after the manner of others, on leaves of trees or plants, or open to our obfervation; but under the bark, in the trunk and branches, and in the roots of trees, and fometimes in the body of fruits. Thefe are eafily diftinguifhed from thofe worms and maggots which are found in roots and fruits, and owe their origin to flies of another kind; but are liable to be confounded with a fort of animals, called by M. Reaumur, *falfe* or *baftard caterpillars*, which carry a great refemblance in their figure to real caterpillars, but which have more legs than any of the true ones have, and are finally transformed into four-winged flies, which are not true butterflies.

The butterflies which are the parents of thofe caterpillars that lie immured in trees or fruits, lay their eggs on the furface; and the young caterpillars, when hatched, eat their way in. What appears fomething furprifing, however, in this, is, that there ufually is only one caterpillar in a fruit which is large enough to afford food to a great number; and if there are fometimes found two creatures within, one is ufually a caterpillar, the other a worm of fome other kind. The whole occafion of this is, that the operation of penetrating into the fruit is fo difficult to the young animal, that it feldom fucceeds in it; and though the butterfly depofits many eggs on each fruit, and thefe all hatch, yet it is only here and there one on a fruit that can find its way into it.

Thefe creatures, when once lodged in their prifon, have nothing to do but to eat up the fubftances which inclofe them, leaving the outer hard fhell unhurt, which ftill ferves as a cafe for them. This is a very frequent cafe in grains of corn, where the farinaceous fubftance ferves as aliment, and the hard outer fkin becomes a firm hollow cafe afterwards for the

animal. The farinaceous fubftance in this cafe ufually proves enough for the animal in its caterpillar ftate; but if it does not, the creature has recourfe to a very fingular expedient: it eats again its own excrements; and finds its now ftronger ftomach able to feparate nourifhment from that very matter which had before paffed off from its weaker ftomach undigefted.

Of thefe fpecies of caterpillars, fome go out of their prifon in order to change into their chryfalis, and thence into their butterfly ftate; but the greater number remain there, and pafs through all their changes within. Thefe caterpillars, like all the other kinds, have certain flefh-eating worms, whofe parents are of the fly-kind, for their terrible enemies and deftroyers; and it is not unfrequent, on opening one of thefe fpoiled fruits, inftead of the expected caterpillar, to find a fly juft ready to come out: this has been produced from the chryfalis of a worm, which had before found its way into the fruit, and eat up the caterpillar, which was the original poffeffor of the place.

ERUDITION, denotes learning or knowledge; and chiefly that of hiftory and antiquity, of languages and of books, which is the refult of hard ftudy and extenfive reading. The Scaligers were men of deep erudition: the writings of M. Launoy, a prieft of the Oratory, are full of erudition. Mr. Locke fays, it is of more ufe to fill the head with reflections than with points of erudition. If the mind be not juft and right, ignorance is better than erudition, which only produces confufion and obfcurity. M. Balzac calls a heap of ill chofen erudition the luggage of antiquity.

ERUPTION, in medicine, a fudden and copious excretion of humours, as pus or blood: it fignifies alfo the fame with exanthema, any breaking out, as the puftules of the plague, fmall-pox, meafles, &c.

Eruption *of Volcanoes*. See Ætna, Etna, Vesuvius, Volcano, &c.

ERVUM, the lentil; a genus of the decandria order, belonging to the diadelphia clafs of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The calyx is quinquepartite, the length of the corolla. There are fix fpecies; of which the moft remarkable is the lens, or common lentil. It is cultivated in many parts of England, either as fodder for cattle, or for the feeds, which are frequently ufed in meagre foups. It is an annual plant, and rifes with weak ftalks about 18 inches high, garnifhed with winged leaves compofed of feveral pairs of narrow lobes, terminated by a clafper or tendril, which faftens to any neighbouring plant, and is thereby fupported: the flowers come out three or four together, upon fhort footftalks from the fide of the branches. They are fmall, of a pale purple colour, and are fucceeded by fhort flat pods, containing two or three feeds which are flat, round, and a little convex in the middle. The feeds of this plant are moft commonly fown in the month of March, where the land is dry; but in moift ground, the beft time is April. The ufual quantity of feed allowed for an acre of land is from one bufhel and a half to two bufhels. If thefe are fown in drills in the fame manner as peafe, they will fucceed better than when fown in broadcaft: the drills fhould be a foot and a half afunder, to allow room for the Dutch hoe to clean the ground between them; for if the weeds are permitted to grow among them, they will get above the lentils and ftarve them.

There is another fort of lentil alfo cultivated in this country under the name of *French lentil*. It is twice the fize of the former, both in plant and feed; and is much better worth cultivation than the other. It fhould be fown in March, after a fingle ploughing, in the ground that bore corn the year before. Manure is not abfolutely neceffary, though it will undoubtedly increafe the crop. Its grafs is faid to be very copious; it may be mowed many times in the year, and affords a healthy as well as an agreeable food to horfes, cows, and fheep: the milk of cows fed with it is faid to be very copious and good. Long and numerous pods ripen about the beginning of winter, which afford a new kind of legumen, to be eaten as common lentils: when frefh, it makes admirable peafe-foup; dry, it is greedily eaten by the poultry. The dried herb is alfo a good refource for cattle in winter. It grows on any kind of ground.

ERYMANTHUS, a mountain, river, and town of Arcadia, where Hercules killed a prodigious boar, which he carried on his fhoulders to Euryftheus; who was fo terrified at the fight, that he hid himfelf in a brazen veffel.

ERYNGIUM, sea-holly, or *Eryngo*; a genus of the digynia order, belonging to the pentandria clafs of plants; and in the natural method ranking under the 45th order, *Umbellatæ*. The flowers are collected into a round head, and the receptacle is paleaceous. There are nine fpecies; moft of which are hardy herbaceous perennials, producing erect ftalks from one to two or three feet high; with fimple, entire, or divided prickly leaves; and the ftalks terminated by roundifh aggregate heads of quinquepetalous flowers, of white, blue, or purple colours. They all flower moftly in July, and the feeds ripen in September. They are propagated by feeds fown in a bed or border, either in fpring or autumn. The plants are to be removed the autumn after they come up, into thofe places where they are defigned to remain. The leaves of one of the fpecies (viz. the maritimum, which grows naturally on the fea-coafts of England and Scotland) are fweetifh, with a light aromatic warmth and pungency. The young flowering fhoots, eaten like afparagus, are very grateful and nourifhing.

ERYSIMUM, hedge-mustard; a genus of the filiquofa order, belonging to the tetradynamia clafs of plants; and in the natural method ranking under the 39th order, *Siliquofæ*. The filiqua is long, linear, and exactly tetragonal; the calyx clofe. There are fix fpecies; of which the moft remarkable is the officinale, hedge-muftard, or bank-creffes. It grows naturally in Britain under walls, by the fides of highways, and among rubbifh. It is warm and acrid to the tafte; and, when cultivated, is ufed as a vernal pot-herb. Birds are fond of the feeds; fheep and goats eat the herb; cows, horfes, and fwine refufe it. The feeds are faid to promote expectoration, and excite urine, but they are fcarcely ever employed in medicine at prefent.

ERYSIPELAS, in furgery, an eruption of a fiery or acrid humour, from which no part of the body is exempted, though it chiefly attacks the face. See Surgery.

ERYTHEA, or Erythia, an ifland adjoining, according to the ancients, either to or a part of Gades; no where now to be found by the defcription given of it by ancient authors. The poets feign this to be the habitation of the fabulous Geryon, difarmed by Hercules, who drove away his cattle.

ERYTHRÆA, a town of Crete, fituated in the fouth-eaft of the ifland, at the promontory Erythræum.

ERYTHRÆUM mare, erroneoufly called *Rubrum* by the Romans. Thus the ocean that wafhes Arabia and Perfia, and extends a great way farther, is denominated. Hence it is, Herodotus fays, that the Euphrates and Tigris fall into the Mare Erythræum. He alfo calls it the *South Sea*, on which the Perfians dwell. It takes its name, not from its colour, the error of the Romans, who tranflated *Erythræum*, "Rubrum;" but from *Erythras*, fon of Perfeus and Andromeda, whofe kingdom lay on the confines of that fea; whence its name *Erythræum*.

ERYTHRINA, coral-tree; a genus of the decandria order, belonging to the diadelphia clafs of plants; and in the natural method ranking under the 32d order *Papilionaceæ*. The calyx is bilabiate, the one lip above, the other below; the vexillum of the corolla is very long and lanceolated. There

are four ſpecies, all of them ſhrubby flowering exotics for the ſtove, adorned chiefly with trifoliate or three-lobed leaves, and ſcarlet ſpikes of papilionaceous flowers. They are all natives of the warm parts of Africa and America; and muſt always be kept in pots, which are to remain conſtantly in ſtoves in this country. They are propagated by ſeeds, which are annually imported hither from Africa and America. They are to be ſown half an inch deep in pots of light rich earth, which are then to be plunged in the bark bed of the ſtove; and when the plants are two inches high, they are to be ſeparated into ſmall pots, plunging them alſo in the bark-bed, giving them frequent waterings, and as they increaſe in growth ſhifting them into larger pots. The inhabitants of Malabar make ſheaths of the wood for ſwords and knives. They uſe the ſame, together with the bark, in waſhing a ſort of garments which they call ſaraſſas; and make of the flowers the confection caryl. The leaves pulveriſed and boiled with the mature cocoa-nut have been deemed uſeful in venereal complaints. The juice of the leaves, combined with any greaſy matter, alſo cures the itch and ſome other eruptions.

ERYTHRINUS, in ichthyology, a ſpecies of Sparus.

ERYTHROIDES, in anatomy, the firſt of the proper tunics or coats which cover the teſticles.

ERYTHRONIUM, dog's-tooth violet; a genus of the monogynia order, belonging to the hexandria claſs of plants; and in the natural method ranking under the 11th order, *Sarmentaceæ*. The corolla is hexapetalous and campanulated; with a nectarium of two tubercles adhering to the inner baſe of every other petal. There is only one ſpecies, which, however, admits of ſeveral varieties in its flowers, as white, purple, pale red, dark red, crimſon, and yellow. The plants are low and herbaceous, with a purple ſtalk and hexapetalous flowers. All the varieties are hardy and durable; and may be planted in ſmall patches in borders, where they will make a good appearance. They rarely perfect their ſeeds in this country, but may be propagated by offsets. In Siberia, according to Gmelin, they dry and mix the root of this plant with their ſoups. It grows there in great abundance; and is called by the people of the country *beſs*.

ERYTHROXYLON, in botany; a genus of the trigynia order, belonging to the decandria claſs of plants; and in the natural method ranking with thoſe the order of which is doubtful. The calyx is turbinated; the petals of the corolla have each a nectariferous emarginated ſcale at the baſe; the ſtamina are connected at the baſe; the fruit a bilocular plum.

ERYX, a ſon of Butes and Venus, who relying upon his ſtrength, challenged all ſtrangers to fight with him in the combat of the ceſtus. Hercules accepted his challenge after many had yielded to his ſuperior dexterity; and Eryx was killed in the combat, and buried on the mountain, where he had built a temple to Venus. Virg. Æn. 5. ver. 402. A mountain of Sicily near Drepanum, alſo received its name from Eryx, who was buried there. This mountain was ſo ſteep, that the houſes which were built upon it ſeemed every moment ready to fall. Dædalus had enlarged the top, and encloſed it with a ſtrong wall. He alſo conſecrated there to Venus Erycina a golden heifer, which reſembled life ſo much, that it ſeemed to exceed the power of art.

ERZERUM, a large and ſtrong town of Turkey in Aſia, with Armenian and Greek epiſcopal ſees. It ſtands in a peninſula, formed by the ſources of the river Euphrates, called Frat by the Turks. It is a large place five days journey from the Black Sea, and 10 from the frontiers of Perſia, built in a beautiful plain, at the foot of a chain of mountains, fruitful in all ſorts of corn. Wood is very ſcarce, for which reaſon their fuel is only cow dung. It is ſurrounded by double walls, defended by ſquare towers. The Turks, who are all Janiſaries, are about 12,000 in number: they are moſt of them tradeſmen, and receive no pay. The Armenians have two churches, the Greeks but one. The latter are moſtly braſiers; and, as they are always making a noiſe, night and day, with their hammers, they are obliged to live in the ſuburbs. They drive a great trade here in furs and gall-nuts. This town is a thoroughfare, and a reſting-place for the caravans which paſs to the Indies. Their merchandiſe is Perſian ſilks, cottons, calicoes, and drugs. Lon. 40. 41. E. Lat. 39. 57. N.

ESCALADE, or Scalade, a furious attack of a wall or a rampart; carried on with ladders, to paſs the ditch or mount the rampart; without proceeding in form, breaking ground, or carrying on regular works to ſecure the men. When the troops are prepared to paſs the ditch, either with the aſſiſtance of boards, hurdles, and faſcines, when it is muddy, or with ſmall boats of tin, or baſkets covered with ſkins or oil-cloth, when it is deep and filled with water, a party muſt be placed on the counterſcarp, oppoſite to the landing-place, ready to fire at the garriſon if they are alarmed, and oppoſe the mounting on the rampart. If the ditch is dry, the ladders are fixed in ſome place fartheſt diſtant from the centry; and as ſoon as they get upon the rampart, they put themſelves in order to receive the enemy; if the centry ſhould be ſurpriſed and ſilently overcome, the detachment haſtens to break open the gate, and to let in the reſt of the party. If the ditch is wet, the rampart high, and provided with a revêtement, it will be difficult to ſurpriſe the town in this way; but if there is no revêtement, the troops may hide themſelves along the outſide of the rampart till all are over. Since the invention and uſe of gunpowder, and the walls of cities have been flanked, they are ſeldom taken by eſcalade.

ESCALLONIA, in botany; a genus of the monogynia order, belonging to the pentandria claſs of plants. The fruit is bilocular and polyſpermous; the petals diſtant and tongue-ſhaped; the ſtigma headed.

ESCAPE, in law; a violent or privy evaſion out of ſome lawful reſtraint, without being delivered by due courſe of law. There are two ſorts of eſcapes, voluntary and negligent. Voluntary, when a man arreſts another for felony, or other crime, and afterwards lets him go free by conſent; in which caſe, the party that permits ſuch eſcape is held guilty, committed, and muſt anſwer for it. Negligent eſcape, on the contrary, is where one is arreſted, and afterwards eſcapes againſt the will of the perſon that arreſted him, and is not purſued with freſh ſuit, and retaken before the perſon purſuing hath loſt ſight of him. By ſtat. 8 and 9 Will. III. c. 26. the keepers of priſons conniving at eſcapes ſhall forfeit 500l.; and in civil caſes the ſheriff is anſwerable for the debt.

ESCHALOT, or Shallot. See Allium.

ESCHAR, in ſurgery, the cruſt or ſcab occaſioned by burns or cauſtic applications.

ESCHARA, in natural hiſtory, the name of a ſpecies of coralline, &c. the characters of which are theſe: they are of a ſtony or coral-like hardneſs, and reſemble a woven cloth in their texture; and the microſcope informs us, that they conſiſt of arrangements of very ſmall cells, whoſe ſurfaces appear much in that form. Linnæus makes it a ſpecies of millepora, in the claſs of lithophytes. See Plate 86. Vol. II.

The narrow-leaved hornwrack, fig. 9. divides, as it riſes, into narrow leaves made up of regular rows of oblong ſquare-ſhaped cells placed alternately by each other, and oppoſite to an equal number on the other ſide of the leaf, like an honeycomb: from theſe leaves proceed other ſtill ſmaller foliaceous ramifications, many of which ſeem to be connected at the lower part by tubuli, as in the corallines; by which means they can ply to and fro more freely in the water.—*c*, Gives the natural appearance of this coralline. E repreſents two leaves with their tubuli and

cells magnified. E 1 is a croſs ſection of one of the leaves at E, ſhowing the partition and inner form of their cells.

The broad-leaved hornwrack, fig. 10. when freſh taken out of the ſea, is of a ſpongy texture, and ſmells very fiſhy; but when it has lain for ſome time on the ſhore, it becomes ſtiff and horny, like ſome ſorts of withered leaves. Both ſurfaces, when examined by glaſſes, appear to be covered with cells; and, when a piece of it is cut acroſs, one may diſcover the thin membrane that ſerves as a baſe to the cells of each ſurface. The form of the cells is very remarkable, each one being arched at the top, and contracted a little at the lower part of the ſides to make way for the arches of the two next adjoining cells; ſo that by this particular conſtruction no room is loſt. The entrance of the cells is immediately under the arch of each cell, and the walls of the cells ſeem to be fortified with ſpines. Juſſieu diſcovered ſmall polypes extending themſelves out of theſe cells, which he has deſcribed in the memoirs of the Academy of Sciences 1742.—*f*, Gives the natural appearance of a leafy branch of this coralline. F is a part of a leaf magnified to ſhow the ſuperficial figure of the cells, and the manner in which they are diſpoſed. F 1 ſhows a croſs ſection of a leaf, and diſcovers the ſeveral partitions of the cells. At the entrance of many of the cells a ſmall teſtaceous body like a bivalve ſhell is diſcovered: F 2, the figure of the cell, with the ſhell in it; it is of a tranſparent amber colour, ſo clear that one may ſee the dead animal through it, repreſented by the black ſpot.

ESCHEAT, in law, ſignifies any lands or tenements that caſually fall to a lord within his manor. It is one of the conſequences of tenure in chivalry: (See Feodal *Syſtem*, Knight-*Service*, and Tenure.) It is the determination of the tenure or diſſolution of the mutual bond between the lord and tenant, from the extinction of the blood of the latter by either natural or civil means: if he died without heirs of his blood, or if his blood was corrupted and ſtained by commiſſion of treaſon or felony; whereby every inheritable quality was entirely blotted out and aboliſhed. In ſuch caſes the land eſcheated or fell back to the lord of the fee; that is, the tenure was determined by breach of the original condition, expreſſed or implied in the feodal donation. In the one caſe, there were no heirs ſubſiſting of the blood of the firſt feudatory or purchaſer, to which heirs alone the grant of the feud extended: in the other, the tenant, by perpetrating an atrocious crime, ſhowed that he was no longer to be truſted as a vaſſal, having forgotten his duty as a ſubject: and therefore forfeited his feud, which he held under the implied condition that he ſhould not be a traitor or a felon. The conſequence of which in both caſes was, that the gift being determined, reverted to the lord who gave it. The word *eſcheat* is ſometimes uſed for the place or circuit within which the king or other lord is intitled to eſcheats; alſo for a writ to recover the ſame from the perſon in poſſeſſion after the tenant's death. In Scots law, it denotes that forfeiture of eſtate and property which is incurred upon a perſon's being denounced a rebel. See Law.

ESCHEVIN, or Echevin *(Scabinus)*, in the French and Dutch polity, a magiſtrate elected by the inhabitants of a city, to take care of their common concerns, the good order, conveniency, and decoration of the city, &c. At Paris there is a prevôt and four *eſchevins*; in moſt other cities a mayor and *eſchevins*. Anciently the *eſchevins* were the aſſeſſors and counſellors of the comites or judges of cities; on which account they were called in ſome places *pairs, pares*; they even took cognizance of petty cauſes themſelves. Du-Cange obſerves, that the judges and their aſſeſſors, who were choſen by the inhabitants, were called *ſcabini* "eſchevins," and their college *ſcabinagium* or "eſchevinage." Till the late revolution in Holland, the *ſcabins* or *eſchevins* were judges of all civil affairs at firſt hand. They alſo take cognizance of criminal matters: and if the criminal confeſs himſelf guilty, they can ſee their ſentence executed without appeal. They can even give torture. The number is not the ſame in all cities; at Amſterdam there are nine, at Rotterdam ſeven," &c.

ESCHRAKITES, or Esrakites, a ſect of philoſophers, among the Mahometans, who adhere to the doctrines and opinions of Plato. The word is derived from the Arabic שרק *ſchraca*, which in the fourth conjugation אשרק *aſchraca*, ſignifies "to ſhine, glitter like the ſun;" ſo that *Eſchrakite* ſeems to import "illumined." The *Eſchrakites*, or Mahometan Platoniſts, place their higheſt good and happineſs in the contemplation of the Divine Majeſty; deſpiſing the groſs imaginations of the Alcoran touching paradiſe. They are very careful in avoiding all vice; they preſerve an equal and eaſy temper, love muſic, and divert themſelves with compoſing little poems or ſpiritual ſongs. The ſhaeicks or prieſts, and the chief among the preachers of the imperial moſques, are Eſchrakites.

ESCLAIRCISSEMENT, a French term adopted into our language, ſignifying the explaining or clearing up of ſome difficulty or obſcurity.

ESCORT, a French term, ſometimes uſed in Engliſh authors, to denote a convoy or company of armed men, attending ſome perſon or thing, in a journey or voyage, to defend or ſecure it from inſults. Some derive the word from the Latin *cohors*.

ESCOUADE, or Squad, is uſually the third or fourth part of a company of foot; ſo divided for mounting guards, and for the more convenient relieving of one another. It is equivalent to a brigade of a troop of horſe. See Brigade.

ESCUAGE, in our old cuſtoms, a kind of knight-ſervice, called *ſervice of the ſhield*, by which the tenant was bound to follow his lord to the wars at his own charge. See the articles Chivalry, Feodal *Syſtem*, and Knight-*Service*.

ESCULENT, an appellation given to ſuch plants or the roots of them as may be eaten: ſuch are beets, carrots, artichokes, leeks, onions, parſnips, potatoes, radiſhes, ſcorzonera, &c.

ESCURIAL, a village of Spain, in New Caſtile, where Philip II. built a famous monaſtery in 1563, in memory of the victory gained over the French near St. Quentin. It is called by the Spaniards the eighth wonder of the world. It conſiſts of a royal palace, a church, cloiſters, a college, a library, ſhops of different artiſts, apartments for a great number of people, beautiful walks, large alleys, an extenſive park, and fine gardens, adorned with a vaſt number of fountains. It ſtands in a dry barren country, ſurrounded by rugged mountains, and where nothing grows but what is cultivated with extraordinary care. It is built of gray ſtones, found in the neighbourhood, which was the principal reaſon of its being erected on ſo diſagreeable a ſpot. They worked at this ſtructure 22 years, and it coſt 6,000,000 of crowns. It is a long ſquare of 280 feet, and four ſtories high: they reckon 800 pillars, 11,000 ſquare windows, and 14,000 doors. The moſt remarkable part is the vaulted chapel, in which is a magnificent ſepulchre, called the Pantheon, becauſe it is built in imitation of that church at Rome: it is the burying-place of the kings and queens of Spain, and is thought by ſome to be the moſt curious piece of architecture in the world. The fathers, belonging to the monaſtery, are 200 in number, and have an income of 40,000 ducats a year, which is ſufficient to maintain them in great plenty. The church is built after the model of St. Peter's at Rome. It is ſeated on the river Guadara, 15 miles N. W. of Madrid. Long. 3. 35. W. Lat. 40. 35. N.

ESCUTCHEON, in heraldry, is derived from the French *eſcuſſon*, and that from the Latin *ſcutum*, and ſignifies the ſhield whereon coats of arms are repreſented. Moſt nations of the remoteſt antiquity were wont to have their ſhields diſtinguiſhed by certain marks painted on them; and to have ſuch on their ſhields was a token of honour, none being permitted to have them till they had performed ſome honourable action. The

efcutcheon, as ufed at prefent, is fquare, only rounded off at the bottom.

ESDRAS, a Jewifh prieft, and doctor of the law. Artaxerxes Longimanus fent him with rich prefents for the ufe and ornament of the temple at Jerufalem, rebuilt under Zerubbabel; the king alfo ordered the neighbouring governors to provide him with what conduced to the pomp of the Jewifh religion, and to exempt the priefts from paying taxes. He is fuppofed to be the collector of the Canon of Scripture; and that, by divine infpiration, he added fome things which happened after the deaths of the authors. It is gueffed he wrote the Chronicles, befides thofe books which bear his name, the two laft of which are exploded even by the church of Rome.

ESK, the name of feveral rivers both in England and Scotland, particularly of one which forms part of the boundary between the two kingdoms. It runs from north-eaft to fouth-weft, and gives name to the county of Efkdale.

ESKIMAUX, a people of N. America, inhabiting all that vaft tract of country called Labrador, or New Britain. They have no fixed abode, but rove from place to place; for they fometimes come as far S. as Newfoundland, and fometimes are met with on the coafts of the ftraits and bays that the Englifh have been in when they went in fearch of the N. W. paffage. They are of a different race from the other native Americans; for, as they have no beards, thefe have them fo thick and large, that it is difficult to difcover any features of their faces. They have fmall eyes, large dirty teeth, and black rugged hair. They are always well clothed, for there is nothing to be feen but part of their faces and their hands. They have a fort of fhirts, made of the guts of fifh, with a coat of bear or bird fkins, and a cap on their heads. They have likewife breeches, made of fkins, with the hair within, and covered with furs without. They have alfo two pair of boots, one over another, of the fame fort of fkins. In fummer, they have nothing to cover them in the night; but, in winter, they lodge together promifcuoufly in caves. The drefs of the women is nearly the fame as that of the men. They are very fuperftitious, and have fome fort of facrifices. Their chief employment is hunting and fifhing.

ESNE, Asne, or Essenay, a town of Egypt, on the Nile, fuppofed to be the ancient Syena, but Norden thinks it was Latopolis. It is a large place, in the centre of which is an ancient temple, with walls on three fides, and in the front 24 columns, well preferved: they fupport ftones, placed crofswife, on which great tables are laid, which form a roof. Within the temple are three ftories of hieroglyphics, of men about three feet high, and at one end the loweft figures are as big as the life; one of them had the head of Ibis. The ceiling is curioufly adorned with all forts of animals, painted in beautiful colours. The temple appears to have been ufed as a church, for there are feveral infcriptions on the wall, in black letters. On the N. fide of the town is another temple, with pillars fomewhat like thofe of the Corinthian order. The whole building is richly carved with hieroglyphics. A man with a goat's head, and another with that of a crocodile, are cut over the middle of the door: there are other crocodiles' heads, and whole crocodiles, fo that it is probable that this animal was worfhipped here. However, it muft be obferved, that Strabo mentions the city of Crocodiles as diftinct from Aphroditopolis and Latopolis. A mile to the S. is the monaftery of St. Helen, by whom fome fay it was founded. It now appears to have been a large burying-ground, and there are many magnificent tombs in it. Efne lies near the grand cataract. Lon. 31. 40. E. Lat. 24. 46. N.

ESOX, in ichthyology, a genus of fifhes belonging to the order of abdominales. See the article Barracida.

ESPALIERS, in gardening, are rows of trees planted about a whole garden or plantation, or in hedges, in fuch a manner as to inclofe quarters or feparate parts of a garden; and are trained up regularly to a lattice of wood-work in a clofe hedge for the defence of tender plants againft the injuries of wind and weather. They are of admirable ufe and beauty in a kitchen-garden, ferving not only to fhelter the tender plants, but fcreen them from the fight of perfons in the walks. The trees chiefly planted for efpaliers, are apples, pears, and fome plums: fome plant apples grafted upon paradife-ftocks: but as thefe are of fhort duration, it is better to plant thofe grafted upon crabftock, or upon what the gardeners call *Dutch-ftocks*; which will both caufe them to bear fooner, and prevent their growing too luxuriant. The beft kinds of apple for this purpofe, are the golden pippen, nonpareil, rennet, &c. and the beft forts of pear are the jargonelle, blanquette, &c. Thefe laft, if defigned for a ftrong moift foil, fhould be grafted upon quince-ftocks; but if for a dry foil, upon free-ftocks. While the trees are young, it will be fufficient to drive a few ftakes into the ground on each fide of them; faftening the branches to thefe in a horizontal pofition, as they are produced. This method will do for the firft three years; after which an efpalier fhould be made of afh-poles, whereof there muft be two forts, larger and fmaller; the former to be driven upright into the ground a foot afunder, and the latter, or flender poles, to be nailed acrofs thefe, at about nine inches. Some prefer to this another fort of efpalier, made of fquare timber cut to any fize: thefe are, indeed, more fightly, but withal vaftly more expenfive. When the efpalier is thus framed, the branches are to be faftened to it with ofier-twigs; obferving to train them in a horizontal pofition. and at equal diftances. Fruit-trees thus managed are preferable to any others; not only as bearing better-tafted fruit, but as taking up very little room in a garden, fo as to be lefs hurtful to plants which grow in the quarters.

ESPLANADE, in fortification, the floping of the parapet of the covered-way towards the campaign.

ESPLEES, in law, the general products which lands yield, or the profit or commodity that is to be taken or made of a thing.

ESPOUSALS, in law, fignify a contract or promife made between a man and a woman to marry each other; and in cafes where marriages may be confummated, efpoufals go before. Marriage is termed an efpoufal *de præfenti*. The efpoufals amongft the Jews were either by writing, or by a piece of filver given and received, or by cohabitation. Amongft the Greeks, after the parents and friends of the young couple had finifhed their negotiation, the couple themfelves pledged their faith to each other, the man fwearing that he would be conftant and true, the woman that fhe would marry him, and make him mafter of all fhe had. Then they ratified their agreement by a kifs and joining right hands. Amongft the Romans the efpoufals confifted in an engagement of friends on both fides, whether abfent or prefent, in public or without witneffes. But the common way was by writings drawn up by common confent, and fealed by both parties: befides this, the man fent a ring to the woman, confifting of iron and without a ftone.

ESQUILIÆ, one of the feven hills of Rome, which Varro will have to be two, viz. Cifpius and Oppius; alfo Mons Efquilinus, foftened from Exquilinus; and this again from Excubinus, the watch or guard Romulus kept here, from a jealoufy he entertained of his colleague Titus Tatius. On the eaft fide it reached the city walls; on the fouth, the Via Lavicana; on the weft, the wide valley between mount Coelius and the Palatinate; on the north, the Mons Viminalis; on the eaft fide was the Porta Efquilina. This hill by fome of the ancients was called *Suburranus*, from the ftreet *Suburra* to the north of it: by the poets, *Efquilius*.

ESQUIMAUX. See Eskimaux.

ESQUIRE (from the French *efcu*, and the Latin *fcutum*, in

Greek σκυτος, which fignifies a hide, of which fhields were anciently made, and afterwards covered; for, in the time of the Anglo-Saxons, the fhields had a covering of leather), was originally he, who, attending a knight in time of war, did carry his fhield; whence he was called *efcuier* in French, and *fcutifer*, or *armiger*, i. e. armour-bearer, in Latin. Hotoman fays, that thofe whom the French called *efquires*, were a military kind of vaffals, having *jus fcuti*, viz. liberty to bear a fhield, and in it the enfigns of their family, in token of their gentility or dignity. But this addition hath not of long time had any relation to the office or employment of the perfon to whom it hath been attributed, as to carrying of arms, &c. but hath been merely a title of dignity, and next in degree to a knight. For thofe to whom this title is now due, fee the article Commonalty. Officers of the king's courts, and of the king's houfehold, counfellors at law, juftices of the peace, are only *efquires* in reputation; and he who is a juftice of peace has this title only during the time he is in commiffion, and no longer, if he is not otherwife qualified to bear it. A fheriff of a county being a fuperior officer, bears the title of *efquire* during his life; in refpect of the great truft he has in the commonwealth. The chief of fome ancient families are efquires by prefcription; and in fome acts of parliament, many wealthy perfons commonly reputed to be fuch, were ranked among the efquires of this kingdom. There is a general opinion, that every gentleman of landed property who has 300l. a year, is an efquire; which is a vulgar error. By cuftom, however, and by way of compliment, this title is indifcriminately given to every gentleman who lives on his private fortune, to rich merchants alfo, and even opulent tradefmen or manufacturers.

Esquires *of the King*, are fuch as have that title by creation, wherein there is fome formality ufed, as the putting about their necks a collar of SS, and beftowing on them a pair of filver fpurs, &c.

ESRAKITES. See Eschrakites.

ESSAY, a trial or experiment for proving the quality of any thing; or an attempt to learn, whether or not any invention will fucceed.

Essay, in literature, a peculiar kind of compofition, the character whereof is to be free, eafy, and natural; not tied to ftrict order or method, nor worked up and finifhed like a formal fyftem.

ESSAYING, or Assaying, in chemiftry and metallurgy, fignifies the examination of a fmall quantity of any ore or mineral by fire, in order to difcover its contents. This is very neceffary for thofe who intend to deal largely in metallurgic operations, in order to avoid unneceffary expence, by becoming previoufly acquainted with the nature of the ores.

The firft attempts in this way were no doubt extremely rude; but fucceeding trials have advanced it to the form of a fcience or art practifed by numbers of people under the title of *effaymafters*. No treatife was publifhed on this fubject till after the middle of the 16th century; and the firft book we have upon it is attributed to Lazarus Ercker, which appeared in 1574. Agricola, however, in his feventh book *De re Metallica*, publifhed in 1576, defcribed both the inftruments and proceffes, illuftrating the whole with plates; and there is inconteftable evidence that this treatife had been prefented to the elector of Saxony in 1567, though it did not appear to the world till after the publication of Ercker's book. Since that time, the art has been greatly improved; but the operations in the dry way are not materially different from thofe defcribed under Metallurgy. The Blow pipe likewife affords an excellent method of examining fmall quantities of metal in the dry way; but the greateft improvement hitherto made in it is that of effaying by the moift way introduced by Mr. Bergman.

This celebrated chemift obferves, that in the *Docimafia Sicca*, or effaying in the dry way, three things are requifite: 1. That the metal contained in the ore be all reduced to a complete form; for fuch part of it as is deficient in that refpect cannot be united with the eliquated metal. 2. That the whole be collected into one mafs; for when it is difperfed in numerous fmall grains, fome of them are very eafily fcattered, and diminifh the weight. 3. That the metallic form be preferved; for the extracted regulus muft inevitably be diminifhed more or lefs by calcination. All thefe requifites are frequently effected conveniently enough in a crucible by fufion with proper ftrata of charcoal, provided the ore is free from fulphur and other volatile mixtures, and is entirely without a matrice, or united to one that can be melted by a moderate degree of heat; but if the matrice be refractory, notwithftanding the moft fubtile pulverifation, it will cover many of the metallic particles, and thus the reduction and fufion will be in fome meafure prevented. When this happens to be the cafe, we muft add fuch other fubftances as not only promote fufion, but make the matter flow fufficiently thin to allow the reguline particles to fall to the bottom. Thefe fubftances, which from the effect they have on the matter are called *fluxes*, are of a faline nature, and muft therefore neceffarily corrode the metals more or lefs; and hence the fcoria, which are almoft always tinged, contain a quantity of calcined metal. But as long as we are deftitute of a fure method of meafuring intenfe degrees of heat, and as long as it is neceffary to perform the operation in clofe veffels to prevent the accefs of air, the force and proper continuance of the fire will be uncertain *. Now, by every excefs or defect in this point fome part of the regulus is loft; fo that any judgment of the goodnefs of the ore, formed from the weight of the regulus, muft be fallacious, or at leaft fomewhat inaccurate.

Hence we may underftand, that experiments upon ores made in the dry way, are liable to many faults and imperfections; to which we may add the following, viz. that a given quantity of ore fubjected to trial almoft always exceeds in weight the regulus to be extracted from it. Now, fince it is impoffible to avoid a certain lofs both during calcination and fufion, this lofs will be the more remarkable, as the mafs to be weighed becomes ultimately lighter. The cafe is quite otherwife with experiments made in the moift way; for here the weighty fediment, from which the quantity of the contents is judged, is never lefs, but often greater, than that obtained by fire.

In the attempts made to effay ores in the humid way previous to thofe of Mr. Bergman, both methods were ufed, the metallic part being extracted by a menftruum, and afterwards reduced by fire. Our author, however, has now fhown a method of performing the operation without either calcination or fufion. "It muft indeed be confeffed (fays he), that experiments in the humid way often require more care and pains than the other; but if accurate conclufions are thereby obtained, we ought not to grudge the flownefs. Befides, in many cafes this method is more expeditious than the other; and indeed almoft always, if we content ourfelves with fuch difcoveries as can be made by the common calcinations and fufions: nay, fometimes the dry method is obvioufly infufficient, when the metallic content is either very fmall or volatile; but particularly if it be inflammable, as is the cafe with zinc."

In this method the ores to be examined fhould be reduced to a very fubtile powder by pulverization and calcination. In

* The newly invented thermometer of Mr. Wedgwood has furnifhed us with a method of meafuring intenfe degrees of heat; but farther experiments are wanting to fhew how far this may be made ufeful in practice.

diſſolving ſuch ores as contain ſulphur, we ought to employ the vitriolic or marine acid; for the nitrous, by long continued heat, deſtroys the ſulphur. Too great heat alſo diſſipates ſome of it in vapours, or melts it into globules containing heterogeneous matters; therefore boiling ought to be avoided where it can be done. All the precipitates muſt be carefully collected, waſhed, and dried. Diſtilled water ought conſtantly to be uſed, and all the menſtrua carefully depurated. Vitriolic acid our author calls *diluted*, when its ſpecific gravity is below 1.3, the nitrous when below 1.2, and the marine when below 1.1. The precipitations ſhould be carefully made in glaſs veſſels; ſo that nothing may remain either through the deficiency of the precipitant, or be rediſſolved through its too great quantity. The clear liquor is to be decanted from the precipitate, water poured on in its place, the veſſel ſhaken, and then ſuffered to ſtand; the water again decanted off, and more poured on in its ſtead, until it will no longer affect certain precipitants by which it muſt be examined. The ſediment is then to be collected on a filter, the latter being previouſly weighed, and made of paper not impregnated with alum. It is to be dried at firſt with a gentle heat, but afterwards expoſed for five minutes to a heat of 100°. On cooling, it is to be weighed together with the filter; the known weight of which muſt afterwards be ſubtracted. The ſediment is beſt waſhed in a bottle; for a filter when once impregnated with ſaline matter cannot be freed from it again without great difficulty, eſpecially if an interval of ſome hours intervenes.

The alkali made uſe of in Mr. Bergman's experiments, was that of ſoda ſaturated with aerial acid. His phlogiſticated alkali is made by deflagrating equal weights of pure nitre and cream of tartar intimately mixed together; the reſiduum is the common white flux. Half an ounce of this is diſſolved in half a quadrans of diſtilled water. To this he adds, in a digeſting heat, two ounces of Pruſſian blue, carefully avoiding ſuch an effervefcence as may throw any thing over, which eaſily happens if the quantity be too large. The pigment ſoon loſes its beautiful blue colour, growing not red but black; which ſhows that a decompoſition has taken place. The Pruſſian blue uſed in his experiments contained in 100 parts only 23 of the pigment and 77 of the clay; ſo that if we employ the blue made without any alum, 221 grains of it will ſaturate the half ounce of alkaline ſalt more completely than the two ounces of the kind already deſcribed. But in whatever manner the operation is performed, after the addition of the laſt quantity, the whole muſt be expoſed to a ſtronger digeſting heat, and ſtirred with a wooden ſpatula. If the liquor be too much diminiſhed by evaporation, the defect muſt be ſupplied by adding more water. When the liquor becomes clear, the reſiduum muſt be collected upon filtering paper, and gradually waſhed with warm water until all the ſoluble part is extracted; when, if the operation has been properly conducted, the filtered liquor amounts to a whole quadrans, of a browniſh yellow colour, and ſo well ſaturated with colouring matter, that it does not change the colour of paper tinged with Braſil wood. This lixivium, however, contains a ſmall quantity of Pruſſian blue, about 4 lb. to a cwt. of the alkali. Theſe ſhould be previouſly ſeparated by an acid, or, which is better, corrected by ſubtracting from the weight of the ſediment 16 eſſay pounds for each quadrans of the lixivium. When we wiſh to examine the colour of the precipitate exactly, however, the lixivium we employ muſt neceſſarily be well depurated; for by neglecting this precaution we may eaſily perſuade ourſelves that any metal precipitated by the lixivium has a blue colour. When we only wiſh to aſcertain the weight, the lixivium, having the ſmall proportion of Pruſſian blue intermixed, may be employed: but ſtill the proper correction muſt ultimately be made uſe of; for the precipitating acid is wont to impair the qualities of the lixivium, and even to deſtroy them altogether, eſpecially in a warm temperature. Calcareous earth, whether in its mild or cauſtic ſtate, is alſo capable of abſtracting a coloured ſubſtance from iron and other metals.

In the precipitation of metals by metals, it is to be obſerved, that the acid of the ſolution ought to be ſomewhat predominant; but any conſiderable exceſs muſt be corrected occaſionally, either by alkali, water, or ſpirit of wine.

It would extend this article to an immoderate length were we to enter into the particular mode in which the aſſaying of each of the ores of the different metals is to be attempted. For this therefore we refer to Mr. Bergman's publications, and proceed to conſider that kind of *eſſaying* which is underſtood, in metallurgic operations, to ſignify the method of determining how much gold or ſilver is contained in any maſs of metal already ſmelted from its ore.

1. *Eſſay of the Value of Silver*, to examine its purity, or the quantity of alloy mixed with it. The common method of examining the purity of ſilver, is by mixing it with a quantity of lead proportionable to the quantity of imperfect metals with which it is ſuppoſed to be alloyed; by teſting this mixture; and afterwards by weighing the remaining button of ſilver. The loſs of weight which the ſilver ſuffers by cupellation ſhows the quantity of imperfect metals which it contained.

We may hence perceive, that the eſſay of ſilver is nothing elſe than the refining of it by cupellation. The only difference between theſe two operations is, That when ſilver is teſted merely for the purpoſe of refining it, its value is generally known; and it is therefore mixed with the due proportion of lead, teſted, without any neceſſity of attending to the loſs of weight it ſuſtains during the operation: whereas, in the eſſay, all poſſible methods ought to be employed to aſcertain preciſely this loſs of weight. The firſt of theſe operations, or the mere refining of ſilver, is made in the great, in the ſmelting of ſilver ores, and in mints for making money. See REFINING. The ſecond operation is never made but in ſmall; becauſe the expences of ſmall operations are leſs than of great, and the requiſite accuracy is more eaſily attended to. The laſt operation is our preſent object, and is to be performed in the following manner: We ſuppoſe, firſt, that the maſs or ingot of ſilver of which an eſſay is to be made, conſiſts of 12 parts perfectly equal; and theſe 12 parts are called *pennyweights*. Thus, if the ingot of ſilver be an ounce weight, each of theſe 12 parts will be $\frac{1}{12}$ of an ounce; or if it be a mark, each of theſe will be $\frac{1}{12}$ of a mark, &c. Hence, if the maſs of ſilver be free from all alloy, it is called *ſilver of* 12 *penny-weights*; if it contains $\frac{1}{12}$ of its weight of alloy, it is called *ſilver of* 11 *penny-weights*; if $\frac{2}{12}$ of its weight of alloy, it is called *ſilver of* 10 *penny-weights*; and theſe 10 penny-weights or parts of pure ſilver are called *fine penny-weights*.

We ought to obſerve here concerning theſe penny-weights, that eſſayers give alſo the name *penny-weight* to a weight equal to 24 real grains: which latter real penny-weight muſt not be confounded with the former, which is only ideal and proportional; and ſuch a confuſion is the more likely to take place, as this ideal penny-weight is alſo, like the former, divided into 24 ideal grains, which are called *fine grains*.

An ingot of fine ſilver, or ſilver of 12 penny-weights, contains then 288 fine grains; if this ingot contains $\frac{1}{288}$ part of alloy, it is ſaid to be *ſilver of* 11 *penny-weights and* 23 *grains*; if it contains $\frac{2}{288}$ of alloy, it is called *ſilver of* 11 *penny-weights and* 22 *grains*; if it contains $\frac{14}{288}$, it is called *ſilver of* 11 *penny-weights and* 10 *grains*; and ſo on. Laſtly, the fine grain has alſo its fractions, as $\frac{1}{2}$ to $\frac{1}{4}$ of a grain, &c.

As eſſays to diſcover the value of ſilver are always made in ſmall, eſſayers only take a ſmall portion of an ingot for the trial; and the cuſtom in France is to take 36 real grains for

this purpofe, which is confequently the largeft weight they employ, and reprefents 12 fine penny-weights. This weight is fubdivided into a fufficient number of other fmaller weights, which alfo reprefent fractions of fine penny-weights and grains. Thus 18 real grains, which is half of the quantity employed, reprefent fix fine penny-weights; three real grains reprefent one fine penny-weight, or 24 fine grains; a real grain and a half reprefent 12 fine grains; and $\frac{1}{32}$ part of a real grain reprefents $\frac{1}{4}$ part of a fine grain, which is only $\frac{1}{752}$ part of a mafs of 12 penny-weights. We may eafily perceive, that weights fo fmall, and effay-balances, ought to be exceedingly accurate. Thefe balances are very fmall, fufpended and inclofed in a box, the fides of which are panes of glafs, that they may be preferved from duft, and that their motion may not be affected by agitated air, fo as to diforder their action: See *Affay*-BALANCE.

When an effay of a mafs or ingot of filver is to be made, the cuftom is to make a double effay. For this purpofe, two fictitious femi-marks, each of which may be equal to 36 real grains, are to be cut from the ingot. Thefe two portions of filver ought to be weighed very exactly; and they ought alfo to have been taken from oppofite fides of the ingot.

Perfons accuftomed to thefe operations know pretty nearly the value of filver merely by the look of the ingot, and ftill better by rubbing it on a touchftone. By the judgment they form of the purity of the ingot, they regulate the quantity of lead which is to be added to it, as this quantity muft be always proportionable to the quantity of imperfect metal mixed with the filver.

Neverthelefs, this proportion of lead to the alloy has not been precifely determined. Authors who treat of this fubject differ much. They who direct the largeft quantity of lead fay, that thereby the alloy is more certainly deftroyed; and others who direct a fmall quantity of lead, pretend, that no more of that metal ought to be ufed than is abfolutely neceffary, becaufe it carries off with it always fome portion of filver. Every effayer ufes his own particular method of proceeding, to which he is attached.

To afcertain thefe doubtful points, three chemifts of the Academy of Sciences at Paris, Meffrs. Hellot, Tillet, and Macquer, were appointed by the French government. They were directed to afcertain every thing concerning the effay of gold and filver by authenticated experiments, made under the infpection of a minifter, whofe fuperior knowledge was equal to his defire of public good, and in prefence of the officers of the mint.

The experiments made by thefe chemifts, and the confequent regulation, have determined that four parts of lead are requifite for one part of filver of 11 penny-weights and 12 grains, that fix parts of lead are requifite for filver of 11 penny-weights, eight parts of lead for filver of 10 penny-weights, 10 parts of lead for filver of nine penny-weights, and fo on in the fame progreffion.

Two cupels of equal fize and weight are to be chofen. The cuftom is to ufe cupels of fuch a fize that their weight fhall be equal to that of one half of the lead employed in the effay; becaufe fuch cupels have been found capable of imbibing all the litharge formed during the operation. Thefe cupels are to be placed together under a muffle in an effay-furnace. The fire is to be kindled, and the cupels are to be made red-hot, and to be kept fo during half an hour at leaft before any metal be put into them. This precaution is neceffary to dry and calcine them perfectly; becaufe, if they contained any moifture or inflammable matter, an ebullition and effervefcence would be occafioned in the effay. When the cupels are heated fo as to become almoft white, the lead is to be put into them; the fire is to be increafed, which is done by opening the door of the afh-hole fo as to admit air, till the lead becomes red, fmoking, and is agitated by a motion of its parts called its *circulation*, and till its furface becomes fmooth and clear.

Then the filver, previoufly beat into fmall plates for its eafier fufion, is to be put into the cupels; the fire is to be continued, and even increafed, by putting hot coals at the mouth of the muffle, till the filver fhall have *entered the lead*, that is, till it have melted and mixed with the lead. When the melted matter circulates well, the heat is to be diminifhed by taking away, partly or entirely, the coals put at the mouth of the muffle, and by clofing more or lefs the doors of the furnace. The heat ought to be regulated fo, that the effays in the cupels fhall have furfaces fenfibly convex, and fhall appear ardent, while the cupels are lefs red; that the fmoke fhall rife almoft to the roof of the muffle; that undulations fhall be made in all directions upon the furfaces of the effays, which are called *circulations*; that their middles fhall be fmooth, and furrounded with a fmall circle of litharge, which is continually imbibed by the cupels.

The effays are to be kept in this ftate till the operation is finifhed, that is, till the lead and alloy have foaked into the cupel; and the furfaces of the buttons of filver being no longer covered with a pellicle of litharge, become fuddenly bright and fhining, and are then faid to *lighten*. If the operation has been well conducted, the two effays ought to become bright nearly at the fame time. When the filver has been by this operation well refined, we may fee, immediately after it has brightened, the furface of the filver covered with rainbow colours, which quickly undulate and crofs each other, and then the buttons become fixed or folid.

The management of the fire is an important article in effays. For if the heat be too great, the lead is fcorified and imbibed by the cupel fo quickly, that it has not fufficient time to fcorify and carry along with it all the alloy; and if the heat be too little, the litharge is gathered upon the furface; and does not penetrate the cupel. The effayers fay then that the effay is *choaked* or *drowned*. In this cafe the effay does not advance; becaufe the litharge covering the furface of the metal defends it from the contact of air, which is abfolutely neceffary for the calcination of metals.

We have above related the marks of a fuccefsful effay. The heat may be known to be too great, from the convexity of the furface of the melted metal; from a too ftrong circulation; from the too vivid appearance of the cupel, fo that the colours given to it by the litharge cannot be diftinguifhed; and laftly, by the fmoke rifing up to the roof of the muffle, or not being at all vifible from its being fo ardent and red-hot as not to be diftinguifhable. In this cafe, the heat muft be diminifhed by fhutting the door of an afh-hole: Some effayers, for this purpofe, put round the cupels fmall, oblong, cold pieces of baked clay, which they call *inftruments*.

If, on the contrary, the melted metal have a furface not very fpherical, relatively to its extent; if the cupel appear dark-coloured, and the fmoke of the effay do only creep upon the furface; if the circulation be too weak, and the fcoria, which appears like bright drops, have but a dull motion, and be not foaked into the cupel; we may be affured that the heat is too weak; much more may we be affured of it when the metal *fixes*, as the effayers call it. In this cafe, the fire ought to be increafed by opening the door of the afh-hole, and by placing large burning coals at the mouth of the muffle, or even by laying them acrofs upon the cupels.

As foon as the lead is put into the cupels, the fire is to be increafed, becaufe they are then cooled by the cold metal; and the lead ought to be quickly melted, to prevent its calx from collecting upon its furface in too great quantity, before it be formed into litharge; which it would do, and be difficultly fufed, if the heat were too weak.

When the filver is added to the lead, the heat muft be ftill

increased; not only because the silver cools the mass, but because it is less fusible than lead. And as all these effects ought to be produced as quickly as possible, more heat is at length given than ought to be continued; and therefore, when the silver has entered the lead, the heat is to be diminished till it becomes of a due intensity for the operation.

During the operation, the heat ought gradually to be augmented to the end of it, both because the metallic mixture becomes less fusible as the quantity of lead diminishes; and also because the lead is more difficultly scorifiable, as it is united with a larger proportion of silver. Hence the essays must be rendered very hot before they brighten.

When the operation is finished, the cupels are left in the same heat during some seconds, to give time to the last portions of litharge to be entirely absorbed; because, if any of it remained under the buttons of silver, it would stick to them. The fire is then allowed to go out, and the cupels to cool gradually, till the buttons have entirely fixed, particularly if they be pretty large; because, if they cool too quickly, their surfaces fix and contract before the internal mass, which is thereby so strongly compressed as to burst through the external solid coat and form vegetations, or even to be entirely detached from the rest of the mass, and dissipated. This is called *the vegetation of the button*. It ought to be carefully prevented, because small bits of silver are sometimes thrown out of the cupel.

Lastly, when the buttons are thoroughly fixed, they are to be disengaged from the cupels by a small iron utensil while they are yet hot; otherwise they could not be disengaged clean and free from part of the cupels, which strongly adhere to them when the heat is much diminished. Nothing then remains to complete the essay, but to weigh the buttons. The diminution of weight which they have sustained by cupellation will show the purity or value of the ingot of silver.

We ought to observe, that as almost all lead naturally contains silver, and that after cupellation this silver is mixed with the silver of the ingot in the button of the essay, before we employ any lead in this operation, we ought to know how much silver it contains, that we may subtract this quantity from the weight of the button, when we compute the fineness of the silver of the ingot essayed. For this purpose essayers generally cupel a certain quantity of their lead separately, and weigh accurately the button of silver it yields: or, at the same time when they essay silver, they put into a third cupel, in the muffle, a quantity of lead equal to that employed in both their essays; and when the operation is finished, and the buttons are to be weighed, they throw the small button produced from the lead alone into the scale which contains the weights; and as this exactly counterpoises the small portion of silver which the essay buttons have received from the lead employed in the cupellation, the weights will show precisely the quantity of silver contained in the ingot, and thus the trouble of calculating is prevented. The small button of silver procured from the cupellation of lead alone is called the *witness*. But to prevent this trouble, essayers generally employ lead which contains no silver, such as that from Willach in Carinthia, which is therefore procured by essayers.

In the second place, we shall observe, that a certain quantity of silver always passes into the cupel, as refiners in the great have long observed, and which happens also in assaying small quantities. The quantity of silver thus absorbed, varies according to the quantity of the lead employed, and the matter and form of the cupels; all which objects will undoubtedly be determined by the above-mentioned chemists.

The cupellation which we have now described is exactly the same for essays by which the produce of a silver ore, or of an ore of another metal containing silver, is determined. But as these ores contain frequently gold, and sometimes in considerable quantity, when these essays are made, the buttons of silver obtained by the essays ought to be subjected to the operation called *parting*. See Silver, Refining, &c.

M. Tillet has published a memoir, showing that essays of silver made in the common method are uncertain and not to be depended upon; and that this uncertainty proceeds from the different quantities of silver absorbed by the cupel in different essays, according as the heat and other circumstances happened to vary. He therefore proposes, in order to render essays accurate, to extract from the cupel the quantity of silver it has absorbed during the operation, and to add this particle of silver to the button, as these two contain the whole quantity of silver in the matter essayed.

The variations in the different results of different essayers, or of the same essayers, at different times, upon the same mass of silver, are sufficient proofs of the uncertainty mentioned by M. Tillet. These variations are occasioned, according to that author, principally from the following causes: 1. From the inaccuracy of the balances and weights employed. 2. From the faulty fusion of the mass to be essayed; by which means the contained alloy may be unequally diffused. 3. From the impurity of the lead, especially from its containing silver, which is not always equally diffused through its mass. 4. From the different proportions of lead used by different essayers. 5. From the difference of the intensity of heat: for if the heat be not sufficiently intense, the silver will still contain a portion of alloy; and if the heat be too intense, too much of the silver will be imbibed by the cupel. 6. From the want of care in picking the small particles of silver, which frequently adhere to the sides of the cupel separately, from the principal button. 7. From the spurting which sometimes happens unobserved by the essayer; and which may further falsify the essays of other pieces included under the same muffle, by the falling of the particles thrown out of one cupel into others adjacent. But, with all the attentions to avoid these causes of error, the author obtained different results from different essays of the same mass of silver. Nor could he, by any method, make his different essays consistent with each other, but by adding to each button the particle extracted from the cupel; and this method he found by accurate experiments to be perfectly exact.

M. Tillet observed, that the quantity of lead directed in the regulations established in consequence of the report made by Messrs Macquer, Hellot, and Tillet, is not sufficient to purify the silver perfectly from its alloy. He nevertheless approves of the said regulation; and considers the weight of the alloy retained by the button, as some compensation for the weight of the silver absorbed by the cupel. And as it is a constant fact, that the more lead is used, the greater is the loss by the absorption of the cupel; he remarks, that a regulation, directing a larger proportion of lead for France than is used in other countries, would be disadvantageous to that kingdom; as thereby the silver of the same denomination would be required to be finer in that than in other countries, where a less proportion of lead was employed. He observes, that the above-mentioned rule, "that the more lead is used, the greater is the loss by the absorption of the cupel," does not extend to quantities of lead much above double the usual quantities. Thus 32 parts of lead to one of silver, will not occasion more absorption than 16 parts of lead. For the refining scarcely takes place till the extraordinary quantity of lead be gone, and the silver is only or chiefly carried into the cupel along with the copper. Accordingly, he found, that he could render the silver finer by using four parts of lead at first, and afterwards adding two more parts when the irises began to appear, than by employing all the six parts of the lead at once. By this method of dividing the quantity of lead, the loss of silver by absorption was greater. M. Tillet did not find, that, by employing bismuth alone, or mixed with lead, his

eſſays were more certain than when lead alone was uſed. He obſerved, however, that the addition of biſmuth made the ſilver purer, but occaſioned a greater abſorption by the cupel.

2. *Eſſay of the Value of Gold.* The fictitious weights uſed to determine the purity of gold, and to eſſay this metal, are different from thoſe of ſilver. See the preceding remarks. A maſs of gold perfectly pure, or which contains no alloy, is ideally divided into 24 parts, called *carats*; this pure gold is therefore called *gold of* 24 *carats*. If the maſs or ingot contains $\frac{1}{24}$th part of its weight of alloy, the gold is then of 23 carats; and if it contains $\frac{2}{24}$ths or $\frac{1}{12}$th of alloy, it is gold of 22 carats, &c. Hence we ſee, that the carat of gold is only a relative and proportional weight, ſo that the real weight of the carat varies according to the total weight of the maſs of gold to be examined. If this maſs of gold weighs a mark, the real weight of the carat will be $\frac{1}{24}$th of eight ounces, which is equal to a mark. If the maſs weigh an ounce, the carat will be $\frac{1}{24}$th part of an ounce, or 24 grains. If it is only a penny-weight or 24 grains, the real weight of a carat will be one grain; and ſo on.

For greater accuracy, the carat of gold is divided into 32 parts, which are relative and proportional weights, as the carat itſelf is. Thus $\frac{1}{32}$d of a carat of gold is $\frac{1}{32}$d of $\frac{1}{24}$th, or the $\frac{1}{768}$th of any maſs of gold: and the gold which contains an alloy equal to the $\frac{1}{768}$th part of the whole maſs is called *gold of* 23 *carats, and* $\frac{31}{32}$; gold which contains $\frac{2}{768}$ths of alloy is *gold of* 23 *carats and* $\frac{30}{32}$; and ſo on.

The real weight now generally uſed in the operation for determining the purity of gold is ſix grains. This weight then repreſents 24 carats. The half of this weight, or three real grains, repreſents 12 carats. According to this progreſſion, we ſhall find that $\frac{1}{4}$th of a real grain repreſents one carat, and the $\frac{1}{128}$th part of a grain repreſents the $\frac{1}{32}$d of a carat, or the $\frac{1}{768}$th part of a maſs of gold to be eſſayed. As theſe weights are exceedingly ſmall, ſome eſſayers employ a weight of 12 grains, which muſt be very convenient.

When a maſs or ingot of gold is to be eſſayed, ſix grains are to be cut off, and exactly weighed: alſo 18 grains of fine ſilver are to be weighed. Theſe two metals are to be cupelled together with about ten times as much lead as the weight of the gold. This cupellation is conducted preciſely like that of the eſſay to determine the purity of the ſilver, excepting that the heat muſt be raiſed a little more towards the end of the operation when the eſſay is going to brighten. Then the gold is freed from all alloy but ſilver. If the quantity of copper or other alloy deſtructible by cupellation be required to be known, the remaining button is accurately weighed. The diminution of weight from the ſum of the weights of the gold and of the ſilver determines the quantity of this alloy.

The button containing gold and ſilver is then to be flattened upon a poliſhed piece of ſteel, and care muſt be taken to anneal it from time to time, to prevent its ſplitting and cracking. By this method it is reduced to a thin plate, which is to be rolled up, in order to be parted by aquafortis: See Parting. The diminution found after the parting from the original weight of the gold eſſayed, ſhows the whole quantity of alloy contained in that gold.

The eſſay for determining the purity of gold is then made by two operations: the firſt, which is cupellation, deprives it of all its imperfect metals; and the ſecond, which is parting, ſeparates all the ſilver from it. By antimony alſo gold may be purified, which is a kind of dry parting. By this ſingle operation, all the imperfect metals, and ſilver with which gold is allayed, are ſeparated. See Purification, Gold, Silver, Refining, &c.

Essay-*Hatch*, is the miners' term for a little trench or hole, which they dig to ſearch for ſhoad or ore.

ESSEDARII, a ſort of gladiators, mentioned by Seneca, Suetonius, and Tully, who on ſome occaſions engaged one another out of chariots called *eſſeda*. The *eſſedum* was a ſort of heavy chariot from which the Gauls and Britons engaged the Romans. See Gladiator.

ESSENCE, in metaphyſics, that which conſtitutes the particular nature of each genus or kind, and diſtinguiſhes it from all others: being nothing but that abſtract idea to which this name is affixed, ſo that every thing eontained in it is eſſential to that particular kind. This Mr. Locke calls the *nominal eſſence;* in contradiſtinction to the real eſſence, or conſtitution of ſubſtances on which this nominal eſſence depends. Thus the nominal eſſence of gold is that complex idea the word *gold* ſtands for; let it be, for inſtance, a body, yellow, weighty, malleable, fuſible, and fixed: but its real eſſence is the conſtitution of its inſenſible parts, on which theſe qualities and all its other properties depend, which is wholly unknown to us.

ESSENES, or Essenians, in Jewiſh antiquity, one of the three ancient ſects among that people. They allowed a future ſtate, but denied a reſurrection from the dead. Their way of life was very ſingular: they did not marry; but adopted the children of others, whom they bred up in the inſtitutions of their ſect: they deſpiſed riches, and had all things in common, and never changed their clothes till they were entirely worn out. When initiated, they were ſtrictly bound not to communicate the myſteries of their ſect to others; and if any of their members were found guilty of enormous crimes, they were expelled. Pliny tells us, that they dwelt on the weſt ſide of the lake of Aſphaltites; and that they were a ſolitary kind of men, living without women or money, and feeding upon the fruit of the palm-tree: he adds, that they were conſtantly recruited by new comers, whom the ſurges of ill fortune had made weary of the world; in which manner the ſect was kept up for ſeveral thouſands of years, without any being born among them. The reaſon why we find no mention made of them in the New Teſtament, may be their recluſe and retired way of life, not leſs than their great ſimplicity and honeſty, whereby they lay open to no cenſure or reproof.

ESSENTIAL, ſomething neceſſarily belonging to a thing, from which it cannot be conceived diſtinct: thus the primary qualities of bodies, as extenſion, figure, number, &c. are eſſential or inſeparable from them in all their changes and alterations.

Essential *Oils* are ſuch as are really contained in a plant, and are drawn from it by diſtillation in an alembic with water: they are thus called, in contradiſtinction to empyreumatic oils, which are raiſed by a naked fire without water.

ESSEX, a county of England, bounded on the N. by part of Cambridgeſhire, and by the river Stour, which ſeparates it from Suffolk; on the E. by the German Ocean; on the S. by the Thames, which divides it from Kent; and on the W. by Herts and Middleſex, being divided from the former, in one part by the Stort, and then by the Lea, which ſeparates it likewiſe from Middleſex. It is 54 miles long from E. to W. and 48 broad from N. to S. It is in the dioceſe of London; contains 18 hundreds, 24 market-towns, and 415 pariſhes; and ſends eight members to parliament. It is not diſtinguiſhed by any conſiderable hills: it poſſeſſes, however, a variety of ſoil and face of country. Its S. W. part is occupied principally by the two foreſts of Epping and Hainault; and is noted for its butter, which is ſold at a high price in London, under the name of Epping-butter. The N. W. part, from Saffron-Walden to Cambridge, is famous for the growth of ſaffron, which is almoſt peculiar to this diſtrict. The middle part is a fine corn country, varied with gentle inequalities of ſurface, and ſprinkled with woods. What are called the *Hundreds of Eſſex* (though including only the hundreds of Barſtable, Rochford, and Dengy) bordering on the Thames and the ſea, conſiſt chiefly of

marſhy grounds, which afford excellent paſturage, yet are deemed unwholeſome and agueiſh to a proverb; but more inland, they are dry, elevated, and healthy; and even the worſt parts of them are rendered healthier than formerly, by clearing the woods, draining the ſtagnant waters, and other beneficial improvements. Beſide vaſt quantities of corn of all kinds, abundance of calves are ſent to the London market; alſo wild fowls, and the oyſters ſo well known under the name of Colcheſter oyſters. The towns of Colcheſter, Halſtead, Coggeſhal, Braintree, Bocking, and Dunmow, have been long diſtinguiſhed for the manufacture of baize, which, however, is far from being ſo flouriſhing as formerly. The rivers of Eſſex, beſide the boundary ones already mentioned, are the Chelmer, Blackwater, Coln, Crouch, and Roding. Chelmsford is the county town.

ESTATE, in law, ſignifies the title or intereſt that a perſon has in lands, tenements, or other effects; comprehending the whole in which a perſon hath any property, and will paſs the ſame. Eſtates are either real or perſonal; otherwiſe diſtinguiſhed into FREEHOLDS, which deſcend to heirs; or CHATTELS, that go to executors or adminiſtrators. A fee-ſimple is the ampleſt eſtate our law admits of. See FEE. Eſtates are obtained ſeveral ways; as, by deſcent from a father to a ſon; by conveyance or grant from one perſon to another; by gift or purchaſe; or by deed or will. See DESCENT, SUCCESSION, TENURE, &c.

ESTATES, in a political ſenſe, is uſed either to denote the dominions of ſome prince, or the general claſſes into which the people are divided. In Britain, the eſtates are the king, lords, and commons; or rather the lords and commons, who meet the king in parliament, for reforming abuſes, and enacting good and wholeſome laws.

ESTHER, a canonical book of the Old Teſtament; containing the hiſtory of a Jewiſh virgin, dwelling with her uncle Mordecai at Shuſhan, in the reign of Ahaſuerus, one of the kings of Perſia. The great beauty of this maid raiſed her to the throne of Perſia; whereby ſhe had an opportunity to ſave her countrymen, whoſe deſtruction was plotted by Haman, a favourite of that prince. The learned are not agreed who this Ahaſuerus was.

ESTHONIA, or REVEL, one of the 41 governments into which the Ruſſian empire has been lately divided. It lies on the E. of the Baltic, and is bounded on the N. by the gulf of Finland, on the E. by Ingria, and on the S. by Livonia. After having been long an object of bloody contention between the Ruſſians, the Poles, and the Swedes, it was confirmed to the latter by the peace of Oliva in 1660; but it was ſubdued by Peter the Great in 1710, and finally ceded to Ruſſia in 1721.

ESTOILE'E, or CROSS ESTOILLE'E, in heraldry, a ſtar with only four long rays in form of a croſs; and, accordingly, broad in the centre, and terminating in ſharp points.

ESTOPPEL, formed of the French *eſtouper, oppilare, obſtipare*, "to ſtop or block up," in law, an impediment or bar of action, ariſing from a man's own act or deed; againſt which a man is forbidden, by law, to ſpeak, though it be to ſay the truth.

ESTOVERS, in law, is uſed, by Bracton, for that ſuſtenance which a man, committed for felony, is to have out of his lands or goods for himſelf and his family during impriſonment. In ſtat. 6 Edw. I. it is uſed for an allowance in meat or clothes. In ſome manors, the tenants have *common of Eſtovers*; that is, neceſſary botes or allowances out of the lord's wood: in which laſt ſenſe, eſtovers comprehends houſe-bote, hay-bote, and plow-bote; ſo that if a man have in his grant theſe general words, *de rationabili eſtoverio in boſcis*, &c. he may thereby claim all three. Eſtovers is alſo uſed for alimony, which if the huſband refuſes to pay, there is, beſides the ordinary proceſs of excommunication, a writ at common law, *de eſtoveriis habendis*, in order to recover it.

ESTRAY, or STRAY, ſignifies any tame beaſt, as ſheep, oxen, ſwine, and horſes, or ſwans, found within a lordſhip, and not owned by any man; in which caſe being cried, according to law, in the church, and two market towns adjoining, if it be not claimed by the owner within a year and a day, it becomes the lord's of the ſoil where found. If the owner claims it within the year and day, he muſt pay the charges of finding, keeping, and proclaiming; and he alſo may ſeize it, without telling the marks or proving his property, which may be done at the trial if conteſted. If the beaſt ſtray within the year to another lordſhip, the firſt lord cannot retake it. An eſtray muſt be fed and kept, uninjured, and without labour, till it is reclaimed or the limited time expires.

ESTREAT, EXTRACTUM, in law, is uſed for the true copy or duplicate of ſome original writing, eſpecially of amercements or penalties ſet down in the rolls of a court, to be levied by the bailiff or other officer, on every offender.

ESTREMADURA, a province of Spain, about 175 miles in length, and 100 in breadth, bounded on the N. by Leon and Old Caſtile, on the E. by New Caſtile, on the S. by Andaluſia, and on the W. by Portugal. It abounds with corn, wine, and fruits; but the air is bad for foreigners, on account of the exceſſive heat. It now makes a part of New Caſtile.

ETCHING, a method of engraving on copper, in which the lines or ſtrokes, inſtead of being cut with a tool or graver, are eaten in with aquafortis. See ENGRAVING. Etching, though not very modern, is a later invention than engraving with the tool; of which it was at firſt only an imitation, that was practiſed by painters and other artiſts, who could much ſooner form their hands to, and attain a faculty of, working in this way, than with the graver. But being then nevertheleſs conſidered as a counterfeit kind of engraving, and therefore inferior to the other, it was cultivated in a very confined manner; the cloſeneſs of the reſemblance of the work to that performed by the tool, being made the teſt of its merit, and conſequently the principal object or aim of thoſe who purſued it. This ſervile confinement of the art of etching to the imitation of the original kind of engraving, was a great cauſe of retarding its advancement towards perfection, as many of the moſt able maſters cramped their talents with the obſervance of it: which may be ſeen in the inſtances of Sadelers, Swaneberg, Villamena, and particularly Le Boſſe; who, in his treatiſe on engraving, has laid down as a principle, that the perfection of this kind conſiſts in the cloſe ſimilitude of the work with that done by the tool. This abſurd prepoſſeſſion has been ſince worn out: and the method of working with aquafortis has been ſo far improved, that inſtead of being now deemed a ſpurious kind of engraving, it evidently appears the foundation of an excellence in many modern works, that could never have been produced without it: ſince, though the neatneſs and uniformity of the hatches, which attend the uſe of the tool, is more advantageous with reſpect to portraits; yet the liberty and facility of the other manner give a much greater opportunity to exerciſe the force of genius and fancy in hiſtory-engraving; where the effect of the whole, and not the minute exactneſs in finiſhing all the parts, conſtitutes the principal value.

There are two methods practiſed of engraving in this way; the one with a hard varniſh or ground, the other with a ſoft. The firſt was formerly much uſed, being better accommodated to the intention of imitating the engraving with the tool; as the firmneſs of the body of the varniſh gave more opportunity of retouching the lines, or enlarging them with the oval-pointed needles, called by the French *echoppes*, as was practiſed by Le Boſſe and others for that purpoſe. The latter has now almoſt wholly ſuperſeded the uſe of the other, by the free manner of working it admits of; which affords a power of expreſſion in-

compatible with the greater inflexibility of the hard varnifh, that confines the lines and hatches to fuch a regularity and famenefs, as gives a ftiffnefs of manner and coldnefs of effect to the work.

The mixture of the ufe of the tool and aquafortis, which are now both employed in many cafes, has, however, given that perfection to engraving which it poffeffes at prefent. The truth and fpirit of the outline that the method of working with aquafortis affords, and the variety of fhades which the different kinds of black produce in this way, as well as other means of expreffing the peculiar appearance and character of particular fubjects, furnifh what was defective in the fole ufe of the tool; while, on the other hand, the exactnefs and regularity of the lines, which are required for finifhing many kinds of defigns, are fupplied by the graver; and by a judicious application of both, that complete finifhing is obtained, which either of them alone muft neceffarily want.

The manner by which this art is performed, is the covering the furface of the plate with a proper varnifh or *ground*, as it is called, which is capable of refifting aquafortis; and then fcoring or fcratching away, by inftruments refembling needles, the parts of this varnifh or ground, in the places where the ftrokes or hatches of the engraving are intended to be: then, the plate being covered with aquafortis, the parts that are laid naked and expofed by removing the ground or varnifh, are corroded or eaten away by it; while the reft, being fecured and defended, remain untouched.

There are two methods of etching, as hath been already obferved; the difference of which from each other confifts, as well in the difference of the varnifh or ground, as in that of the aquafortis, adapted to each kind; but the general methods of performing them are alike in both. Thefe varnifhes or grounds are diftinguifhed by the names of *hard* and *foft*: for in their confiftence, or the refiftance they give to the needles, lies their effential variation from each other. The hard varnifh, it is with good reafon conjectured, was not the firft in ufe, but foon took place of the other; and was, for fome time, the moft received in practice, on account of its admitting the work to be made more like that of the graver: the foft has, however, fince, in its turn, prevailed to the exclufion of it in fome degree, except in the cafe of particular fubjects; but not fo entirely as to take away the expedience of fhowing how it is performed. The manner of etching with the foft varnifh is now, however, one of the moft important objects of the art of engraving; and it is at prefent in univerfal ufe, fometimes alone, but more frequently intermixed with the work of the tool, and in fome cafes with great advantage, even where the whole is intended to pafs for being performed by the graver.

Preparation of the foft Varnifh. "Take of white wax and afphaltum, each two ounces; of black pitch and Burgundy pitch, each half an ounce. Melt the wax and pitch in a new earthen-ware glazed pot; and add to them, by degrees, the afphaltum finely powdered. Let the whole boil till fuch time as that, taking a drop upon a plate, it will break when it is cold, on bending it double two or three times betwixt the fingers. The varnifh being then enough boiled, muft be taken off the fire; and letting it cool a little, muft be poured into warm water, that it may work the more eafily with the hands, fo as to be formed into balls; which muft be rolled up, and put into a piece of taffety for ufe." It muft be obferved, firft, that the fire be not too violent, for fear of burning the ingredients; a flight fimmering will be fufficient: fecondly, that while the afphaltum is putting in, and even after it is mixed with them, the ingredients fhould be ftirred continually with the fpatula: and thirdly, that the water, into which this compofition is thrown, fhould be nearly of the fame degree of warmth with it, to prevent a kind of cracking that happens when the water is too cold. The varnifh ought always to be harder in fummer than in winter; and it will become fo if it be fuffered to boil longer, or if a greater proportion of the afphaltum or brown refin be ufed. The experiment above-mentioned, of the drop fuffered to cool, will determine the degree of hardnefs or foftnefs that may be fuitable to the feafon when it is ufed.

Preparation of the hard Varnifh ufed by Callot, commonly called the Florence *Varnifh.* Take four ounces of fat oil very clear, and made of good linfeed oil, like that ufed by painters: heat it in a clean pot of glazed earthen-ware, and afterwards put to it four ounces of maftich well powdered; and ftir the mixture brifkly till the whole be well melted; then pafs the whole mafs through a piece of fine linen into a glafs bottle with a long neck, that can be ftopped very fecurely; and keep it for the ufe that will be explained below.

Method of applying the foft Varnifh to the Plate, and of blackening it. The plate being well polifhed and burnifhed, as alfo cleanfed from all greafinefs by chalk or Spanifh white, fix a hand-vice on the edge of the plate where no work is intended to be, to ferve as a handle for managing it when warm: then put it upon a chafing-difh, in which there is a moderate fire; obferving to hold it fo that it may not burn: keep the plate over the fire till it be fo hot that the varnifh being brought into contact with it may melt: then cover the whole plate equally with a thin coat of the varnifh; and while the plate is warm, and the varnifh upon it in a fluid ftate, beat every part of the varnifh gently with a fmall ball or dauber made of cotton tied up in taffety; which operation fmooths and diftributes the varnifh equally over the plate.

When the plate is thus uniformly and thinly covered with the varnifh, it muft be blackened by a piece of flambeau, or of a large candle which affords a copious fmoke; fometimes two, or even four, fuch candles are ufed together for the fake of difpatch, that the varnifh may not grow cold: which if it does, during the operation, the plate muft then be heated again, that it may be in a melted ftate when that operation is performed: but great care muft be taken not to burn it; which, when it happens, may be eafily perceived by the varnifh appearing coaly, and lofing its glofs. The following expedient is made ufe of for the more commodioufly blackening the varnifh, being particularly neceffary where the plates are large: Fix a ftrong hook in the roof of the room, through which pafs four pieces of cord of equal length, at the end of which are fixed four iron rings of about four inches diameter, for fupporting the corners of the plate. The plate being thus fufpended in the air, with the varnifhed fide downwards, may be blackened with greater convenience: but this is not, however, abfolutely requifite, except in the cafe of large plates that could not, without difficulty, be held up, unlefs this or fome other fuch contrivance were made ufe of.

It is proper to be very cautious in keeping the flambeau or candle at a due diftance from the plate, left the wick touch the varnifh, which would both fully and mark it. If it appear that the fmoke has not penetrated the varnifh, the plate muft be again placed for fome little time over the chafing-difh; and it will be found, that, in proportion as the plate grows hot, the varnifh will melt and incorporate with the black which lay above it, in fuch a manner that the whole will be equally pervaded by it.

Above all things, the greateft caution fhould be ufed in this operation, to keep all the time a moderate fire; and to move frequently the plate, and change the place of all the parts of it, that the varnifh may be alike melted every where, and kept from burning. Care muft alfo be taken, that during this time, and even till the varnifh be entirely cold, no filth,

ſparks, or duſt, fly on it; for they would then ſtick faſt, and ſpoil the work.

Method of applying the hard Varniſh. This is preciſely the ſame as for the ſoft; being ſpread equally over the warm plate with the taffety-ball, and ſmoked in the ſame manner: only after it is ſmoked, it muſt be baked, or dried over a gentle fire of charcoal, till the ſmoke from the varniſh begins to decreaſe; taking care not to overheat the plate, which would both ſoften it and burn the varniſh.

The plate being thus prepared, and an exact drawing of the outlines of the deſign made upon thin paper, the other ſide of the paper muſt be well rubbed with chalk or Spaniſh whitening, or, which is better, with red chalk ſcraped to a powder; the looſe chalk being cleared off with a linen rag: then the ſtained ſide of the paper is laid upon the varniſh, fixing the corners to the plate with wax or wafers, to prevent its ſhuffling; and with a blunted needle or pointer the drawing is ſlightly traced, and communicates to the varniſh an exact outline of the deſign to be etched.

A variety of pointers is neceſſary for the work. Thoſe uſed for the broad large ſtrokes ought to be very blunt, exceeding round, and well poliſhed at the point; the ſoal of a ſhoe anſwers very well for poliſhing the points. The fineſt ought to be as ſharp as a needle. If any ſcratches or falſe ſtrokes happen in the working, they are to be ſtopped up with a hair-pencil dipped in Venetian varniſh, mixed with lamp-black, by which means theſe places will be defended from the action of the aquafortis.

The next operation is that of eating or corroding the plate with aquafortis; in order to which, a border of ſoft wax (being a compoſition of bees-wax melted and tempered with a little Venice turpentine and tallow) muſt be faſtened round the plate about an inch high, in the form of a little wall or rampart, to contain the aquafortis. At one of the corners of this border a gutter is uſually made, which ſerves for pouring commodiouſly the aquafortis off the plate. The plate being thus bordered, take a due quantity of the refiner's aquafortis; mix it with half its quantity of common water; and pour it gently on, till it riſe above a finger's breadth above the ſurface of the plate; when, if all things have been rightly conducted, it will be ſeen that the aquafortis will ſoon exert its action in the hatches which have been ſtrongly touched; but thoſe more weakly engraved will appear at firſt clear, and of the colour of the copper. The menſtruum muſt therefore be ſuffered to continue on the plate till its effects become viſible on the more tender parts: then the aquafortis ſhould be poured off, the plate waſhed with clean water, and dried before the fire: then take a ſmall pencil dipped into the Venetian varniſh, and cover with it the lighter parts of the plate. This being done, the aquafortis muſt again be poured on, and ſuffered to continue a longer or ſhorter time, according to the ſtrength of the menſtruum, or the nature of the engraving; when it muſt be again poured off as before, and the plate immediately waſhed with water.

It may not be improper to obſerve, that, when the aquafortis is on the plate, a feather ſhould be uſed to cleanſe away the foulneſs of the verdigris that gathers in the hatches, when the aquafortis operates on them, and to give it more room to exert its action; for by moving the aquafortis to and fro on the plate by the feather, and bruſhing away the black ſaline matter where it appears to be formed, the hatches will be cleanſed, and the aquafortis exert its whole force equally on every part.

The plate being thus ſufficiently corroded by the aquafortis, and well waſhed with water, it muſt be warmed at the fire, and the border of wax removed; after which, it muſt be made hotter till the varniſh melt; then it muſt be well wiped with a linen cloth, and afterwards rubbed heartily with oil of olives; when it will be ready to be retouched and finiſhed by the graver. See the article Engraving.

ETERNITY, an attribute of God, expreſſing his infinite or endleſs duration. See Logic and Metaphysics.

Eternity, in mythology, a divinity among the Romans, who had neither temples nor altars. They repreſented it under the figure of a woman, who held the ſun in one hand and the moon in the other: her ſymbols were a phœnix, globe, and elephant.

ETESIÆ, or Etesian *winds*, are ſuch as blow at ſtated times of the year, from what part ſoever of the compaſs they come. They are ſo called from the Greek word ἔτος, "year," being yearly or anniverſary winds, ſuch as our ſeamen call *monſoons* and *trade-winds*, which in ſome parts of the world continue conſtantly blowing for certain ſtated ſeaſons of the year. Thus, the north winds, which, during the dog-days, conſtantly blow upon the coaſts of Egypt, and hinder all ſhips from ſailing out of Alexandria for that ſeaſon, are called *eteſiæ* in Cæſar's Commentaries. In other authors, the weſt and eaſt winds are called *eteſiæ*, when they continue blowing for certain ſeaſons of the year. Cellarius endeavours to prove that thoſe winds are properly eteſian which blow from that part of the horizon which is between the north and weſt about the time of the ſolſtice. In ancient writers, they are repreſented as of a very mild and gentle nature; and were called by mariners *ſomniculoſi* or *delicati*, from their ſleeping and ceaſing to blow in the night.

ETHER: See Chemistry, p. 461.

ETHERIDGE (Sir George), a celebrated wit and comic genius in the reigns of Charles II. and James II. deſcended from an ancient family in Oxfordſhire, and born in 1636. He travelled in his youth; and, not being able to confine himſelf to the ſtudy of the law, devoted himſelf to the gayer accompliſhments. His firſt dramatic performance, The Comical Revenge, or Love in a Tub, appeared in 1664, and introduced him to the leading wits of the time: in 1668 he produced a comedy called She would if ſhe could; and in 1676 he publiſhed his laſt comedy, called The Man of Mode, or Sir Fopling Flutter; which is perhaps the moſt elegant comedy, and contains more of the real manners of high life than any one the Engliſh ſtage was ever adorned with. This piece he dedicated to the beautiful ducheſs of York, in whoſe ſervice he then was; and who had ſo high a regard for him, that when, on the acceſſion of James II. ſhe came to be queen, ſhe procured his being ſent ambaſſador firſt to Hamburg, and afterwards to Ratiſbon, where he continued till after his majeſty quitted the kingdom. Our author being addicted to certain gay extravagances, had greatly impaired his fortune; to repair which, he paid his addreſſes to a rich widow: but ſhe, being an ambitious woman, had determined not to condeſcend to a marriage with any man who could not beſtow a title upon her; on which account he was obliged to purchaſe a knighthood. None of the writers have exactly fixed the period of Sir George's death, though all ſeem to place it not long after the Revolution. Some ſay, that on this event he followed his maſter king James into France, and died there; but the authors of the Biographia Britannica mention a report, that he came to an untimely death by an unlucky accident at Ratiſbon; for that after having treated ſome company with a liberal entertainment at his houſe there, where he had taken his glaſs too freely, and being, through his great complaiſance, too forward in waiting on his gueſts at their departure, fluſhed as he was, he tumbled down ſtairs and broke his neck, and ſo fell a martyr to mirth and jollity. As to Sir George's literary character, he certainly was born a poet, and ſeems to have been poſſeſſed of a genius whoſe vivacity needed no cultivation; for we have no proofs of his having been a ſcholar. His works,

however, have not efcaped cenfure on account of that licentioufnefs which in general runs through them, which renders them dangerous to young unguarded minds; and the more fo, for the lively and genuine wit with which it is gilded over, and which has therefore juftly banifhed them from the purity of the prefent ftage.

ETHICS, the doctrine of manners, or the fcience of moral philofophy. The word is formed from ηθος, ηθη, *mores*, "manners;" becaufe the fcope or object thereof is to form the manners. See Moral *Philofophy*.

ETHIOPIA, a celebrated, though very much unknown empire of Africa, whofe boundaries have never been exactly defined either by ancient or modern geographers. By fome writers of antiquity the title of *Ethiopians* was given to all nations whofe complexion was black: hence we find the Arabians as well as many other Afiatics fometimes falling under this denomination; befides a number of Africans whofe country lay at a diftance from Ethiopia properly fo called. Thus the Africans in general were by thefe writers divided into the weftern or Hefperian Ethiopians, and thofe above Egypt fituated to the eaft of the former; the latter being much more generally known than the former, by reafon of the commerce they carried on with the Egyptians.

From this account we may eafily underftand why there fhould be fuch a feeming difagreement among ancient authors concerning the fituation of the empire of Ethiopia, and likewife why it fhould pafs under fuch a variety of names. Sometimes, for example, it was named *India*, and the inhabitants *Indians*; an appellation likewife applied to many other diftant nations. It was alfo denominated *Atlantia* and *Etheria*, and in the moft remote periods of antiquity *Cephenia*; but more ufually *Abafene*, a word fomewhat refembling *Abaffia* or *Abyffinia*, two of its modern names. On the other hand, we find Perfia, Chaldæa, Affyria, &c. ftyled *Ethiopia* by certain writers; and all the countries extending along the coafts of the Red Sea were promifcuoufly denominated *India* and *Ethiopia*. By the Jews the empire of Ethiopia was ftyled *Cufh* and *Ludim*.

Notwithftanding this diverfity of appellations, and vaft diffufion of territory afcribed to the Ethiopians, there was one country to which the title was thought more properly to belong than to any of the reft; and which was therefore called *Ethiopia Propria*. This was bounded on the north by Egypt, extending all the way to the leffer cataract of the Nile, and an ifland named *Elephantine*; on the weft it had Libya interior; on the eaft the Red Sea, and on the fouth unknown parts of Africa; though thefe boundaries cannot be fixed with any kind of precifion. In this country the ancients diftinguifhed a great variety of different nations, to whom they gave names either from fome perfonal property, or from their manner of living. See Abyssinia.

ETHIOPS or Æthiops, in pharmacy, a name heretofore given to feveral black powders, but of late rejected by the college. The new name for *Ethiops Mineral*, the principal of thefe compofitions, is *Hydrargyrus cum fulphure*. See the article Pharmacy.

ETHMOIDES, in anatomy, a bone fituated in the middle of the bafis of the forehead or os frontis, and at the top of the root of the nofe, filling almoft the whole cavity of the noftrils. It has its name from ηθμος *cribrum*, "a fieve," and ειδος "form," becaufe all fpongy and porous. See Anatomy, p. 163.

ETHNARCHA, Ethnarch, formed of εθνος *nation*, and αρχη *command*, a governor or ruler of a nation. There are fome medals of Herod I. furnamed the *Great*, on one fide whereof is found Ηρωδου, and on the other Εθναρχου q. d. *Herod the Ethnarch*. After the battle of Philippi, we read that Antony, paffing over into Syria, conftituted Herod and Phafael his brother tetrarchs, and in that quality committed to them the adminiftration of the affairs of Judea. (Jof. Ant. lib. xiv. cap. 23.) Herod therefore had the government of the province before ever the Parthians entered Syria, or before Antigonus's invafion, which did not happen till fix or feven years after Herod was commander in Galilee. (Jof. lib. xiv. cap. 24, 25.) Confequently Herod was then truly ethnarch, for he can be no otherwife denominated; fo that it muft have been in that fpace of time that the medals were ftruck, which only give him this title: which medals are a confirmation of what we read in hiftory of the government which that prince was intrufted with before he was raifed to the royalty. Jofephus gives Herod the appellation of *tetrarch* in lieu of that of *ethnarch*; but the two terms come fo near to each other, that it is eafy to confound them together. Though Herod the great left by will to Archelaus all Judea, Samaria, and Idumea, yet Jofephus tells us he was then only called *ethnarch*.

ETHNOPHRONES, in antiquity, a fect of heretics in the feventh century, who made a profeffion of Chriftianity, but joined thereto all the ceremonies and follies of paganifm, as judicial aftrology, fortileges, auguries, and other divinations.

ETIQUETTE, a French term, primarily denoting a ticket or title affixed to a bag or bundle of papers, expreffing its contents. It is alfo ufed, when applied to the Spanifh and fome other courts, to fignify a particular account of what is to be done daily in the king's houfehold, and in the chief ceremonies relating to it. It likewife denotes thofe forms that regulate the decorum of conduct towards perfons of various ranks and ftations in life.

ETMULLER (Michael), a moft eminent phyfician, born at Leipfic in 1646. After having travelled through the greateft part of Europe, he became profeffor of botany, chemiftry, and anatomy, at Leipfic; where he died in 1683. He was a very voluminous writer; his works making no lefs than 5 vols. folio, as printed at Naples in 1728. His fon Michael Erneft Etmuller was alfo an ingenious phyfician, who publifhed feveral pieces, and died in 1732.

ETNA, or Ætna, a famous burning mountain of Sicily, and the largeft in Europe. The form of mount Etna is that of a cone, very broad at the bafe, which is more than 40 miles in circumference. From the bottom you afcend ten leagues before reaching its fummit on the fouth fide; and on any of the other fides, the way being not fo ftraight, would be confiderably longer. Etna is entirely compofed of fubftances that have been difcharged from the volcano in its various explofions.

It appears from the quantities of marine bodies depofited all over the under part of Etna, that it muft have been once covered by the fea to at leaft one half of its prefent height. The whole ifland of Sicily, and the greateft part of mount Etna, have been, in M. Houel's opinion, formed under water. But the period when the eruptions from this volcano firft commenced, the manner in which the fea fubfided, and the precife time at which it fell fo low as the prefent level on the fhores of Sicily, are facts concerning which we have no certain knowledge. The general principle, however, that author thinks may be regarded as undeniable.

When the fea fubfided from mount Etna, the mountain muft have been covered over with fuch matters as the fea ufually depofits; confequently with calcareous fubftances. A part of thofe matters would be indurated by the action of the atmofphere, while the reft would be carried down by the rain-waters, and again conveyed into the ocean. The torrents of rain-water which pour down the fides of mount Etna have furrowed its fides, by cutting out for themfelves channels; and they have removed from its fummit, and are ftill removing to a farther diftance, all the extraneous bodies upon it. In many places, they flow at prefent over a channel of lava, having cut through all the matters which lay above it: ftill, however, there remain

in many places, both calcareous matter and other marine productions, which ſhow that this volcano has been once covered by the waters of the ocean. But theſe are daily waſting away; not only by the rains, but by men likewiſe, who carry them off as materials for lime and for building.

No fewer than 77 cities, towns, and villages, are ſcattered over the ſides of Etna. They are moſt numerous on the ſouth ſide, where the temperature of the air is milder than on the north. Reckoning thoſe cities, towns, and villages, one with another, to contain each 1200 or 1500 ſouls, the whole number of the inhabitants of mount Etna will then be 92,400, or 115,500. But it is certainly much more conſiderable.

In plate 14, fig. 1, is exhibited a view of the north-eaſt ſide of the mountain, taken at ſea. The lower part preſents to the eye very extenſive plains entirely covered with lava of different thickneſs, on which vegetation has not yet made any progreſs. The nearer the ſhore the more barren is the ground; while the fertility of the ſoil increaſes as we advance farther inwards. The mountain is every where full of vaſt excavations; which our author conſiders as a proof, that inſtead of increaſing in bulk, it is actually in a ſtate of decay and diminution. The vaſt torrents of lava, which overſpread the ſides of it from time to time, he conſiders as inſufficient to repair the waſte occaſioned by rains, rivulets, and torrents flowing down from the ſummit. Unleſs the eruptions, therefore, become more frequent than they have been for ſome time paſt, he ſuppoſes that, by degrees, the height of the mountain muſt be reduced to that of the ſurrounding beds of lava. He had not an opportunity of meaſuring the altitude of Etna himſelf; but he obſerves that it had been done by the celebrated M. de Sauſſure, who found the elevation to be 10,036 feet. This was done on the 5th of June 1773, at 20 minutes after ſeven in the morning. The height of the barometer on the moſt elevated part at the brink of the crater was 18 inches $11\frac{1}{4}$ lines; which, by the neceſſary corrections, is reduced to 18 inches $10\frac{15}{16}$ lines. At the ſame time the mercury at Catania, placed only one foot above the level of the ſea, ſtood at 28 inches $2\frac{1}{12}$ lines; which muſt be reduced to 28 inches $1\frac{1}{4}$ lines, on account of the neceſſary corrections for the thermometer.

From Giana our author had an opportunity of contemplating the vaſt number of calcareous mounts ſcattered over that part of Etna; which, he ſays, "are nothing more than fragments, the ſlender remains of thoſe enormous maſſes which have been depoſited all around the baſe of mount Etna; and are a very curious monument of the revolutions which this mountain has undergone." They are of a true calcareous nature; and the inhabitants are accuſtomed to ſupply themſelves with limeſtone from them. They alſo uſe the ſtones of which theſe mounts are compoſed for the purpoſes of building; as the lava is ſo hard that it cannot be cut without the greateſt difficulty, and they have no other ſtone in theſe parts.

Leaving this place, our author travelled over ſeveral extenſive plains of lava, covered on each ſide of the way with ſtunted trees, but without any cultivation; the lava being of that kind which is very unfavourable to the growth of vegetables. Arriving at St. Leonardo, he obſerved the courſe of the eruption of water in 1755. This water took its courſe down the weſt ſide of the mountain; and the channel which it cut for itſelf is ſtill viſible. The eruption of water from burning mountains is ſtill much leſs frequent than that of lava or half vitrified ſolid matters, aſhes, &c. though that of water, and even mixed with the ſhells of marine animals (though we are not told whether it was ſalt or not), has ſometimes been obſerved in other volcanoes, particularly Veſuvius. The eruption we now ſpeak of happened in the month of February. It was preceded by an exceedingly thick black ſmoke iſſuing from the crater, intermixed with flaſhes of fire. This ſmoke gradually became thicker, and the burſts of flame more frequent. Earthquakes and ſubterraneous thunder convulſed the mountain, and ſtruck the inhabitants of the adjacent parts with the utmoſt terror. On Sunday, March 2d, the mountain was ſeen to emit a huge column of ſmoke exceedingly denſe and black, with a dreadful noiſe in the bowels of the earth, accompanied alſo with violent flaſhes of lightning. From time to time there were loud cracks, like the exploſions of cannon; the mountain appeared to ſhake from its foundations; the air on that ſide next Maſcali became very dark, and loud peals of thunder were heard. Theſe ſeemed to iſſue from two caverns, conſiderably below the ſummit, on the ſide of the mountain, and were accompanied with violent blaſts of wind like a tempeſt.

Theſe terrible phenomena continued and increaſed: Etna ſeemed ready to ſwallow up at once all thoſe materials which it had been for ſo many years diſgorging, or rather about to ſink at once into the bowels of the earth from whence it appeared to have been elevated. The proſpect was far beyond any idea that can be given by deſcription of this tremendous ſcene. The inhabitants were alarmed beyond meaſure; the ſight of the flames driven by the wind againſt the ſides of the mountain, the ſhocks of the earthquake, and the fall of rocks, ſtruck the imagination with a horror not to be conceived. During this dreadful commotion an immenſe torrent of water was emitted from the higheſt crater of the mountain. The whole ſummit of Etna was at that time covered with a thick coating of ſnow. Through this the boiling water directed its courſe eaſtward; and, in its paſſage, met with frightful precipices. Over theſe it daſhed with the utmoſt violence, adding its tremendous roaring to the complicated horrors of this awful ſcene. The ſnow, melting inſtantaneouſly as the boiling torrent advanced, increaſed its deſtructive power by augmenting its quantity, while the miſchiefous effects of the heat were ſcarce diminiſhed becauſe of the immenſe quantity of boiling liquid which continued to pour from the ſummit of the mountain.

This boiling torrent having daſhed its awful cataracts from one chain of rocks to another, at length reached the cultivated plains, which it overflowed for a number of miles. Here it divided itſelf into ſeveral branches, forming as many deep and rapid rivers; which, after ſeveral other ſubdiviſions, diſcharged themſelves into the ſea.

Though the mountain continued to diſcharge water in this manner only for half an hour, the ravages of it were very terrible. Not only thoſe of common inundation, ſuch as tearing up trees, hurrying along rocks and large ſtones, took place here, but the ſtill more dreadful effects of boiling water were felt. Every cultivated ſpot was laid waſte, and every thing touched by it was deſtroyed. Even thoſe who were placed beyond the reach of the torrent, beheld with inexpreſſible horror the deſtruction occaſioned by it; and though the alarming noiſes which had ſo long iſſued from the mountain now ceaſed in a great meaſure, the ſhocks of earthquakes, and the violent ſmoke which continued to iſſue from the mountain, ſhowed that the danger was not over. Two new openings were now obſerved, and two torrents of lava began to make their way through the ſnow.

On the 7th of March a dreadful noiſe was again heard in the bowels of the mountain, and a new column of very thick and black ſmoke began to iſſue from it. A horrid exploſion of ſmall ſtones ſucceeded; ſome of which were carried as far as the hills of Maſcali, and great quantities of black ſand to Meſſina, and even quite over the ſtrait to Reggio in Calabria. On the ſhifting of the wind to the northward this ſand reached as far as the plains of Agoſta. Two days after, the mountain opened again, and a new torrent of lava was diſcharged; which, however, advanced very ſlowly towards the plain, moving only at the rate of a mile in a day. It continued to flow in this manner for ſix

days, when every thing appeared ſo quiet, that the Canon Recupero ſet out to view the changes which had taken place.

That gentleman's deſign was to trace the courſe of the dreadful torrent of water above mentioned. This he was very eaſily enabled to do by the ravages it had made; and, by following the channel it had cut all the way from the ſea to the ſummit of the volcano, he found that this immenſe quantity of water had iſſued from the very bowels of the mountain. After iſſuing from the crater, and increaſing its ſtream by paſſing through and melting the ſnow which lay immediately below the ſummit, it deſtroyed in an inſtant a fine and extenſive foreſt of fir-trees. All of theſe were torn up by the violence of the current, though many were no leſs than 24 to 30 inches in diameter. He obſerved that the great ſtream had, in its deſcent, divided itſelf into four branches; and theſe had again ſubdivided themſelves into ſeveral ſmaller ones, eaſily diſtinguiſhable by the quantity of ſand they had depoſited. Afterwards reuniting their ſtreams, they formed many iſlands, and rivers 900 feet in breadth, and of a depth which could not eaſily be determined. Proceeding farther down, and ſtill forcing its way among the beds of old lava, the channel of the waters was widened to 1500 feet, until it was again contracted in the valleys as before. Every object which ſtood in the way of this tremendous torrent was moved from its place. Enormous rocks were not only hurried down, but ſeveral of them moved to more elevated ſituations than thoſe they formerly occupied. Whole hills of lava had been removed and broken to pieces, and their fragments ſcattered along the courſe of the river, and the valleys were filled up by vaſt quantities of ſand which the waters had depoſited. Our author obſerved, that even at the time he viſited the mountain, about 10 years after the eruption, the whole ſide of it ſtill bore the marks of this deluge.

All along the eaſtern ſide of mount Etna the ſoil is broken, but filled with beautiful varieties of baſaltes, highly worthy of obſervation. Indeed, according to our author's opinion, there is no volcano in Europe ſo rich as Etna in baſaltes, nor where ſo many curious figures of it are to be ſeen.

M. Houel having ſpent ſome more time in viſiting the baſaltic columns around the foot of the mountain, ſet out from Aci to viſit a famous cheſnut-tree, which is known in that country by the name of *The cheſnut-tree for an hundred horſes*. This tree is 160 feet in circumference, but quite hollow within. This, however, affects not its verdure; for the cheſnut tree, like the willow, depends upon its bark for ſubſiſtence, and by age loſes its internal part. As the cavity of this enormous maſs is very conſiderable, the people have built a houſe in it, where they have an oven for drying nuts, almonds, and cheſnuts, &c. of which they make conſerves. They frequently ſupply themſelves with wood from the tree which incircles their houſe, ſo that it ſeems likely, in a ſhort time, to go to ruin through the ingratitude and thoughtleſſneſs of the inhabitants.

It has been thought that this tree was compoſed of a number of others grown together; but our author is of a different opinion. In deſcribing it in the *plan*, however, we muſt ſeparate it from the trunks *i*, *k*, *l*, (plate 13.) which properly belong to three other trees. The dotted line, and the letters *a*, *b*, *c*, *d*, *e*, *f*, *g*, mark out the true circumference of the tree we ſpeak of. The parts of that circumference are not all contiguous, ſeveral pieces having been taken away from the places marked *g* and *n*, between which the houſe ſtands. In other parts the bark is rent aſunder; but, ſays our author, "by a natural motion, the divided parts, ſeeking to reunite, or rather to ſhelter themſelves from the action of the external air, are bent inwards, ſo as to form the circular arcs *a*, *b*, *c*, *d*, which may indeed be taken for ſo many different trees, though they doubtleſs properly belong to the ſame trunk.

Beſides this, there are abundance of other trees in the neighbourhood very remarkable for their ſize. Our traveller was ſhown a number of young trees of the ſame ſpecies, all very beautiful and ſtraight, and almoſt as ſmooth as poliſhed marble. One of theſe was 38 feet in circumference, and there were a number of others nearly of the ſame ſize. Among theſe there were ſeven ſtanding together, which have received the name of the *ſeven brethren*. Another is denominated *the ſhip*, from the general figure of its top, which has ſome ſlight reſemblance to a ſhip. Its diameter is 25 feet, ſo that the circumference cannot be leſs than 75. In theſe extenſive foreſts, however, there are cheſnut-trees of every age and ſize.

Our author's next viſit was paid to a ſnow grotto, being one of thoſe magazines where that article, ſo neceſſary in the hot climate of Sicily, is preſerved for uſe. In his way thither he viſited the foreſt of pines; which is ſo much ſurrounded by rocks and precipices, that it is ſcarce acceſſible; and vaſt numbers of the trees are dying of old age. Some of the neighbouring peaſants, however, will now and then attempt to carry them off; and our author ſaw them at this work. The tree was drawn by oxen, who were yoked to it by a chain connected with the beam by an iron cramp. But the extreme roughneſs of the road made the tree leap and bound in ſuch a manner, that the poor creatures were every moment in danger of having their legs broken, or being hurried over precipices along with their driver; accidents which happen not unfrequently, and which render this occupation leſs generally practiſed than otherwiſe it would be.

The ſnow grotto is but lately formed by the action of the waters under the beds of lava, and carrying away the ſtratum of pozzolane below them. It is ſituated on a mount named *Finocchio*, which, though of very conſiderable ſize, is only a protuberance on the ſide of Etna. It has been repaired in the inſide at the expence of the knights of Malta, who have hired this as well as ſeveral other caverns in the mountain for the purpoſe of holding ſnow, which they have ſtill more occaſion for in their iſland than the inhabitants of Sicily. There are two openings above, at which they throw in the ſnow; and flights of ſteps have been cut to theſe as well as in the internal parts. A conſiderable extent of ground is levelled and incloſed with high walls above the grotto; ſo that when the wind, which at this elevation blows with great violence, carries the ſnow down from the higher parts of the mountain, it is ſtopped and detained by the walls of this incloſure. It is then thrown into the grotto, where the thickneſs of the beds of lava which cover it prevents any impreſſion from the ſummer-heat. When the ſeaſon for exportation comes on, the ſnow is put into large bags, and preſſed into them as cloſe as poſſible. Thus it is rendered compact and heavy, and likewiſe runs the leſs riſk of being affected by the heat. It is then carried out upon men's ſhoulders, and conveyed to the ſhore on mules. Before it is put into the bags, the lumps of ſnow are carefully wrapt up in leaves, which is another preſervative; at the ſame time that the freſh congelation of the little which melts, unites the maſſes ſo together, that our author informs us he has ſeen pieces of the ſnow preſerved in this manner, which looked like the faireſt and moſt tranſparent cryſtal.

Our author's next excurſion was to Mount Roſſo, or the Red Mountain, which is one of the mouths of Etna, through which it diſcharges from time to time great quantities of lava, ſand, aſhes, &c. It is the moſt celebrated of all the numerous mouths which have opened on the ſide of the mountain, though it has become ſo noted only for having poured forth the matter of the great eruption in 1669, and which is the moſt remarkable of any recorded in hiſtory. "When a new crater (ſays our author) is formed on mount Etna, it is always in conſequence of ſome ſhock that is powerful enough to break the arches of its caverns. Doubtleſs it is inconceivable that there ſhould be any

agent endowed with ſuch force; but when ſuch a fracture is once made, it is neceſſarily very large, and the ſurface of the ground above cannot but be broken in ſeveral different places at conſiderable diſtances from one another. The matter which is diſcharged always iſſues from the principal opening and thoſe adjoining to it. None of theſe mouths, however, continue open, excepting that which is directly in the line in which the matter is diſcharged; the latter choking up thoſe which are in a more oblique direction."

Our author went down one of theſe openings with torches; but could not reach the bottom, and was obliged to return on account of the extreme cold. The deſcent was extremely difficult, and became more ſo in proportion as he advanced. This crater is of an oval form, and the opening through which he deſcended was in one extremity; but he was tempted to think that the crater which riſes above it had been formed of matter diſcharged by another mouth; or perhaps it might have had a more centrical opening, through which the ſtones, ſand, &c. which form the crater, &c. were diſcharged.

Four of the mouths of this mount appear to be compoſed of a reddiſh pozzolano, which has procured it the name of the *Red Mountain:* but when we aſcend the pyramids, or rather funnels, which they form, we find them compoſed of different coloured layers of ſand. Some of theſe are of a blueiſh grey colour, others of a fine yellow, and ſome of a kind of green formed by a mixture of grey and yellow, while others are of a red colour. A great number of ſmall cryſtals, black ſchoerls, and granites, are found among them, as well as pieces of ſcoria, which had been diſcharged from the volcano in the form of a thick and glutinous matter. All theſe mouths have internally the form of a funnel, and their ſhape is nearly that of a mutilated cone or round pyramid. This is the natural and unavoidable conſequence of the perpendicular fall of the pulveriſed matter which the volcano diſcharges from the orifice at the bottom. The ſides of the craters are not all of one height; the parts to the eaſt and weſt being conſiderably higher than the intermediate ſummits, becauſe the currents of the aſhes paſſed alternately from eaſt to weſt, and fell upon theſe ſides in greater quantities than on the others; which circumſtance has given to this volcano the appearance of having two ſummits.

The majeſtic foreſts which ſurround Etna afford a ſingular ſpectacle, and bear no reſemblance to thoſe of other countries. Their verdure is more lively, and the trees of which they conſiſt are of a greater height. Theſe advantages they owe to the ſoil whereon they grow; for the ſoil produced by volcanoes is particularly favourable to vegetation, and every ſpecies of plants grows here with great luxuriance. In ſeveral places where we can view their interior parts, the moſt enchanting proſpects are diſplayed. The hawthorn trees are of an immenſe ſize. Our author ſaw ſeveral of them of a regular form, and which he was almoſt tempted to take for large orange-trees cut artificially into the figures they repreſented. The beeches appear like ſo many ramified pillars, and the tufted branches of the oak like cloſe buſhes impenetrable to the rays of the ſun. The appearance of the woods in general is exceedingly picturesque, both becauſe of the great number and variety of the trees, and the inequality of the ground, which makes them riſe like the ſeats in an amphitheatre, one row above another; diſpoſing them alſo in groups and glades, ſo that their appearance changes to the eye at every ſtep: and this variety is augmented by accidental circumſtances, as the ſituation of young trees among others venerable for their antiquity; the effects of ſtorms, which have often over-turned large trees, while ſtems ſhooting up from their roots, like the Lernæan hydra, ſhow a number of heads newly ſprung, to make up for that which was cut off.

About three hours after the departure of our travellers from St. Nicholas, they reached the *Grotto of the Goats.* It is formed by a bed of lava, which having flowed over a pile of ſand and pozzolano while in a fluid ſtate, ſettled and cooled in that ſituation; and the ſand or pozzolano being afterwards carried off by the filtration of water through the lava, a void ſpace has been left, which the torrents have gradually enlarged to its preſent ſize. This grotto ſtands about 5054 feet above the level of the ſea, according to the calculations of M. de Sauſſure. It affords a retreat for thoſe travellers who viſit the ſummit of Etna, who generally refreſh themſelves by taking a repaſt and making a fire at the entry, for which there is plenty of dry wood at hand; while the ſand ſerves for a bed to repoſe on. Here our author and his company ſupped, and about midnight ſet off for the ſummit. They had the advantage of the moonlight; and our author adviſes all thoſe who intend to viſit the top of Etna to take ſuch a time for their journey as may enable them to enjoy this advantage. As they advanced beyond the grotto of the goats, the trees became gradually thinner. In a ſhort time they were ſo thin, that they might readily be counted; and, proceeding ſtill farther, only a very few were ſeen ſcattered here and there, whoſe beauty and ſize were diminiſhed ſeemingly in proportion to their numbers. A few clumps of trees and ſome tufts of odoriferous herbs were now only to be ſeen; and in a little time theſe alſo became thinner, aſſuming a withered or ſtunted appearance. Then they ſeemed nothing but the languiſhing remains of an abortive vegetation; and a few paces further not even this appeared, the eye being preſented only with barren ſand.

Having now got above the region of the trees, they entered the third, which our author denominates the *Region of Snow* and ſterility. The wind became more briſk and keen as they advanced; and they were frequently obliged to croſs conſiderable ſtreams of water formed by the melting of the ſnow. In general the ſurface was ſufficiently hard to bear them; but having at laſt overcome all difficulties, they arrived at the large plain on the ſummit of Etna, and in the midſt of which is the crater of the volcano. It is entirely compoſed of lava, cinders, ice, and ſnow; nevertheleſs it is ſtyled, ironically as our author thinks, *Monte Triumente.* Here the wind continued to blow with exceſſive violence; and our author informs us, that in order to have any notion of its keenneſs, we muſt be accuſtomed to feel it on ſome very elevated ſtation, as it is impoſſible to judge from what we feel at inferior altitudes. They took ſhelter behind a lump of lava, the only one which appeared in the whole plain, and, which our author ſays, would ſeem deſigned expreſsly for the ſhelter of travellers. Here they lay, wrapped up in their cloaks, for an hour; but as ſoon as it was day, ſo that they could diſtinguiſh the place where the ſun was to riſe, they got up and advanced towards the ruins of the building known by the name of the *Philoſopher's Tower.* The wind ſtill blew ſo violently, that after an effort of four minutes they fell down exhauſted: but the extreme cold obliging them again to get up, they made a ſecond attempt: and after ſeveral intermiſſions of this kind, at laſt accompliſhed their deſign. They were ſurpriſed, however, to find nothing but the corner of a wall not more than two feet high, conſiſting of two rows of unpoliſhed ſtones; great part of it having been probably buried by the ſand and other matters diſcharged by the mountain. Here, being ſheltered from the wind, and the day advancing, they began to enjoy the glorious proſpect which every moment became more extenſive. At the riſing of the ſun, the horizon was ſerene, without a ſingle cloud. It was as if the univerſe had been obſerved ſuddenly ſpringing from the night of non exiſtence. The tall foreſts, the lofty hills, and extenſive plains of Etna, now preſented themſelves to view. Its baſe, the vaſt tracts of level ground which lie adjacent, the cities of Sicily, its parched ſhores, with the daſhing waves and vaſt expanſe of the ocean, gradually preſented themſelves, while ſome fleeting

vapours, which moved ſwiftly before the wind, ſometimes veiled part of this vaſt and magnificent proſpect.

The violence of the wind beginning now to abate a little, the travellers ſet out for the very ſummit, in order to take a view of the great crater; in which journey, our author ſays, it would be difficult to make people, who have never engaged in ſuch enterpriſes, comprehend all the obſtacles they had to encounter. This cone (the little mountain mentioned by Sir William Hamilton) is compoſed of aſhes, ſand, and pozzolano, thrown up at different times by the volcano. The materials are ſo looſe, that the adventurous traveller ſinks about mid-leg at every ſtep, and is in conſtant terror of being ſwallowed up. At laſt, when the ſummit is reached, the ſulphureous exhalations, which are continually emitted from the pores of the mountain, threaten ſuffocation, and irritate the fauces and lungs in ſuch a manner as to produce a very troubleſome and inceſſant cough. The looſeneſs of the ſoil, which gives way under the feet, obliges the traveller, every now and then, to throw himſelf flat on his belly, that ſo he may be in leſs danger of ſinking. In this poſture our author viewed the wide unfathomable gulph in the middle of the crater; but could diſcover nothing except a cloud of ſmoke, which iſſued from a number of ſmall apertures ſcattered all around, and accompanied with a kind of noiſe. Another and more dreadful ſound, however, iſſues from the bowels of the volcano, and which, according to our author, "ſtrikes the heart with terror, ſo that all the ſtrength of reaſon is neceſſary to prevent the obſerver from flying with precipitation from ſuch a dreadful place." Several travellers who had viſited this cone before him, were ſo terrified by theſe dreadful ſounds, that they fled with the utmoſt haſte till they arrived at the foot of the mountain.

M. Houel compares theſe ſounds to a diſcharge of cannon in the wide abyſs; and, with very great probability, ſuppoſes them to be occaſioned by the exploſions of the internal fire, or, as he calls it, the *focus* of the volcano, ſtriking againſt the ſides of theſe immenſe caverns. The ſounds thus produced are re-echoed through their cavities, and probably multiplied in an extraordinary manner; ſo that what would be only a ſlight exploſion in the open air, occaſions a ſound more tremendous than the loudeſt thunder. To ſuch as are convinced of this, and have ſufficient courage to reſiſt the firſt impreſſions which theſe ſounds muſt unavoidably occaſion, they will in a ſhort time not only appear exceedingly ſublime, but, by their variety, even ſomewhat agreeable. "They enable us (ſays our author) to form ſome conception of the ſpace through which they muſt paſs before they reach the ear, and of the vaſt extent and width of the hollows of the mountain."

Having for ſome time contemplated this awful ſpectacle, our author wiſhed to meaſure the crater by walking round it; but found this impoſſible. On the north ſide the ſurface is hard and ſmooth, the aſhes having been ſo far diſſolved by the moiſture depoſited by the ſmoke as to cement them into one uniform maſs. This is ſometimes diſſolved even into a fluid ſtate, in ſuch a manner as to run down the ſides of the cone; ſo that, after ſeveral attempts, he was at laſt obliged to abandon his deſign.

Fig. 2. in plate 14. exhibits a view of the crater of Etna taken on the brink of the eaſt ſide. The fore-ground *a a* of the figure is one diviſion of the crater. Beyond it are two eminences *b* and *c*, higher than that on which ſome human figures are repreſented. All the three form a triangle nearly equilateral; but, when viewed from any conſiderable diſtance, only two of them can be ſeen; for which reaſon the Sicilians have termed the mountain *bicornæ*, or double-horned.

The ſmoke, as repreſented in the figure, iſſues from all quarters, either from chinks or holes ſcattered over the whole crater. But the ſituation of the principal mouth is in the midſt of the three eminences. Its diameter, when our author viſited this mountain, was only about 60 feet, and ſo filled with ſmoke that nothing remarkable could be diſcovered. From the height *d*, the rock ſituated on the left ſide of the print, and on which the human figures are repreſented, all the way to the rock *e* on the right, the diſtance is no more than 900 feet. Our author obſerves that the cone is not exactly in the middle of the plain, but is ſituated more towards the north than the ſouth. He did not attempt to croſs the central valley *f*, on account of the looſeneſs of the ground, and that there was no object apparently worthy of the riſk he muſt run in ſo doing. At the neareſt view he took, it was only obſerved that there was ſnow lying in ſeveral parts of it, though the heat which otherwiſe prevailed ſeemed to be very intenſe.

The ſmoke which iſſues from the crater of Etna is generally carried in a direction from ſouth to north; and, as it brings along with it a conſiderable quantity of water, the latter, condenſed by the cold winds, runs down the ſide of the mountain in plentiful ſtreams, and often leaves pretty permanent marks of its courſe. In this manner he accounts for the great eruption of water in 1755, which he ſuppoſes to have been occaſioned only by an unuſual quantity of water falling into the burning focus of the mountain, there rarefied into ſteam, and afterwards condenſed by the coldneſs of the atmoſphere.

Like other travellers to mount Etna, this gentleman found the wind blowing from the ſouth; and he is of opinion, that a ſouth wind blows here more frequently than any other, as he did not obſerve any channels cut by the water on any other ſide than the north. He had ſeveral opportunities of making this obſervation, having frequently viſited the top of Etna, and always paid attention to the crater. The ſand on the eaſt and weſt ſides was always looſe, while that on the north was compacted into a ſolid body. The three ſummits were of a later date than the reſt of the crater, having been probably thrown up by ſome eruption which had burſt it aſunder. The black ſpots on the fore-ground repreſent a number of hillocks about the ſize of mole-hills, from which a ſulphureous vapour conſtantly iſſues, and by which the adjacent ground is tinged of an ochery colour. This vapour iſſues from the crevices with a kind of hollow whiſtling noiſe; which, with the volcanic thunder, ſmoke, and noxious ſmell, renders it very diſagreeable to ſtay here even for a few moments.

The ſmoke is repreſented in the figure preciſely as it was on the day that he aſcended, which was very warm. But it does not always riſe in this manner; for, when the cold is very intenſe, it collects into a body, and thickens around the edge of the crater: on which occaſions it is condenſed into water, which diffuſes itſelf around the edge of the crater, and mixing with the aſhes converts them into a kind of clay. The cold on the top of this mountain is ſo intenſe, that travellers very often find their clothes inſufficient to protect them; and it is remarkable that ſuch intenſe cold is always produced by a ſouth wind. The day that our author took his drawing, the wind blew faintly from the north.

The baſe of mount Etna, according to M. Houel's obſervations, conſiſts of alternate layers of lava and marine ſubſtances, which have been depoſited ſucceſſively one upon another. Theſe alternate layers extend to an unknown depth. They muſt indeed go as far down as the level of the ſtratum of lava which was diſcharged by the volcano at its firſt origin. The laſt depoſited by the ſea is a range of calcareous mountains of a conſiderable height, and which are placed on a baſis of lava. Beneath that layer of lava is another of ſea-pebbles, which are well known to be rounded by their attrition againſt one another by the motion of the waves. This layer is of conſiderable depth, and lies upon a yellowiſh rock conſiſting of a ſpecies of indurated ſand. The river Simeto flows over this rock, which

it has cut away conſiderably. That part which is at preſent the bed of the river is much higher than the baſe of Etna that is on a level with the ſea; and not the leaſt thing occurs to ſuggeſt an idea of what has been the primary baſe of the volcano. The marine ſubſtances, already taken notice of, lie nearly in an horizontal direction, more or leſs ſo according to the nature of the ſurface on which they have been depoſited.

Etna abounds very much with ſprings, fountains, and even rivers of conſiderable magnitude. Our author has computed, that if all the water flowing down the ſides of this mountain were collected, it would fill the channel of a river 36 feet broad and 6 in depth. Many of the ſprings afford fine ſalt; ſome are very pure, and others are impregnated with noxious ſubſtances; while others are remarkable for their uſe in dyeing particular colours.

It has been a queſtion, Whether the eruptions of mount Etna were more frequent in ancient than in modern times? At firſt it ſeems impoſſible to give a preciſe anſwer to ſuch a queſtion; but when we conſider, that the matter in the volcanic focus was then greater in quantity than at preſent, in proportion to the ſpace which it occupied; that the cavities were then ſooner filled with vapour; and that the centre of the focus was then leſs remote, we need not heſitate to pronounce, that in earlier times the eruptions were more frequent as well as more copious.

Mount Etna, as we have already remarked, has been a celebrated volcano from the remoteſt antiquity. Diodorus Siculus mentions eruptions of it as happening 500 years before the Trojan war, or 1693 years before the Chriſtian æra. From Homer's ſilence with regard to the phenomenon of Etna, it is to be preſumed that the volcano had been many ages in a ſtate of inactivity, and that no tradition of its burning remained among the inhabitants at the time he compoſed his Odyſſey; perhaps it never had emitted flames ſince the country was peopled. The firſt eruption taken notice of by ancient, but by no means contemporary, authors, happened before the Greeks landed on the iſland, and is ſuppoſed to have ſcared the Sicani from the eaſt part of Sicily.

Pindar is the oldeſt writer extant who ſpeaks of Etna as a volcano. The firſt recorded eruption was in the time of Pythagoras. Plato was invited by the younger Dionyſius to examine the ſtate of the mountain after the ſixth. It threw up flames and lava near an hundred times between that period and the battle of Pharſalia: it was particularly furious while Sextus Pompeius was adding the horrors of war to its devaſtations. Charlemagne happened to be at Catania during one of the eruptions; and from his reign the chronicles mention fifteen down to that of the year 1669, the moſt terrible of them all. Since 1669 there have been ſeveral eruptions, but none of them comparable to it. In that which happened in 1766, the lava ſprung up into the air to a conſiderable height, twelve miles below the ſummit; but formed a ſtream only ſix miles in length and one mile in breadth.

The laſt eruption happened in 1787. From the 1ſt to the 10th of July, there were ſigns of its approach. On the 11th, after a little calm, there was a ſubterraneous noiſe, like the ſound of a drum in a cloſe place, and it was followed by a copious burſt of black ſmoke. It was then calm till the 15th, when the ſame prognoſtics recurred. On the 17th, the ſubterraneous noiſe was heard again; the ſmoke was more abundant, ſlight ſhocks of an earthquake followed, and the lava flowed from behind one of the two little mountains which form the double head of Etna. On the 18th, while the ſpectators were in anxious expectation of a more ſevere eruption, all was quiet, and continued ſo more than 12 hours: ſoon after, they perceived ſome new ſhocks, accompanied with much noiſe; and the mountain threw out a thick ſmoke, which, as the wind was weſterly, ſoon darkened the eaſtern horizon: two hours afterwards a ſhower of fine black brilliant ſand deſcended: on the eaſt ſide it was a ſtorm of ſtones; and, at the foot of the mountain, a deluge of flaſhes of fire, of ſcoria and lava.

Theſe appearances continued the whole day; at the ſetting of the ſun the ſcene changed. A number of conical flames roſe from the volcano; one on the north, another on the ſouth, were very conſpicuous; and roſe and fell alternately. At three in the morning, the mountain appeared cleft, and the ſummit ſeemed a burning maſs. The cones of light which aroſe from the crater were of an immenſe extent, particularly the two juſt mentioned. The two heads ſeemed to be cut away; and at their ſeparation was a cone of flame, ſeemingly compoſed of many leſſer cones. The flame ſeemed of the height of the mountain placed on the mountain; ſo that it was probably two miles high, on a baſe of a mile and a half in diameter. This cone was ſtill covered with a very thick ſmoke, in which there appeared very brilliant flaſhes of lightning, a phenomenon which Etna had not before afforded. At times, ſounds like thoſe from the exploſion of a large cannon were heard, ſeemingly at a leſs diſtance than the mountain. From the cone, as from a mountain, a jet of many flaming volcanic matters was thrown, which were carried to the diſtance of ſix or ſeven miles: from the baſe of the cone a thick ſmoke aroſe, which, for a moment, obſcured ſome parts of the flame, at the time when the rivers of lava broke out. This beautiful appearance continued three quarters of an hour. It began the next night with more force: but continued only half an hour. In the intervals, however, Etna continued to throw out flames, ſmoke, ſtones ignited, and ſhowers of ſand. From the 20th to the 22d, the appearances gradually ceaſed. The ſtream of lava was carried towards Bronte and the plain of Lago.

After the eruption, the top of the mountain on the weſtern ſide was found covered with hardened lava, ſcoria, and ſtones. The travellers were annoyed by ſmoke, by ſhowers of ſand, mephitic vapours, and exceſſive heat. They ſaw that the lava which came from the weſtern point divided into two branches, one of which was directed towards Libeccio; the other, as we have already ſaid, towards the plain of Lago. The lava on the weſtern head of the mountain had from its various ſhapes been evidently in a ſtate of fuſion; from one of the ſpiracula, the odour was ſtrongly that of liver of ſulphur. The thermometer, in deſcending, was at 40 degrees of Fahrenheit's ſcale; while near the lava, in the plain of Lago, it was 140 degrees. The lava extended two miles; its width was from 12 to $13\frac{1}{4}$ feet, and its depth $13\frac{3}{4}$ feet.

A variety of particulars reſpecting this celebrated mountain may be found in different volumes of the Philoſophical Tranſactions.

ETOLIA, a country of ancient Greece, comprehending all that tract now called the *Deſpotat*, or *Little Greece*. It was parted on the eaſt by the river Evenus, now the Fidari, from the Locrenſes Ozolæ: on the weſt, from Acarnania by the Achelous; on the north, it bordered on the country of the Dorians and part of Epirus; and, on the ſouth, extended to the bay of Corinth.

ETON, a town of Bucks, oppoſite Windſor. It is ſeated on the Thames, over which is a bridge. It is famous for a ſchool and college founded by Henry VI. King's college in Cambridge admits no other ſtudents for fellows but what have been brought up here. It is 20 miles W. of London. Lon. 0. 36. W. Lat. 50. 30. N.

ETRURIA. See Hetruria.

ETYMOLOGY, that part of grammar which conſiders and explains the origin and derivation of words, in order to arrive at their firſt and primary ſignification, whence Quintilian calls it *originatio*.—The word is formed of the Greek ἔτυμος *verus*, "true," and λεγω *dico*, "I ſpeak;" whence λογια *diſcourſe*, &c.

and thence Cicero calls the etymology *notatio* and *veriloquium*; though Quintilian chooſes rather to call it *originatio*. A judicious inquiry into etymologies is thought by ſome of conſiderable uſe; becauſe nations, who value themſelves upon their antiquity, have always looked on the antiquity of their language as one of the beſt titles they could plead; and the etymologiſt, by ſeeking the true and original reaſon of the notions and ideas fixed to each word and expreſſion, may often furniſh an argument of antiquity, from the traces remaining thereof, compared with the ancient uſes. Add, that etymologies are neceſſary for the thorough underſtanding of a language. For, to explain a term preciſely, there ſeems a neceſſity for recurring to its firſt impoſition, in order to ſpeak juſtly and ſatisfactorily upon it. The force and extent of a word are generally better conceived when a perſon knows its origin and etymology.

It is objected, however, that the art is arbitrary, and built altogether on conjectures and appearances; and the etymologiſts are charged with deriving their words from whence they pleaſe. And indeed it is no eaſy matter to go back into the ancient Britiſh and Gauliſh ages, and to follow, as it were, by the track, the various imperceptible alterations a language has undergone from age to age; and as thoſe alterations have ſometimes been merely owing to caprice, it is eaſy to take a mere imagination or conjecture for a regular analogy: ſo that it is no wonder the public ſhould be prejudiced againſt a ſcience which ſeems to ſtand on ſo precarious a footing. It muſt certainly be owned, that etymologies are frequently ſo far-fetched, that one can ſcarce ſee any reſemblance or correſpondence in them. Quintilian has ſhown, that the ancient etymologiſts, notwithſtanding all their learning, fell into very ridiculous derivations.

The etymologies of our Engliſh words have been derived from the Saxon, Welch, Walloon, Daniſh, Latin, Greek, &c. In the preſent work the etymologies of terms are generally noted, where their obviouſneſs does not render it unneceſſary, or their dubiety or unimportance uſeleſs.

EVACUANTS, in pharmacy, are properly ſuch medicines as have a tendency to reduce the ſtrength. Thus, in inflammatory diſeaſes, phyſicians direct evacuations by bleeding, ſweating, purging, &c.

EVAGRIUS SCHOLASTICUS, a famous hiſtorian, born at Epiphania about the year 536. He practiſed the profeſſion of an advocate, from which he was called *Scholaſticus*, which name was then given to the pleaders at the bar. He was alſo tribune and keeper of the prefect's diſpatches. He wrote an eccleſiaſtical hiſtory, which begins where Socrates and Theodoret ended theirs; and other works, for which he was rewarded by the emperors Tiberius and Mauricius. M. de Valois publiſhed at Paris a good edition of Evagrius's eccleſiaſtical hiſtory, in folio; and it was republiſhed at Cambridge in 1620, in folio, by William Reading, with additional notes of various authors.

EVANDER, a famous Arcadian chief, called the ſon of Mercury, on account of his eloquence, brought a colony of his people into Italy, about 60 years before the taking of Troy; when Faunus, who then reigned over the Aborigenes, gave him a large extent of country, in which he ſettled with his friends. He is ſaid to have taught the Latins the uſe of letters, and the art of huſbandry. He kindly received Hercules when he returned from the conqueſt of Geryon, and he was the firſt who raiſed him altars. He gave Æneas aſſiſtance againſt the Rutuli, and diſtinguiſhed himſelf by his hoſpitality. It is ſaid that he firſt brought the Greek alphabet into Italy, and introduced there the worſhip of the Greek deities. He was honoured as a god after death, and his ſubjects raiſed him an altar on mount Aventine.

EVANGELISTS, the inſpired authors of the goſpels. The word is derived from the Greek *ευαγγελιον*, formed of *ευ bene*, "well," and *αγγελος* "angel or meſſenger." The denomination *evangeliſts* was likewiſe given in the ancient church to ſuch as preached the goſpel up and down, without being attached to any particular church, being either commiſſioned by the apoſtles to inſtruct the nations, or of their own accord abandoning every worldly attachment, and conſecrating themſelves to the ſacred office of preaching the goſpel. In this ſenſe ſome interpreters think it is that St. Philip, who was one of the ſeven deacons, is called the *evangeliſt*, in the 21ſt chapter of the Acts of the Apoſtles, ver. 8. Again, St. Paul writing to Timothy, ep. ii. cap. iv. ver. 5. bids him do the work of an evangeliſt. The ſame apoſtle, Eph. iv. 11. ranks the evangeliſts after the apoſtles and prophets.

EVANID, a name given by ſome authors to ſuch colours as are of no long duration, as thoſe in the rainbow, in clouds before and after ſun-ſet, &c. Evanid colours are alſo called *fantaſtical* and *emphatical* colours.

EVANTES, in antiquity, the prieſteſſes of Bacchus, thus called, becauſe in celebrating the orgia they ran about as if diſtracted, crying, *Evan, evan, ohe evan*. See BACCHANALIA.

EVAPORATION, the act of diſſipating the humidity of a body in fumes or vapour; differing from exhalation, which is properly a diſperſion of dry particles iſſuing from a body.

Evaporation is uſually produced by heat, and by the change of air: thus, common ſalt is formed by evaporating all the humidity in the brine or ſalt water; which evaporation is either performed by the heat of the ſun, as in the ſalt-works on the ſea-coaſt, &c.; or by means of fire, as at the ſalt-ſprings, &c.: and it is well known how uſeful a briſk wind is in drying wet clothes, or the ſurface of the ground; while in a calm, ſtill atmoſphere, they dry extreme ſlowly.

But, though Evaporation be generally conſidered as an effect of the heat and motion of the air, yet M. Gauteron, in the Memoires de l'Acad. des Scienc. an. 1705, ſhews, that a quite oppoſite cauſe may have the ſame effect, and that fluids loſe more of their parts in the ſevereſt froſt than when the air is moderately warm: thus, in the great froſt of the year 1708, he found that the greater the cold, the more conſiderable the evaporation; and that ice itſelf loſt full as much as the warmer liquors that did not freeze.

There are indeed few ſubjects of philoſophical inveſtigation that have occaſioned a greater variety of opinion than the theory of Evaporation, or of the aſcent of water, in ſuch a fluid as air, between 8 and 9 hundred times lighter than itſelf, to different heights according to the different denſities of the air; in which caſe it muſt be ſpecifically lighter than the air through which it aſcends. The Carteſians account for it by ſuppoſing, that by the action of the ſun upon the water, ſmall particles of the water are formed into hollow ſpheres and filled with the *materia ſubtilis*, which renders them ſpecifically lighter than the ambient air, ſo that they are buoyed up by it.

Dr. Nieuwentyt, in his Religious Philoſopher, cont. 19, and ſeveral others, have alleged, that the ſun emits particles of fire which adhere to thoſe of water, and form moleculæ, or ſmall bodies, lighter than an equal bulk of air, which conſequently aſcend till they come to a height where the air is of the ſame ſpecific gravity with themſelves; and that theſe particles being ſeparated from the fire with which they are incorporated, coaleſce and deſcend in dew or rain.

Dr. Halley has advanced another hypotheſis, which has been more generally received: he imagined that, by the action of the ſun on the ſurface of the water, the aqueous particles are formed into hollow ſpherules, that are filled with a finer air highly rarefied, ſo as to become ſpecifically lighter than the external air. Philoſ. Tranſ. number 192, or Abr. vol. 2, p. 126.

Dr. Deſaguliers, diſſatisfied with theſe two hypotheſes, propoſes another in the Philoſ. Tranſ. number 407, or Abr. vol. 7,

pa. 61. See alſo his Courſe of Experimental Philoſophy, vol. 2, p. 336. He ſuppoſes that heat acts more powerfully on water than on common air; that the ſame degree of heat which rarefies air two-thirds, will rarefy water near 14,000 times; and that a very ſmall degree of heat will raiſe a ſteam or vapour from water, even in winter, whilſt it condenſes the air; and thus the particles of water are converted into vapour by being made to repel each other ſtrongly, and, deriving electricity from the particles of air to which they are contiguous, are repelled by them and by each other, ſo as to form a fluid which, being lighter than the air, riſes in it, according to their relative gravities. The particles of this vapour retain their repellent force for a conſiderable time, till, by ſome diminution of the denſity of the air in which they float, they are precipitated downwards, and brought within the ſphere of each other's attraction of coheſion, and ſo join again into drops of water.

Many objections have been urged againſt this opinion, by Mr. Clare in his Treatiſe of the Motion of Fluids, pa. 294, and by Mr. Rowning in his Syſtem of Philoſophy, part 2, diſſ. 6; to which Dr. Hamilton has added the two following, viz. that if heat were the only cauſe of evaporation, water would evaporate faſter in a warm cloſe room, than when expoſed in a colder place, where there is a conſtant current of air; which is contrary to experience; and that the evaporation of water is ſo far from depending on its being rarefied by heat, that it is carried on even whilſt water is condenſed by the coldneſs of the air, till it freezes; and ſince it evaporates even when frozen into hard ice, it muſt alſo evaporate in all the leſſer degrees of cold. And therefore heat does not ſeem to be the principal, much leſs the only cauſe of Evaporation.

Others have more ſucceſsfully accounted for the phenomena of Evaporation on another principle, viz. that of ſolution; and ſhewn, from a variety of experiments, that what we call Evaporation, is nothing more than a gradual ſolution of water in air, produced and ſupported by the ſame means, viz. attraction, heat, and motion, by which other ſolutions are effected.

It ſeems the Abbé Nollet firſt ſtarted this opinion, though without much purſuing it, in his Leçons de Phyſique Experimentale, firſt publiſhed in 1743: he offers it as a conjecture, that the air of the atmoſphere ſerves as a ſolvent or ſponge, with regard to the bodies that encompaſs it, and receives into its pores the vapours and exhalations that are detached from the maſſes to which they belong in a fluid ſtate; and he accounts for their aſcent on the ſame principles with the aſcent of liquors in capillary tubes. On this hypotheſis, the condenſation of the air contributes, like the ſqueezing of a ſponge, to their deſcent.

Dr. Franklin, in a paper of Philoſophical and Meteorological Obſervations, Conjectures and Suppoſitions, delivered to the Royal Society about the year 1747, and read in 1756, ſuggeſted a ſimilar hypotheſis: he obſerves, that air and water mutually attract each other; and hence he concludes, that water will diſſolve in air, as ſalt in water; every particle of air aſſuming one or more particles of water; and when too much is added, it precipitates in rain. But as there is not the ſame contiguity between the particles of air as of water, the ſolution of water in air is not carried on without a motion of the air, ſo as to cauſe a freſh acceſſion of dry particles. A ſmall degree of heat ſo weakens the coheſion of the particles of water, that thoſe on the ſurface eaſily quit it, and adhere to the particles of air: a greater degree of heat is neceſſary to break the coheſion between water and air; for its particles being by heat repelled to a greater diſtance from each other, thereby more eaſily keep the particles of water that are annexed to them from running into coheſions that would obſtruct, refract, or reflect the heat: and hence it happens that when we breathe in warm air, though the ſame quantity of moiſture may be taken up from the lungs as when we breathe in cold air, yet that moiſture is not ſo viſible. On theſe principles he accounts for the production and different appearances of fogs, miſts, and clouds. He adds, that if the particles of water bring electrical fire when they attach themſelves to air, the repulſion between the particles of water electrified, joins with the natural repulſion of the air to force its particles to a greater diſtance, ſo that the air being more dilated, riſes and carries up with it the water: which mutual repulſion of the particles of air is increaſed by a mixture of common fire in the particles of water. When air, loaded with ſurrounding particles of water, is compreſſed by adverſe winds, or by being driven againſt mountains, &c. or condenſed by taking away the fire that aſſiſted it in expanding, the particles will approach one another, and the air with its water will deſcend as a dew; or if the water ſurrounding one particle of air come in contact with the water ſurrounding another, they coaleſce and form a drop, producing rain; and ſince it is a well-known fact, that vapour is a good conductor of electricity, as well as of common fire, it is reaſonable to conclude with Mr. Henley, that Evaporation is one great cauſe of the clouds becoming at times ſurcharged with this fluid. Philoſ. Tranſ. vol. 67, pa. 134. See alſo vol. 55, p. 128, or Franklin's Letters and Papers on Philoſophical Subjects, p. 42, &c. and pa. 182, ed. 1769.

M. le Roi, of the Academy of Sciences at Paris, has alſo advanced the ſame opinion, and ſupported it by a variety of facts and obſervations in the Memoirs for the year 1751. He ſhews, that water does undergo in the air a real diſſolution, forming with it a tranſparent mixture, and poſſeſſing the ſame properties with the ſolutions of moſt ſalts in water; and that the two principal cauſes which promote the ſolution of water in the air, are heat and wind; that the hotter the air is, within a certain limit, the more water it will diſſolve; and that at a certain degree of heat the air will be ſaturated with water; and by determining at different times the degree of the air's ſaturation, he eſtimates the influence of thoſe cauſes on which the quantity depends that is ſuſpended in the air in a ſtate of ſolution. Accordingly, the air, heated by evaporating ſubſtances to which it is contiguous, becomes more rare and light, riſes and gives way to a denſer air; and, by being thus removed, contributes to accelerate the Evaporation. The fixed air contained in the internal parts of evaporating bodies, put into action by heat, ſeems alſo to increaſe their Evaporation. The wind is another cauſe of the increaſe of Evaporation, chiefly by changing and renewing the air which immediately encompaſſes the evaporating ſubſtances; and from the conſideration of theſe two cauſes combined, it appears why the quantity of vapour raiſed in the night is leſs than that of the day, ſince the air is then both leſs heated and leſs agitated. To the objection urged againſt this hypotheſis, on account of the Evaporation of water in a vacuum, this ingenious writer replies, that the water itſelf contains a great quantity of air, which gradually diſengages itſelf, and cauſes the Evaporation; and that it is impoſſible that a ſpace containing water which evaporates ſhould remain perfectly free from air. To this objection a late writer, Dr. Dobſon of Liverpool, replies, that though air appears, by unqueſtionable experiments, to be a chemical ſolvent of water, and as ſuch is to be conſidered as one cauſe of its Evaporation, heat is another cauſe, acting without the intervention of air, and producing a copious Evaporation in an exhauſted receiver; agreeably to an experiment of Dr. Irving, who ſays, that in an exhauſted receiver water riſes in vapour more copiouſly at 180° of Fahrenheit's thermometer, than in the open air at 212°, its boiling point. Dr. Dobſon farther adds, that water may exiſt in air in three different ſtates; in a ſtate of perfect ſolution, when the air will be clear, dry, and heavy, and its powers of ſolution ſtill active; in a ſtate of beginning precipitation, when it becomes moiſt and foggy, its powers of ſolution are diminiſhed, and it becomes lighter in proportion as its water is depoſited; and alſo, when it is completely precipitated, which

may happen either by a ſlower proceſs, when the diſſolved water falls in a drizzling rain, or by a more ſudden proceſs, when it deſcends in briſk ſhowers. Philoſ. Tranſ. vol. 67, p. 257, and Phipps's Voyage towards the North Pole, p. 211.

Dr. Hamilton, profeſſor of philoſophy in the univerſity of Dublin, tranſmitted to the Royal Society in 1765, a long Diſſertation on the nature of Evaporation, in which he propoſes and eſtabliſhes this theory of ſolution; and though other writers had been prior in their conjectures, and even in their reaſoning on this ſubject, Dr. Hamilton aſſures us, that he has not repreſented any thing as new which he was conſcious had ever been propoſed by any one before him, even as a conjecture. Dr. Hamilton having evinced the agreement between Solution and Evaporation, concludes, that Evaporation is nothing more than a gradual ſolution of water in air, produced and promoted by attraction, heat, and motion, juſt as other ſolutions are effected.

To account for the aſcent of aqueous vapours into the atmoſphere, this ingenious writer obſerves, that the loweſt part of the air being preſſed by the weight of the upper againſt the ſurface of the water, and continually rubbing upon it by its motion, attracts and diſſolves thoſe particles with which it is in contact, and ſeparates them from the reſt of the water. And ſince the cauſe of ſolution in this caſe is the ſtronger attraction of the particles of water towards the air, than towards each other, thoſe that are already diſſolved and taken up, will be ſtill farther raiſed by the attraction of the dry air that lies over them, and thus will diffuſe themſelves, riſing gradually higher and higher, and ſo leave the loweſt air not ſo much ſaturated but that it will ſtill be able to diſſolve and take up freſh particles of water; which proceſs is greatly promoted by the motion of the wind. When the vapours are thus raiſed and carried by the winds into the higher and colder parts of the atmoſphere, ſome of them will coaleſce into ſmall particles, which ſlightly attracting each other, and being intermixed with air, will form clouds; and theſe clouds will float at different heights, according to the quantity of vapour borne up, and the degree of heat in the upper parts of the atmoſphere: and thus clouds are generally higher in ſummer than in winter. When the clouds are much increaſed by a continual addition of vapours, and their particles are driven cloſe together by the force of the winds. they will run into drops heavy enough to fall down in rain. If the clouds be frozen before their particles are gathered into drops, ſmall pieces of them being condenſed and made heavier by the cold, fall down in thin flakes of ſnow. When the particles are formed into drops before they are frozen, they become hailſtones. When the air is replete with vapours, and a cold breeze ſprings up, which checks the ſolution of them, clouds are formed in the lower parts of the atmoſphere, and compoſe a miſt or fog, which uſually happens in a cold morning, and is diſperſed when the ſun has warmed the air, and made it capable of diſſolving theſe watry particles. Southerly winds commonly bring rain, becauſe, being warm and replete with aqueous vapours, they are cooled by coming into a colder climate; and therefore they part with ſome of them, and ſuffer them to precipitate in rain: whereas northerly winds, being cold, and acquiring additional heat by coming into a warmer climate, are ready to diſſolve and receive more vapour than they before contained; and therefore, by long continuance, they are dry and parching, and commonly attended with fair weather.

Changes of the air, with reſpect to its denſity and rarity, as well as its heat and cold, will produce contrary effects in the ſolution of water, and the conſequent aſcent or fall of vapours. Several experiments prove that air, when rarefied, cannot keep ſo much water diſſolved as it does in a more condenſed ſtate; and therefore when the atmoſphere is ſaturated with water, and changes from a denſer to a rarer ſtate, the high and colder parts of it will let go ſome of the water before diſſolved, forming new clouds, and diſpoſing them to fall down in rain: but a change from a rarer to a denſer ſtate will ſtop the precipitation of the water, and enable the air to diſſolve, either in whole or in part, ſome of thoſe clouds that were formed before, and render their particles leſs apt to run into drops and fall down in rain: on this account, we generally find that the rarefied and condenſed ſtates of the atmoſphere are reſpectively attended with rain or fair weather. See more on this ſubject in the Philoſ. Tranſ. vol. 55, pa. 146, or in Hamilton's Philoſophical Eſſays, p. 33.

Dr. Halley, before mentioned, has furniſhed ſome experiments on the Evaporation of water; the reſult of which is contained in the following articles: 1. That water ſalted to about the ſame degree as ſea-water, and expoſed to a heat equal to that of a ſummer's day, did, from a circular ſurface of about 8 inches diameter, evaporate at the rate of 6 ounces in 24 hours: whence by a calculus he finds that, in ſuch circumſtances, the water evaporates 1-10th of an inch deep in 12 hours: which quantity, he obſerves, will be found abundantly ſufficient to furniſh all the rains, ſprings, dews, &c. By this experiment, every 10 ſquare inches of ſurface of the water yield in vapour *per diem* a cubic inch of water: and each ſquare foot half a wine pint; every ſpace of 4 feet ſquare, a gallon; a mile ſquare, 6914 tuns; and a ſquare degree, of 69 Engliſh miles, will evaporate 33 millions of tuns a day; and the whole Mediterranean, computed to contain 160 ſquare degrees, at leaſt 5280 millions of tuns each day. Philoſ. Tranſ. number 189, or Abridg. vol. 2, pa. 108.

2. A ſurface of 8 ſquare inches, evaporated purely by the natural warmth of the weather, without either wind or ſun, in the courſe of a whole year, 16292 grains of water, or 64 cubic inches; conſequently, the depth of water thus evaporated in one year amounts to 8 inches. But this being too little to anſwer the experiment of the French, who found that it rained 19 inches of water in one year at Paris; or thoſe of Mr. Townley, who found the annual quantity of rain in Lancaſhire above 40 inches; he concludes, that the ſun and wind contribute more to Evaporation than any internal heat or agitation of the water. In effect, Dr. Halley fixes the annual Evaporation of London at 48 inches; and Dr. Dobſon ſtates the ſame for Liverpool at $36\frac{3}{4}$ inches. Philoſ. Tranſ. vol. 67, p. 252.

3. The effect of the wind is very conſiderable, on a double account; for the ſame obſervations ſhew a very odd quality in the vapours of water, viz. that of adhering and hanging to the ſurface that exhaled them, which they clothe as it were with a fleece of vapourous air; which once inveſting the vapour, it afterwards riſes in much leſs quantity. Whence, the quantity of water loſt in 24 hours, when the air is very ſtill, was very ſmall, in proportion to what went off when there was a ſtrong gale of wind abroad to diſſipate the fleece, and make room for the emiſſion of vapour; and this, even though the experiment was made in a place as cloſe from the wind as could be contrived. Add, that this fleece of water, hanging to the ſurface of waters in ſtill weather, is the occaſion of very ſtrange appearances, by the refraction of the vapours differing from and exceeding that of common air: whence every thing appears raiſed, as houſes like ſteeples, ſhips as on land above the water, the land raiſed, and as it were lifted from the ſea, &c.

4. The ſame experiments ſhew that the Evaporation in May, June, July, and Auguſt, which are nearly equal, are about three times as great as thoſe in the months of November, December, January, and February. Philoſ. Tranſ. Nº 212, or Abr. vol. 2, pa. 110.

Dr. Brownrigg, in his Art of making common ſalt, pa. 189, fixes the Evaporation of ſome parts of England at 73.8 inches during the months of May, June, July, and Auguſt; and the Evaporation of the whole year at more than 140 inches. But

the evaporation of the four summer months at Liverpool, on a medium of 4 years, was found to be only 18·88 inches. Alſo Dr. Hales calculates the greateſt annual Evaporation from the ſurface of the earth in England at 6·66 inches; and therefore the annual Evaporation from a ſurface of water is to the annual Evaporation from the furface of the earth at Liverpool, nearly as 6 to 1. See the Philoſ. Tranſ. vol. 67.

In the Tranſactions of the American Philoſophical Society, vol. 3, pa. 125, there is an ingenious paper on Evaporation, by Dr. Wiſtar. It is there ſhewn, that evaporation ariſes when the moiſt body is warmer than the medium it is incloſed in. And, on the contrary, it acquires moiſture from the air, when the body is the colder. This carrying off, and acquiring of moiſture, it is ſhewn, is by the paſſage of heat out of the body, or into it.

This ſubject, regarded in a chemical view, will be found fully treated under the article CHEMISTRY, pages 375 and 381.

EVAPORATOR, a contrivance calculated for expediting the proceſs of evaporation. A model of it was preſented by the inventor, Mr. Browne of Derby, to the Society for the encouragement of arts, &c. who conferred on him their gold medal. From Mr. Browne's communication, inſerted in the Society's volume for 1794, we extract the following account.

"I herewith (ſays the author) ſend you a plan and model of a furnace I uſe for evaporation, and have found more ſerviceable for that purpoſe than any copper or boiler I ever ſaw; and I am of opinion it might be advantageouſly applied to the drying malt, as the heat is more equally diſperſed, and the vapour carried off, much quicker than by the mode now practiſed. I have not obſerved the exact quantity of moiſture which may be exhaled in a given time by a given quantity of fuel; but I can with ſafety ſay that at leaſt one half of the fuel, and a great deal of trouble, is ſaved by this contrivance, as it does not require near the attendance that boilers in general do, in ſupplying it with liquor or fuel, which need only be done twice in twenty-four hours; for the fire, being confined in the firſt inſtance to the bottom, and the evaporation being regular, a certain quantity either of fuel or liquor may be put in at certain times: but the greateſt advantage this furnace poſſeſſes, and the only part I flatter myſelf may be called new, is, the atmoſphere being rendered of an equal heat with the liquor; by which means more moiſture is carried away by the current of hot air, than by any other means I am acquainted with.

"The utility of this Evaporator, therefore, is in my opinion twofold: firſt, the evaporation is much quicker, with a leſs quantity of fuel, than in the generality of the boilers now in uſe; ſecondly, the operator, as well as the whole neighbourhood, cannot in the leaſt be affected or annoyed, let the vapour or ſteam be ever ſo pernicious. That evaporation is much greater by this mode, will appear very plain, when the courſe of the heat is pointed out: it is firſt carried under the veſſel, then reverted back on the ſides, and finally it is carried over the ſurface; by which means the air, that is in contact with the liquor, is ſo heated and highly rarefied, that the fluid is raiſed into vapour or ſteam, much quicker, and with leſs fuel, than if the atmoſphere was cold; and, as the air neceſſary to keep the fuel in combuſtion paſſes over the ſurface of the liquor, every pernicious vapour is carried with it into the fire, where it is decompoſed, or at leaſt ſo changed as to be no longer pernicious.

"As the diminution of labour in all operations is ſo much to be wiſhed, I think it neceſſary to add, that by this contrivance one man can do more work than three can in the uſual method, the fire-place being ſo contrived, that as much fuel may be put on at one time as will ſerve twelve, or even twenty-four hours; and the ſame may be ſaid of the ſupplying the veſſel with freſh liquor."

"A view of the Evaporator is exhibited in plate 15, where Fig. 1. is a complete view of the whole. Fig. 2. A ſection lengthwiſe of the boiler, fire-place, &c. Fig. 3. A tranſverſe ſection of the boiler and flues, looking towards the fire-place. Fig. 4. A plan from A. to B. of fig. 2. Fig. 5. Plan from C. to D. Fig. 6. Plan from E to F. Fig. 7. Plan from G. to H. *a*. The opening or hole through which the air enters; and being admitted through the three holes *b*, *b*, *b*, paſſes over the ſurface of the liquor in the ciſtern or boiler *x*, and then paſſing again by ſimilar openings at the oppoſite end of the ciſtern *y*, *y*, deſcends by the vacuity *c*, *c*, and, by the holes *d*, *d*, is conveyed, by the paſſages *e*, *e*, to the aſh-hole or under-ſide of the grate, and thus ſerves to actuate the fire, bringing with it the ſteam ariſing from the boiler.

"The air and ſteam, having thus ſerved the purpoſe of actuating the fire, are, with the ſmoke ariſing from the fuel, conveyed by the back of the furnace *g*, *g*, under the boiler along the paſſage *h*, *h*; and, riſing through an aperture *i*, *i*, under an inclined caſt-iron plate *k*, *k*, paſſes through two holes, *l*, *l*, into the paſſages *m*, *m*, and riſes, by two other holes *n*, *n*, into a vacuity *o*, *o*, whence it ariſes again by two holes *p*, *p*, enters the flues *q*, *q*, and thence into the chimneys *r*, *r*. *s*, *s*. The ſtoking-hole of the furnace. *t*, *t*. The aſh hole. *v*, *v*. The opening through which the fuel is put into the furnace. *w*. The door, or opening to the ciſtern.

"The ſame letters refer to the ſame parts in all the ſeveral delineations in the plate."

EVASION, in law, is uſed for any ſubtile endeavour to ſet aſide truth, or to eſcape the puniſhment of the law, which will not be endured. Thus, if a perſon ſays to another that he will not ſtrike him, but will give him a pot of ale to ſtrike him firſt, and accordingly he ſtrikes, the returning of it is puniſhable; and if the perſon firſt ſtriking be killed, it is murder; for no man ſhall evade the juſtice of the law by ſuch a pretence to cover his malice.

EVATES, a branch or diviſion of the druids, or ancient Celtic philoſophers. Strabo divides the Britiſh and Gauliſh philoſophers into three ſects; bards, evates, and druids. He adds, that the bards were the poets and muſicians; the evates, the prieſts and naturaliſts; and the druids were moraliſts as well as naturaliſts: But Marcellus and Hornius reduce them all to two ſects, *viz.* the BARDS and DRUIDS.

EUBAGES, an order of prieſts or philoſophers among the ancient Celtæ or Gauls: ſome will have the eubages to be the ſame with the druids and ſaronidæ of Diodorus; and others, that they were the ſame with what Strabo calls EVATES.

EUCHARIST, the ſacrament of the Lord's ſupper, properly ſignifies *giving thanks*.—The word in its original Greek, Ευχαριϛια, literally imports *thankſgiving*; being formed of ευ *bene*, "well," and χαρις *gratia*, "thanks." This ſacrament was inſtituted by Chriſt himſelf, and the participation of it is called *communion*. As to the manner of celebrating the euchariſt among the ancient Chriſtians, after the cuſtomary oblations were made, the deacon brought water to the biſhops and preſbyters, ſtanding round the table, to waſh their hands; according to that of the pſalmiſt, "I will waſh my hands in innocency, and ſo will I compaſs thy altar, O Lord." Then the deacon cried out aloud, "Mutually embrace and kiſs each other;" which being done, the whole congregation prayed for the univerſal peace and welfare of the church, for the tranquillity and repoſe of the world, for the proſperity of the age, for wholeſome weather, and for all ranks and degrees of men. After this followed mutual ſalutations of the miniſter and people; and then the biſhop or preſbyter having ſanctified the elements by a ſolemn benediction, he brake the bread, and delivered it to the deacon, who diſtributed it to the communicants, and after that the cup. Their ſacramental wine was uſually diluted or mixed with water. During the time of adminiſtration, they ſang hymns and pſalms; and having concluded with prayer and thankſgiving, the people ſaluted each other with a kiſs of peace, and ſo the aſſembly broke up.

EUCHITES, or Euchitæ, a fect of ancient heretics, who were firft formed into a religious body towards the end of the fourth century, though their doctrine and difcipline fubfifted in Syria, Egypt, and other eaftern countries before the birth of Chrift; they were thus called becaufe they prayed without ceafing, imagining that prayer alone was fufficient to fave them. Their great foundation were thofe words of St. Paul, (1 Theffalonians v. 17.) *Pray without ceafing*. The word is formed of the Greek, ευχη *prayer*, whence ευχιται, the fame with the Latin, *precatores*, "prayers." They were alfo called *Enthufiafts* and *Meffalians*; a term of Hebrew origin, denoting the fame as Euchites.

The Euchites were a fort of myftics who imagined, according to the oriental notion, that two fouls refided in man, the one good and the other evil; and who were zealous in expelling the evil foul or dæmon, and haftening the return of the good fpirit of God, by contemplation, prayer, and finging of hymns. They alfo embraced the opinions nearly refembling the Manichean doctrine, and which they derived from the tenets of the oriental philofophy. The fame denomination was ufed in the 12th century, to denote certain fanatics who infefted the Greek and Eaftern churches, and who were charged with believing a double Trinity, rejecting wedlock, abftaining from flefh, treating with contempt the facraments of baptifm and the Lord's fupper, and the various branches of external worfhip, and placing the effence of religion folely in external prayer, and maintaining the efficacy of perpetual fupplications to the fupreme Being for expelling an evil being or genius, which dwelt in the breaft of every mortal. This fect is faid to have been founded by a perfon called *Lucopetrus*, whofe chief difciple was named *Tichicus*. By degrees it became a general and invidious appellation for perfons of eminent piety and zeal for genuine Chriftianity, who oppofed the vicious practices and infolent tyranny of the priefthood; much in the fame manner as the Latins comprehended all the adverfaries of the Roman pontiff under the general terms of Waldenses and Albigenses.

EUCHOLOGIUM, Ευχολογιον, a Greek term, fignifying literally *a difcourfe on prayer*. The word is formed of ευχη *prayer*, and λογος *difcourfe*. The Euchologium is properly the Greek ritual, wherein are prefcribed the order and adminiftration of their ceremonies, facraments, ordinations, &c. F. Goar has given us an edition of the Greek Euchologium in Greek and Latin, with notes, at Paris.

EUCLID *of* Megara, a celebrated philofopher and logician, flourifhed about 400 B. C. The Athenians having prohibited the Megarians from entering their city on pain of death, this philofopher difguifed himfelf in women's clothes to attend the lectures of Socrates. After the death of Socrates, Plato and other philofophers went to Euclid at Megara, to fhelter themfelves from the tyrants who governed Athens. Euclid admitted but one chief good; which he fometimes called *God*, fometimes *Spirit*, and fometimes *Providence*.

Euclid *of Alexandria*, the celebrated mathematician, flourifhed in the reign of Ptolemy Lagus, about 277 B. C. He reduced all the fundamental principles of pure mathematics, which had been delivered down by Thales, Pythagoras, Eudoxus, and other mathematicians before him, into regularity and order, and added many others of his own difcovering; on which account he is faid to be the firft who reduced arithmetic and geometry into the form of a fcience. He likewife applied himfelf to the ftudy of mixed mathematics, and efpecially to aftronomy, in which he alfo excelled. The moft celebrated of his works is his Elements of Geometry, of which there have been a great number of editions in all languages; and a fine edition of all his works was printed in 1703, by David Gregory, Savilian profeffor of aftronomy at Oxford.

EUCRASY, of ευ *well*, and κρασις *temperature*, in medicine, an agreeable well proportioned mixture of qualities, whereby a body is faid to be in good order and difpofed for a good ftate of health.

EUDIOMETER, an inftrument for afcertaining the purity of the atmofpherical air, or the quantity of oxygenous gas or vital air contained in it, chiefly by means of its diminution on a mixture with nitrous air. See Aerology, p. 61. Several kinds of thefe have been invented, the principal of which are the following.

I. The Eudiometer originally ufed by Dr. Prieftley is a divided glafs tube, into which, after having filled it with common water, and inverted it into the fame, one meafure or more of common air, and an equal quantity of nitrous air, are introduced by means of a fmall phial, which is called the meafure; and thus the diminution of the volume of the mixture, which is feen at once by means of the graduations of the tube, inftantly difcovers the purity of the air required.

II. The difcovery of Dr. Prieftley was announced to the public in the year 1772; and feveral perfons both at home and abroad prefently availed themfelves of it, by framing other more accurate inftruments. The firft of thefe was contrived by M. Landriani; an account of which is publifhed in the 6th volume of Rofier's Journal for the year 1775. It confifts of a glafs tube, fitted by grinding to a cylindrical veffel, to which are joined two glafs cocks and a fmall bafon; the whole being fitted to a wooden frame. In this inftrument quickfilver is ufed inftead of water; though that is attended with an inconvenience, becaufe the nitrous air acts upon the metal, and renders the experiment ambiguous.

III. In 1777, Mr. Magellan publifhed an account of three Eudiometers invented by himfelf, confifting of glafs veffels of rather difficult conftruction, and troublefome ufe. Mr. Cavallo obferves, that the conftruction of all the three is founded on a fuppofition, that the mixture of nitrous and atmofpherical air, having continued for fome time to diminifh, afterwards increafes again; which it feems is a miftake: neither do they give accurate or uniform refults in any two experiments made with nitrous and common air of precifely the fame quality.

IV. A preferable method of difcovering the purity of the air by means of an Eudiometer, is recommended by M. Fontana, of very great accuracy. The inftrument is originally nothing more than a divided glafs tube, though the inventor afterwards added to it a complicated apparatus, perhaps of little or no ufe. The firft fimple Eudiometer confifted only of a glafs tube, uniformly cylindrical, about 18. inches long, and 3-4ths of an inch diameter within fide, the outfide being marked with a diamond at fuch diftances as are exactly filled by equal meafures of elaftic fluids: and when any parts of thefe divifions are required, the edge of a ruler, divided into inches and fmaller parts, is held againft the tube, fo as that the firft divifion of the ruler may coincide with one of the marks on the tube. The nitrous and atmofpherical air are introduced into this tube, in order to to be diminifhed, and thence the purity of the atmofpheric air afcertained.

V. M. Sauffure of Geneva has alfo invented an Eudiometer, which he thinks is more exact than any of thofe before defcribed; the apparatus of which is as follows: 1. A cylindrical glafs bottle, with a ground ftopple, containing about $5\frac{1}{2}$ ounces, which ferves a receiver for mixing the two airs. 2. A fmall glafs phial, to ferve as a meafure, and is about one-third the fize of the receiver. 3. A fmall pair of fcales that will weigh very exactly. 4. Several glafs bottles, for containing the nitrous or other air to be ufed, and which may fupply the place of the recipient when broken. The method of ufing it is as follows: The receiver is to be filled with water, clofed exactly with its glafs ftopple, wiped dry on the outfide, and then weighed very nicely. Being then immerged in a veffel of water, and held with the mouth downwards, the ftopple is removed, and, by means of a funnel, two meafures of common and one of ni-

trous air are introduced into it, one after another: theſe diminiſh as ſoon as they come into contact; in conſequence of which the water enters the recipient in proportionable quantity. After being ſtopped and well ſhaken, to promote the diminution, the receiver is to be opened again under water; then ſtopped and ſhaken again, and ſo on for three times ſucceſſively, after which the bottle is ſtopped for the laſt time under water, then taken out, wiped very clean and dry, and exactly weighed as before. It is plain that now, the bottle being filled partly with elaſtic fluid and partly with water, it muſt be lighter than when quite full of water; and the difference between thoſe two weights, ſhows nearly what quantity of water would fill the ſpace occupied by the diminiſhed elaſtic fluid. Now, in making experiments with airs of different degrees of purity, the ſaid difference will be greater when the diminution is leſs, or when the air is leſs pure, and vice verſa; by which means the comparative purity between two different kinds of air is determined.

VI. But as this method, notwithſtanding the encomiums beſtowed on it by the inventor, is ſubject to ſeveral errors and inconveniences; to remedy all theſe, another inſtrument was invented by Mr. Cavallo; the deſcription of which, being long, may be ſeen in his Treatiſe on the Nature and Properties of Air, page 344.

VII. In the 73d volume of the Philoſophical Tranſactions, we have an account of a new Eudiometer by Mr. Cavendiſh. He prefers the Abbe Fontana's to all the reſt: the great improvement in which (he ſays) is, that as the tube is long and narrow, and the orifice of the funnel not much leſs than the bore of the tube, and the meaſure made to deliver its contents very quick, the air riſes ſlowly up the tube in one continued column; ſo that there is time to take the tube off the funnel, and to ſhake it before the airs come quite into contact; by which means the diminution is much greater and more certain than it would otherwiſe be. Thus, if equal meaſures of nitrous and common air are mixed together in this manner, the bulk of the mixture will, in general, be about one meaſure; but if the airs are ſuffered to remain in contact about a quarter of a minute before they are ſhaken, the bulk will hardly be leſs than one meaſure and one fifth; and it will be very different according to the length of time they are ſuffered to remain before they are ſhaken. In like manner, if, through any fault in the apparatus, the air riſes in bubbles, as in that caſe it is impoſſible to ſhake the tube ſoon enough, the diminution is always leſs than it ought to be. Another very conſiderable advantage ariſing from the method of mixing the airs juſt mentioned is, that the diminution takes place in its full extent almoſt inſtantly; but if they are allowed to remain for ſome time in contact before they are ſhaken, the mixture will continue diminiſhing for many hours afterwards.

The reaſon of theſe differences, according to our author, is, that, in the Abbe Fontana's method, the water is ſhaken briſkly up and down in the tube while the airs are mixing; by which means every ſmall portion of nitrous air muſt be in contact with water either at the inſtant it mixes with the common air, or at leaſt immediately after; and it ſeems that the water, by abſorbing the nitrous acid the moment it is formed, greatly contributes to the quickneſs of the diminution, as well as to the quantity of it. Hence Mr. Cavendiſh was induced to try whether the diminution would not be more certain and regular, if one of the airs were added to the other ſlowly and in ſmall bubbles, the veſſel being kept ſhaking all the while that the mixture took place: and on trial he found that this method fully anſwered his expectations.

The apparatus uſed by our author is, 1. A cylindrical glaſs veſſel *A*, fig. 1. plate 16, with braſs caps at top and bottom. To the upper cap a braſs cock *B* is fitted: the bottom cap is open, but made to fit cloſe into the braſs ſocket *Dd*, and is fixed into it in the ſame manner as a bayonet is on a muſket. This ſocket has a ſmall hole *E* in its bottom, and is faſtened to the board of the tub by the bent braſs *F f G*, in ſuch a manner that *b*, the top of the cock, may be about half an inch under water: conſequently, if the veſſel *A* is placed in its ſocket with any quantity of air in it, and the cock is then opened, the air will run out by the cock; but will do ſo very ſlowly, as it can eſcape no faſter than the water can enter by the ſmall hole *E* to ſupply its place. 2. Beſides this veſſel, there are three glaſs bottles ſimilar to *M*, fig. 2. having each a flat braſs cap at bottom to make it ſtand ſteady, and a ring at top to ſuſpend it; alſo ſome glaſs meaſures of different ſizes, as *B* fig. 3. having a flat braſs cap at bottom with a wooden handle. Theſe are filled with the air to be meaſured, then ſet upon the braſs knob *C* fitted to the board of the tub below the ſurface of the water, which drives out ſome of the air, leaving only the proper quantity.

In mixing the airs together, our author commonly adds the reſpirable ſlowly to the nitrous; to do which, a proper quantity of nitrous gas is put into the bottle *M*, by means of one of the meaſures already deſcribed, and another quantity of reſpirable air is put into the veſſel *A*, fig. 1, by firſt filling it with this air, and then putting it on the knob *C*, as was done by the meaſure; after which the veſſel *A* is fixed in the ſocket, and the bottle *M* placed with its mouth over the cock. The quantities of air made uſe of, and the diminution of the mixture, are determined by weighing the veſſels under water in the following manner. From one end of a balance, placed in ſuch a manner as to hang over the tub of water, a forked wire is ſuſpended, to each end of which fork is fixed a fine copper wire; and in trying the experiment, the veſſel *A*, with the reſpirable air in it, is firſt weighed by ſuſpending it from one of thoſe copper wires, ſo that it may remain entirely under water. The bottle *M*, with the proper quantity of nitrous air in it, is then hung in the ſame manner on the other wire, and the weight of both together determined. The air is then let out of the veſſel *A* into the bottle *M*, and the weight of both veſſels together found a ſecond time; by which we know the diminution of bulk the airs ſuffer on being mixed. Laſtly, the bottle *M* is taken off, and the veſſel *A* weighed again by itſelf, which gives the quantity of reſpirable air made uſe of. It is needleſs to determine the quantity of nitrous air by weight; becauſe, as the quantity uſed is always ſufficient to produce a full diminution, a ſmall difference therein makes no ſenſible one in the diminution. No ſenſible error can ariſe from any difference in the ſpecific gravity of the air; for the thing found by weighing the veſſel is the difference of weight of the included air and an equal bulk of water; which, as air is no leſs than 800 times lighter than water, is very nearly equal to the weight of a quantity of water equal in bulk to the included air. A common balance is not convenient for weighing the bottles under water, without ſome addition to it: for the lower the veſſel of air ſinks under water, the more the air is compreſſed; which makes the veſſel heavier, and thereby cauſes that end of the beam to preponderate. Hence we muſt either have the index placed below the beam, as in many eſſay-balances; or by ſome other means remove the centre of gravity of the beam ſo much below the centre of ſuſpenſion, as to make the balance vibrate, notwithſtanding the tendency which the compreſſibility of the air in the veſſels has to prevent it.

In this manner of determining the quantities of the air by weight, care muſt be taken to proportion the lengths of the copper wires in ſuch a manner that the ſurface of the water in *A* and *M* ſhall be on the ſame level, when both have the uſual quantity of air in them; as otherwiſe ſome errors will ariſe from the air being more compreſſed in one than the other. This precaution, indeed, does not entirely take away the error, as the level of the water in *M* is not the ſame after the airs are mixed

that it was before; but in veſſels of the ſize uſed by our author, this error could never be equal to the 500dth part of the whole; which therefore is quite inconſiderable: but even if it was much greater, it could be of no conſequence, as it would always be the ſame in trying the ſame kind of air.

The veſſel *A*, fig. 1, uſed in theſe experiments, holds 282 grains of water, and is the quantity denominated *one meaſure* by our author. There are three bottles for making the mixture, with a meaſure *B*, fig. 3, for the nitrous air, adapted to each. The firſt of theſe holds three meaſures, and the correſponding meaſure one and one fourth of the former meaſure; the ſecond bottle holds ſix, and the correſponding meaſures $2\frac{1}{2}$; the third holds 12, and the correſponding meaſure five. The firſt bottle and meaſure are made uſe of in trying common air, and the others for the dephlogiſticated or purer kinds. As the ſame quantity of reſpirable air is always made uſe of, $1\frac{1}{4}$ meaſure of nitrous air is added to one of the common atmoſpherical kind; and in trying very pure oxygenous gas, five meaſures of the nitrous kind are made uſe of; and our author is of opinion, that there is no kind of air ſo pure as to require a greater quantity of nitrous air. The way by which it is known whether a ſufficient quantity of nitrous air has been added, is to obſerve the bulk of the mixture; for if that is not leſs than one meaſure, that is, than the reſpirable air alone, it is a ſign that the quantity of nitrous air is ſufficient, or that it will produce the proper diminution, unleſs it be very impure. It muſt be obſerved, however, that though the quantity of reſpirable air will always be nearly the ſame, as being put in by meaſure, yet the obſerved diminution will commonly require ſome correction. For example, ſuppoſe that the obſerved diminution was 2.353 meaſures, and that the quantity of reſpirable air was found to be .985 of a meaſure; then the obſerved diminution muſt be increaſed by .035, in order to have the true diminution, or that which would have been produced if the reſpirable air made uſe of had been exactly one meaſure; whence the true diminution is 2.388.

In weighing common air, our author ſomewhat abridges the proceſs above deſcribed. He does not weigh the veſſel *A*, but only the bottle *M* with the nitrous air in it; then mixes the airs, and again weighs the ſame bottle with the mixture in it, and finds the increaſe of weight; which added to one meaſure, is very nearly the true diminution whether the quantity of common air made uſe of was a little more or a little leſs than one meaſure. The reaſon of this is, that as the diminution produced by the mixture of common and nitrous air is only a little greater than the bulk of the common air, the bulk of the mixture will be very nearly the ſame whether the bulk of the common air be a little greater or a little leſs than one meaſure. Let us ſuppoſe, for example, that the quantity of common air made uſe of is exactly one meaſure, and that the diminution of bulk on mixing is 1.08 of a meaſure; then muſt the increaſe of the weight of the bottle *M*, on adding the common air, be .08 of a meaſure. Let us next ſuppoſe that the quantity of common air made uſe of is 1.02 of a meaſure; then will the diminution, on adding the nitrous air, be $1.08+\frac{1.02}{1.00}$ or 1.1016 of a meaſure; and conſequently the increaſe of the weight of the bottle *M* will be 1.1016—1.02, or .0816 of a meaſure, almoſt exactly the ſame as if preciſely one meaſure of common air had been employed.

The ſame bottle is made uſe of; viz. that which holds three meaſures, when the nitrous is added to the reſpirable air. In this experiment the bottle *M* is firſt weighed without any air in it, and then weighed again when full of reſpirable air, which gives the quantity of the latter made uſe of. The nitrous air is then put into the veſſel *A*, and weighed together with the bottle *M*; after which, having mixed them together, the diminution takes place, and they are weighed again, in order to diſcover its quantity. In this method a ſmaller quantity of nitrous air is neceſſary than in the former. In the firſt method, it was found that the diminution was ſcarce ſenſibly leſs when one meaſure of nitrous air was uſed than with a much larger quantity: ſo that one meaſure may be accounted fully ſufficient. Our author, however, choſe to employ $1\frac{1}{4}$ meaſure, leſt the nitrous air ſhould be impure. There was no ſenſible diminution whether the orifice of the veſſel *A* opening into the bottle *M* was $\frac{1}{10}$th or $\frac{1}{4}$th of an inch; that is, whether the air eſcaped in ſmall or large bubbles: the diminution was rather greater when the bottle was ſhaken briſkly than otherwiſe; but all the difference that could be perceived between theſe two methods of ſhaking did not exceed .01 of a meaſure. The diminution, however, was remarkably leſs when the bottle was not ſhaken at all; being at firſt only 0.9; in about three minutes it increaſed to 0.93; and after being ſhaken for about a minute it increaſed to 0.99; but when gently ſhaken at firſt, the diminution was 1.08 on mixing, and did not ſenſibly increaſe after that time. Some difference was found to ariſe from the length of time the air took up in paſſing from one veſſel to another. When it took up 80 ſeconds, for inſtance, in paſſing from the one bottle into the other, there was a difference of 5 hundredth parts more than when it took up only 22 ſeconds, and about 2 hundredth parts more than when it took up 45 ſeconds; but at other times the difference was leſs. As the hole in the plate *Dd*, however, was always the ſame in our author's experiments, the time taken up by the air in paſſing from one veſſel into the other varied ſo little that no perceptible difference could ariſe from that cauſe. A greater difference aroſe from the ſize of the bottles and quality of the water made uſe of. When the ſmall bottle, holding three meaſures, was uſed, and filled with diſtilled water, the diminution of common air was uſually 1.08; but when the bottle was filled with water from the tub, it was .05 leſs. Uſing the bottle which held 12 meaſures, and filled with diſtilled water, the diminution was about 1.15; and with the ſame bottle filled with water from the tub it was uſually 1.08. "The reaſon of this (ſays Mr. Cavendiſh) is, that water has the power of abſorbing a ſmall quantity of nitrous air; and the more dephlogiſticated the water is, the more of this air it can abſorb. If the water is of ſuch a nature alſo as to froth or form bubbles on letting in the common air, the diminution is remarkably leſs than in other water. In general the diminution was nearly as great with rain as with diſtilled water; but ſometimes the former would froth a good deal: in which caſe it was no better than water fouled with oak-ſhavings. This difference of diminution, according to the nature of the water, is a very great inconvenience, and ſeems to be the chief cauſe of uncertainty in trying the purity of the air; but it is by no means peculiar to this method, being equally great in that of Fontana's. In his method indeed it makes little difference whether the water be diſpoſed to froth or not; but this is no great advantage, as it is eaſy to find water which will not froth; though it ſhows plainly how little any of the experiments hitherto made on the purity of air can be depended upon." The beſt method of obviating this inconvenience is to be always careful to uſe the ſame kind of water: our author always made uſe of diſtilled water; but found that even this was ſometimes endowed with a greater power of abſorbing nitrous air than at others: and with a view to remedy this, he made the following experiment. Some diſtilled water being purged of its air by boiling, one part was kept for a week in a bottle with dephlogiſticated air, and frequently ſhaken: the other part being treated in the ſame manner with phlogiſticated air. By a mean of three different trials the teſt of common air tried with the firſt of theſe waters was 1.139; the diminution ſuffered by

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ſhaking nitrous air in it for two ſeconds being about 0.285. The teſt of the ſame air tried with the other water was 1.054, and the diminution by nitrous air only 0.09; the heat of the water in the tub and of the diſtilled waters being 45°. The heat of the water in the tub and the diſtilled waters was then raiſed to 67°; when the teſt of the ſame air tried by the firſt water was 1.100, and by the latter 1.044; the diminution of nitrous air with the firſt water being 0.235; by the latter 0.089. Hence it might ſeem that the obſerved teſt ought to be corrected by the ſubtraction of $\frac{1}{10}$ths of the diminution which nitrous air ſuffers by being ſhaken in the water, and adding 002 for every three degrees of heat above 0; but though this correction will undoubtedly diminiſh the error, he is of opinion that it will not by any means take it away entirely; and from ſome circumſtances it appears that diſtilled water poſſeſſes a property of abſorbing different quantities of nitrous air independent of its heat.

In the ſecond method, viz. when the nitrous acid is added to the common air, the diminution is conſiderably leſs than in the other; the reaſon of which is, that when nitrous and common air are mixed together, the former is deprived of part of its phlogiſton, and is thereby converted into phlogiſticated nitrous acid, and in that ſtate is abſorbed by the water; beſides that the common air is phlogiſticated, and thereby diminiſhed: ſo that the whole diminution on mixing is equal to the bulk of nitrous air which is turned into acid, added to the diminution which the common air ſuffers by being phlogiſticated. Now it appears, that when a ſmall quantity of nitrous air comes in contact with a large one of common air, the former is more completely deprived of its phlogiſton, and abſorbed by the water in a more dephlogiſticated ſtate than when a ſmall quantity of common air comes into contact with a large quantity of nitrous: in the ſecond method, therefore, where ſmall portions of nitrous air come in contact with a large quantity of common air, the former, as has been juſt obſerved, is more deprived of its phlogiſton; and therefore a ſmaller quantity of it is required to phlogiſticate the common air than in the former method, where ſmall portions of common air come in contact with a large quantity of nitrous air; ſo that a leſs quantity of the nitrous air is abſorbed in the ſecond method than in the firſt. The common air moſt probably ſuffers an equal diminution in both caſes.

Another proof that a ſmaller quantity of nitrous air is required in this method than the former is, that if common air be mixed with a quantity of nitrous air not ſufficient to phlogiſticate it, the mixture will be more phlogiſticated if the nitrous be added ſlowly to the common air without being in contact with water; the mixture will be found to be ſtill more phlogiſticated than in the ſecond method where the two airs are in contact with water at the time of mixing. The final reſult of Mr. Cavendiſh's experiments on this ſubject is, that nitrous air uſed in the firſt method does not phlogiſticate common air more than three-fourths of the ſame quantity uſed in the ſecond way; and not ſo much as one half of the quantity uſed in the third way, viz. by adding the nitrous air ſlowly to the other, without being in contact with water.

With reſpect to the quality of nitrous air uſed in theſe experiments, our author obſerves that it may vary in two reſpects. 1. In purity; that is, in being more or leſs mixed with phlogiſticated or other air. 2. In two parcels of equally pure air, it is poſſible that one parcel may contain more phlogiſton than the other. A difference in the ſecond reſpect will cauſe an error in the teſt, in whatever proportion it be mixed with the reſpirable air; but if it differs in the firſt reſpect, it will ſcarcely cauſe any error unleſs it be uncommonly impure; provided care is taken to uſe a quantity ſufficient to make a full diminution. It muſt be obſerved, however, that if the nitrous air be mixed with fixed air, an error will be occaſioned, becauſe part of the latter is abſorbed while the teſt is trying; but this will hardly be the caſe, unleſs either the metal from which it is procured be covered with ruſt, or unleſs the water in which it is received contain much calcareous earth ſuſpended by fixed air; as in that caſe, if any of the nitrous acid comes over with the air, it will diſſolve the calcareous earth, and ſeparate ſome fixed air.

To determine whether it be poſſible for nitrous air to differ in the ſecond reſpect, our author procured ſome from quickſilver, copper, braſs, and iron: in making experiments with which, he found that the difference between the teſts tried with the three firſt kinds of air was not greater than what might proceed from the error of the experiment; but thoſe with the air from iron .015 greater than the reſt. From other experiments it appeared that the nitrous air from iron was not only more impure than that from other metals, but that the pure portion it contained had leſs phlogiſton in it than that from copper or quickſilver. He is of opinion, however, that copper affords nitrous air ſufficiently pure for experiments of this kind without having recourſe to quickſilver, as Mr. Cavallo adviſes.

In ſome of his experiments, Mr. Cavendiſh had occaſion to uſe a large apparatus, which is repreſented fig. 4. *A* repreſents a bottle containing nitrous air inverted into the tub of water *DE*. *B* is a bottle fitted with a bent glaſs tube *C*. This bottle is to be filled with common air without any water, and is firſt ſlightly warmed by the hand: the end of the glaſs tube is then put into the bottle of nitrous air as repreſented in the figure. As the bottle *B* cools, a little nitrous air runs into it, which inſtantly loſes its elaſticity in conſequence of coming into contact with the atmoſpherical air. This condenſation occaſions an influx of freſh nitrous air, and ſo on till the whole is exhauſted. By this means the nitrous air is added ſlowly to the other without coming into contact with water, till the whole of it has run out from the bottle *A* into *B*; after which the water flows in to ſupply the vacancy occaſioned by the diminution.

EUDOSIA, Athenaïs (before her converſion to Chriſtianity), a celebrated lady, the daughter of Leontius, philoſopher of Athens; who gave her ſuch a learned education, that at his death he left her only a ſmall legacy, ſaying ſhe was capable to make her own fortune: but pleading at Athens without ſucceſs againſt her two brothers, for a ſhare in her father's eſtate, ſhe carried her cauſe perſonally by appeal to Conſtantinople; recommended herſelf to Pulcheria, the ſiſter of the emperor Theodoſius the younger; embraced Chriſtianity, was baptized by the name of *Eudoſia*, and ſoon after married to the emperor. Their union laſted a conſiderable time: but a difference at laſt taking place, on account of the emperor's jealouſy excited by Chryſapius the eunuch, ſhe retired to Jeruſalem, where ſhe ſpent many years in building and adorning churches and relieving the poor. Dupin ſays, that ſhe did not return thence till after the emperor's death: but Cave tells us, that ſhe was reconciled to him, returned to Conſtantinople, and continued with him till his death; after which ſhe went again to Paleſtine, where ſhe ſpent the remainder of her life in pious works. She died in the year 460, according to Dupin; or 459, according to Cave: the latter obſerves, that on her death-bed ſhe took a ſolemn oath, by which ſhe declared herſelf entirely free from any ſtains of unchaſtity. She was the author of a paraphraſe on the eight firſt books of the Old Teſtament in heroic verſe; and of a great number of poems, which are loſt.

EUDOXIANS, a party or ſect of heretics in the fourth century, ſo denominated from their leader Eudoxius, patriarch of Antioch and Conſtantinople, a great defender of the Arian doctrine. The Eudoxians adhered to the errors of the Arians

and Eunomians, maintaining that the Son was created out of nothing; that he had a will diſtinct and different from that of the Father, &c.

EVE. See VIGIL.

EVELYN (John), a moſt learned and ingenious writer and natural philoſopher, was born at Wotton in Surry, the ſeat of his father, in 1620. After making the tour of Europe, he returned to England about the year 1651, and lived very retired at his rural retreat, Say's Court, near Deptford in Kent; where his diſguſt at the violence and confuſion of the times operated ſo far upon his ſtudious diſpoſition, that he actually propoſed to Mr. Boyle the eſtabliſhing a kind of college for perſons of the ſame turn of mind, where they might aſſociate together without care or interruption. It was owing to Mr. Evelyn's gratitude to the place of his education, that Oxford became poſſeſſed of the famous Arundelian marbles; which he perſuaded the Lord Henry Howard to beſtow on that univerſity. He was very aſſiduous in tranſmitting to the royal ſociety whatever fell within the compaſs of his inquiries; and uſed humbly to ſtyle himſelf *a pioneer in the ſervice*. When the number of books he publiſhed is conſidered, the many he left behind him unfiniſhed and unpubliſhed, and the variety of ſubjects on which he employed his time, his induſtry and application are aſtoniſhing. "His life (ſays the honourable Mr. Walpole) was a courſe of inquiry, ſtudy, curioſity, inſtruction, and benevolence. The works of the Creator, and the mimic labours of the creature, were all objects of his purſuit. He unfolded the perfections of the one, and aſſiſted the imperfections of the other. He adored from examination; was a courtier that flattered only by informing his prince, and by pointing out what was worthy for him to countenance; and was really the neighbour of the Goſpel, for there was no man that might not have been the better for him. He was one of the firſt promoters of the royal ſociety, a patron of the ingenious and indigent, and peculiarly ſerviceable to the lettered world; for, beſides his writings and diſcoveries, he obtained the Arundelian marbles for the univerſity of Oxford, and the Arundelian library for the royal ſociety: nor is it the leaſt part of his praiſe, that he who propoſed to Mr. Boyle the erection of a philoſophic college for retired and ſpeculative perſons, had the honeſty to write in defence of active life againſt Sir George Mackenzie's Eſſay on Solitude. He knew that retirement in his own hands was induſtry and benefit to mankind; but in thoſe of others, lazineſs and inutility." There are five ſmall prints of this gentleman's journey from Rome to Naples, drawn and etched by him; and among his publiſhed works are, 1. A character of England; 2. The ſtate of France; 3. An Eſſay on the firſt book of Lucretius *De rerum natura*; 4. The French gardener; 5. A Panegyric on King Charles II's coronation; 6. *Fumifugum*, or the inconveniencies of the air and ſmoke of London diſſipated; 7. The hiſtory and art of engraving on copper; 8. A parallel between the ancient architecture and the modern; 9. Sylva, or a diſcourſe of foreſt-trees; and ſeveral others. This amiable gentleman died, full of age and honour, in 1706. His ſon John Evelyn, born in 1654, diſtinguiſhed himſelf by his elegant tranſlations and poems: He was one of the commiſſioners of the revenue in Ireland; but died early in life, in 1698.

EUERGETES, a ſurname ſignifying *benefactor*, given to Philip of Macedonia, and to Antigonus Doſon, and Ptolemy of Egypt. It was alſo commonly given to the kings of Syria and Pontus, and we often ſee among the former an Alexander Euergetes, and among the latter a Mithridates Euergetes. Some of the Roman emperors alſo claimed the epithet of Benevolent and Humane.

EVERGREENS, in gardening, a ſpecies of perennials, which continue their verdure, leaves, &c. all the year: ſuch are hollies, phillyreas, lauruſtinuſes, bays, pines, firs, cedars of Lebanon, &c.

EVERLASTING PEA. See LYTHYRUS.

EVES-DROPPERS. See EAVES-*Droppers*.

EVESHAM, a borough of Worceſterſhire, with a market on Mondays. It is ſeated on a hill, which riſes with a gradual aſcent from the Avon, which almoſt ſurrounds it, and over which is a ſtone bridge. It was formerly noted for its abbey, and contains three churches. It is 14 miles S. E. of Worceſter, and 95 N. W. by W. of London. W. lon. 1. 45. N. lat. 52. 4.

EVESHAM, *the Vale of*, in Worceſterſhire, on the banks of the Avon, which flows along the S. E. part of the county in its courſe to meet the Severn. It is celebrated for its fertility and beauty; and, beſide the uſual objects of agriculture, great quantities of garden-ſtuff are here grown, and ſent to the towns around to a conſiderable diſtance. In this vale, Simon de Montfort, earl of Leiceſter, was defeated and ſlain, in 1265, the very year in which, by virtue of his uſurped authority, that admirable part of our conſtitution, the houſe of commons, is ſaid to have firſt received its exiſtence. This vale, communicating with the more ſpacious and extenſive one that borders both ſides of the Severn, gives to it, for no aſſignable reaſon, the ſame general name of the Vale of Eveſham. See SEVERN, *Vale of*.

EUGENE (Francis), prince of Savoy, deſcended from Carignan, one of the three branches of the houſe of Savoy, and ſon of Eugene Maurice, general of the Swiſs and Griſons, governor of Champagne, and earl of Soiſſons, was born in 1663. Louis XIV. to whom he became afterwards ſo formidable an enemy, thought him ſo unpromiſing a youth, that he refuſed him preferment both in the church and the ſtate, thinking him too much addicted to pleaſure to be uſeful in either. Prince Eugene, in diſguſt, quitted France; and, retiring to Vienna, devoted himſelf to the imperial ſervice. The war between the emperor and the Turks afforded the firſt opportunity of exerting his military talents; and every campaign proved a new ſtep in his advancement to the higheſt offices in the army. He gave the Turks a memorable defeat at Zenta; commanded the German forces in Italy, where he foiled marſhal Villeroy in every engagement, and at length took him priſoner. Our limits do not allow a detail of his campaigns; but prince Eugene diſtinguiſhed himſelf greatly, when the emperor and queen Anne united againſt the exorbitant power of Louis XIV. He died at Vienna in the year 1736; and was as remarkable for his modeſty and liberality, as for his abilities in the field and the cabinet.

EUGENIA, the YAMBOO; a genus of the monogynia order, belonging to the icoſandria claſs of plants; and in the natural method ranking under the 19th order, *Heſperideæ*. The calyx is quadripartite, ſuperior; the petals four; the fruit a monoſpermous quadrangular plum. There are two ſpecies, both natives of the hot parts of Aſia. They riſe from 20 to 30 feet high; and bear plum-ſhaped fruit, incloſing one nut. They are too tender to live in this country, unleſs they are conſtantly kept in a ſtove.

EVICTION, in law, ſignifies a recovery of lands or tenements by law.

EVIDENCE, that perception of truth which ariſes either from the teſtimony of the ſenſes or from an induction of reaſon.

EVIDENCE, in law, ſignifies ſome *proof* by teſtimony of men upon oath, or by writings or records. It is called *evidence*, becauſe thereby the point in iſſue in a cauſe to be tried is to be made *evident* to the jury; for *probationes debent eſſe evidentes et perſpicuæ*. The ſyſtem of evidence, as now eſtabliſhed in our courts of common law, is very full, comprehenſive, and re-

fined; far different from, and superior to, any thing known in the middle ages; as far superior in that as in all other improvements and refinements in science, arts, and manners. The nature of evidence during the ages of ignorance was extremely imperfect, and the people were incapable of making any rational improvement. Thus it was the imperfection of human reason that caused the invention and introduction of the ORDEAL, as an appeal to the Supreme Being. As men are unable to comprehend the manner in which the Deity carries on the government of the universe, by equal, fixed, and general laws, they are apt to imagine, that in every case which their passions or interest render important in their own eyes, the Supreme Ruler of all ought visibly to display his power in vindicating innocence, and punishing vice.

EVIL, in philosophy, &c. is either moral or natural. Moral evil is the disagreement between the actions of a moral agent, and the rule of those actions whatever it is. See MORAL PHILOSOPHY. Natural evil is, whatever destroys or any way disturbs the perfection of natural beings: such as blindness, diseases, death, &c.

King's EVIL, or *Scrophula*. See SURGERY.

EULER (Leonard) was born at Basil, on the 14th of April 1707; he was the son of Paul Euler and of Margaret Brucker (of an illustrious family in letters), and spent the first year of his life at the village of Richen, of which place his father was minister. Being intended for the church, his father, who had himself studied under James Bernouilli, taught him mathematics, with a view to their proving the ground-work of his other studies, and in hopes that they would turn out a noble and useful secondary occupation; but they were destined to become a principal one; and Euler, assisted and perhaps secretly encouraged by John Bernouilli (who soon discovered that he was to be the greatest scholar he should ever turn out), soon declared his intention of devoting his life to the pursuit: an intention, which the wise father did not thwart, and which the sensible son did not so adhere to, as not to connect with it a more than common improvement in every other kind of useful learning, insomuch that in his latter days men were wont to wonder how, with such a superiority in one branch, he could have been so near eminence in all the rest. Upon the foundation of the Academy of Sciences at St. Petersburg, in 1723, by Catherine I. the two younger Bernouillis had gone thither, promising, when they set out, to endeavour to procure Euler a place in it: they accordingly wrote to him soon after, to apply his mathematics to physiology: he did so, and studied physic under the best physicians at Basil, but at the same time, i. e. 1727, published a dissertation on the nature and propagation of sound: and an answer to the question on the masting of ships, which the Academy of Sciences at Paris judged worthy of the accessit. Soon after this, he was called to St. Petersburg, and declared adjutant to the mathematical class in the academy, a class in which from the circumstances of the times (Newton, Leibnitz, and so many other immortals having just ceased to live) no easy laurels were to be gathered. Euler now perfected the *calculus integralis*, which before was in its infancy: he was the inventor of a new kind of calculus, that of sines; he simplified analytical operations, and, aided by these powerful helpmates, and the astonishing facility with which he knew how to subdue expressions the most intractable, threw a new light on all the branches of the mathematics. But at Catherine's death the academy was threatened with extinction, by men who knew not the connection which arts and sciences have with the happiness of a people. Euler was offered and accepted a lieutenancy on board one of the Empress's ships, with the promise of speedy advancement. Luckily things changed, and our doctor captain again found his own element, and was named Professor of Natural Philosophy in 1733, in the room of his friend John Bernouilli. The great number of memoirs which Euler produced prior to this period is astonishing, but what he did in 1735 is almost incredible. An important calculation was to be made, without loss of time; the other academicians had demanded some months to do it. Euler asked three days—in three days he did it; but the fatigue threw him into a fever, and the fever left him, but not without the loss of an eye; an admonition which would have made ordinary men more sparing of the other. The great revolution, produced by the discovery of fluctions, had entirely changed the face of mechanics; still, however, there was no complete work on the science of motion, two or three only excepted, of which Euler felt the insufficiency. He saw, with pain, that the best works on the subject, viz. "Newton's Principia," and "Herman's Phoronomia," concealed the method by which these great men had come at so many wonderful discoveries, under a synthetic veil. In order to withdraw this, Euler employed all the resources of that analysis which had served him so well on so many other occasions; and so uniting his own discoveries to those of other geometers, had them published by the academy in 1736. This placed Euler in the rank of the first geometricians then existing, and at a time when John Bernouilli was still living. Such labours demanded some relaxation; the only one which Euler admitted, was music, but even to this he could not go without the spirit of geometry went with him. They produced together the essay on a new theory of music, which was published in 1739, but not very well received, probably, because it contains too much geometry for a musician, and too much music for a geometrician. In 1740, his genius was again called forth by the academy of Paris (who, in 1738, had adjudged the prize to his paper on the nature and properties of fire) to discuss the question of the tides, which demanded a frightful number of calculations, and an entire new system of the world. This prize Euler did not gain alone; but he divided it with Maclaurin and D. Bernouilli, forming with them a triumvirate of candidates, which the altars of science had not often beheld. The agreement of the several memoirs of Euler and Bernouilli, on this occasion, is very remarkable. Though the one philosopher had set out on the principle of admitting vortices, which the other rejected, they not only arrived at the same end of the journey, but met several times on the road; for instance, in the determination of the tides under the frozen zone. Philosophy, indeed, led these two great men by two different paths; Bernouilli, who had more patience than his friend, sanctioned every physical hypothesis he was obliged to make, by painful and laborious experiment. These Euler's impetuous genius scorned; and, though his natural sagacity did not always supply the loss, he made amends by his superiority in analysis, as often as there was any occasion to simplify expressions, to adapt them to practice, and to recognise, by final formulæ, the nature of the result. In 1741, Euler received some very advantageous propositions from Frederic the second (who had just ascended the Prussian throne) to go and assist him in forming an academy of sciences, out of the wrecks of the Royal Society founded by Leibnitz. With these offers the tottering state of the St. Petersburg academy under the regency made it necessary for our philosopher to comply. He accordingly illumined the last volume of the "Melanges de Berlin" with five essays, which are, perhaps, the best things in it, and contributed largely to the academical volumes, the first of which was published in 1744. No part of his multifarious labours is, perhaps, a more wonderful proof of the extensiveness and facility of his genius, than what he executed at Berlin, at a time when he contrived that the Petersburg acts should not suffer from the loss of him. In 1744, Euler published a complete treatise of isoperimetrical curves. The same year beheld

the theory of the motions of the planets and comets; the well-known theory of magnetiſm, which gained the Paris prize; and the much amended tranſlation of Robins's "Treatiſe on Gunnery." In 1746, his "Theory of Light and Colours" overturned Newton's "Syſtem of Emanations;" as it did another work, the (at that time triumphant) "Monads of Wolfe and Leibnitz." And now navigation was the only branch of uſeful knowledge, for which the labours of analyſis and geometry had done nothing. The hydrographical part alone, and that which relates to the direction of the courſe of ſhips, had been treated by geometricians conjointly with nautical aſtronomy. Euler was the firſt who conceived and executed the project of making this a complete ſcience. A memoir on the motion of floating bodies, communicated to the academy of St. Peterſburg in 1735, by M. le Croix, was what gave him the firſt idea. His reſearches on the equilibrium of ſhips furniſhed him with the means of bringing the ſtability to a determined meaſure. His ſucceſs encouraged him to go on, and produced the great work which the academy publiſhed in 1749, in which we find, in ſyſtematic order, the moſt ſublime things in the theory of the equilibrium and motion of floating bodies, and on the exiſtence of fluids; this was followed by a ſecond part, which left nothing to be deſired on the ſubject, except the turning it into a language eaſy of acceſs, and diveſting it of the calculations which prevented its being of general uſe. Accordingly, in 1773, from a converſation with Admiral Knowles, and other aſſiſtance out of the "Scientia Navalis," 2 vols. 4to. was produced the "Theorie complette de la Conſtruction & de la Manœuvre des Vaiſſeaux." This work was inſtantly tranſlated into all languages, and the author received a preſent of 6000 livres from the French king: he had before had 300l. from the Engliſh parliament, for the theorems by the aſſiſtance of which Meyer made his lunar tables.

And now it was time to collect, into one ſyſtematical and continued work, all the important diſcoveries on the infiniteſimal analyſis, which Euler had been making for thirty years, and which lay diſperſed in the memoirs of the different academies. This, accordingly, our profeſſor ſet about; but he prepared the way by an elementary work, containing all the previous requiſites for this ſtudy. This is called "An Introduction to the Analyſis of Infiniteſimals," and is a work in which the author has exhauſted all the doctrine of functions, whether algebraical or tranſcendental, by ſhewing their transformation, their reſolution, and their development. This introduction was ſoon followed by the author's ſeveral leſſons on the "calculus integralis" and "differentialis." Having engaged himſelf to Count Orlow, to furniſh the academy with papers ſufficient to fill their volumes for twenty years after his death, our philoſopher is likely to keep his word, having preſented ſeventy papers, through Mr. Golofkin, in the courſe of his life, and left two hundred and fifty more behind him; nor is there one of theſe but what contains a diſcovery, or ſomething that may lead to one. The moſt ancient of theſe memoirs form the collection lately publiſhed, under the title of "Opuſcula Analytica." Such were Mr. Euler's labours, and theſe his titles to immortality!

Some ſwimmings in the head, which ſeized him on the firſt days of September 1783, did not prevent his laying hold of a few facts, which reached him through the channel of the public papers, to calculate the motions of the aeroſtatical globes; and he even compaſſed a very difficult integration, which the calculation had engaged him in. But the decree was gone forth: on the 7th of September he talked with Mr. Lexell, who had come to dine with him, of the new planet, and diſcourſed with him upon other ſubjects, with his uſual penetration. He was playing with one of his grand-children at tea-time, when he was ſeized with an apoplectic fit. "I am dying," ſaid he before he loſt his ſenſes; and he ended his glorious life a few hours after, aged ſeventy-ſix years five months and three days.

Euler was twice married, and had thirteen children, four of whom only ſurvived him. The eldeſt ſon was well known as his father's aſſiſtant and ſucceſſor; the ſecond became phyſician to the Empreſs; and the third a lieutenant-colonel of artillery, and director of the armory at Seſterbeck. The daughter married Major Bell. From theſe children he had thirty-eight grandchildren.

EULOGY, Eulogia, in church hiſtory. When the Greeks have cut a loaf or piece of bread to conſecrate it, they break the reſt into little bits, and diſtribute it among the perſons who have not yet communicated, or ſend it to perſons that are abſent; and theſe pieces of bread are what they call *eulogies*. The word is Greek ευλογια, formed of ευ *bene*, "well," and λεγω *dico*, "I ſay or ſpeak;" q. d. *benedictum*, "bleſſed." The Latin church has had ſomething like eulogies for a great many ages; and thence aroſe the uſe of their holy bread. The name *eulogy* was likewiſe given to loaves or cakes brought to church by the faithful to have them bleſſed. Laſtly, the uſe of the term paſſed hence to mere preſents made to a perſon without any benediction. See the Jeſuit Gretſer, in his *Treatiſe de Benedictionibus & Maledictionibus*, lib. ii. cap. 22, 24, &c. where he treats of eulogies thoroughly. From a paſſage in Bolandus, on the life of St. Melaine, cap. 4, it appears, that eulogies were not only of bread, but any kind of meat bleſſed and hallowed for that purpoſe. Add, that almoſt every body bleſſed and diſtributed eulogies; not only biſhops and prieſts, but even hermits, though laymen, made a practice of it. Women alſo would ſometimes ſend eulogies. The wine ſent as a preſent was alſo held an eulogy. Bolandus remarks farther, that the euchariſt itſelf was alſo called *eulogy*.

Eulogy, likewiſe means an encomium on any perſon, on account of ſome virtue or good quality. See Elogy.

EUMARIDES, of ευμαρης, "eaſy," among the ancients, a kind of ſhoes common to men and women. The eumarides were uſed for pomp and delicacy, being neat, and painted with various colours.

EUMENES, a celebrated orator of Athens about the beginning of the fourth century. Some of his harangues and orations are extant. An hiſtorical writer in Alexander's army.

EUMENIDES, a name given to the Furies by the ancients. They ſprang from the blood of the wound which Cœlus received from his ſon Saturn. According to others, they were daughters of Earth, and conceived from the blood of Saturn. Some make them daughters of Acheron and Night, or Pluto and Proſerpine. According to the more received opinions, they were three in number, Tiſiphone, Megara, and Alecto, to which ſome add Nemeſis. Plutarch mentions only one called *Adraſta*, daughter of Jupiter and Neceſſity. They were ſuppoſed to be the miniſters of the vengeance of the gods: and were uſually repreſented with a grim and frightful aſpect, with a black and bloody garment, and with ſerpents writhing round their heads inſtead of hair. They held a burning torch in one hand, and a whip of ſcorpions in the other; and were always attended by Terror, Rage, Paleneſs, and Death. In hell they were ſeated around Pluto's throne, as the miniſters of his vengeance.

EUMENIDIA, feſtivals in honour of the Eumenides, called by the Athenians σεμναι θεαι "venerable goddeſſes." They were celebrated once every year, with ſacrifices of pregnant ewes, with offerings of cakes made by the moſt eminent youths, and libations of honey and wine. At Athens none but free-born

citizens were admitted, ſuch as had led a life the moſt virtuous and unſullied.

EUMOLPIDES, the prieſts of Ceres at the celebration of her feſtivals at Eleuſis. They were deſcended from Eumolpus, a king of Thrace, who was made prieſt of Ceres by Erechtheus king of Athens. He became ſo powerful after his appointment to the prieſthood, that he maintained a war againſt Erechtheus. This war proved fatal to both. Erechtheus and Eumolpus were both killed, and peace was re-eſtabliſhed among their deſcendants, on condition that the prieſthood ever remained in the family of Eumolpus, and the regal power in the houſe of Erechtheus. The prieſthood remained in the family of Eumolpus for 1200 years; and this is ſtill more remarkable, becauſe he who was once appointed to the holy office was obliged to remain in perpetual celibacy.

EUNAPIUS, a native of Sardis in Lydia, a celebrated ſophiſt, phyſician, and hiſtorian, who flouriſhed in the 4th century, under the emperors Valentinian, Valens, and Gratian. He wrote "The lives of the Philoſophers and Sophiſts," in which he frequently ſhows himſelf a bitter enemy to the Chriſtians: alſo a "Hiſtory of the Cæſars," which he deduced from the reign of Claudius where Herodian left off, down to that of Arcadius and Honorius. The hiſtory is loſt; but we have the ſubſtance of it in Zoſimus, who is ſuppoſed to have done little more than copy it.

EUNOMIANS, in church-hiſtory, Chriſtian heretics in the 4th century. They were a branch of Arians, and took their name from EUNOMIUS biſhop of Cyzicus; whoſe confeſſion of faith here follows, extracted from Cave's *Hiſtoria Literaria*, vol. I. p. 223. "There is one God uncreated and without beginning; who has nothing exiſting before him, for nothing can exiſt before what is incarnate; nor with him, for what is uncreate muſt be one; nor in him, for God is a ſimple and uncompounded being. This one ſimple and eternal being is God, the creator and ordainer of all things: firſt indeed and principally of his only begotten Son; and then, through him, of all other things. For God begot, created, and made, the Son, only by his direct operation and power, before all things, and every other creature; not producing, however, any being like himſelf, or imparting any of his own proper ſubſtance to the Son: for God is immortal, uniform, indiviſible; and therefore cannot communicate any part of his own proper ſubſtance to another. He alone is unbegotten; and it is impoſſible that any other being ſhould be formed of an unbegotten ſubſtance. He did not uſe his own ſubſtance in begetting the Son, but his will only: nor did he beget him in the likeneſs of his ſubſtance, but according to his own good pleaſure. He then created the Holy Spirit, the firſt and greateſt of all ſpirits, by his own power indeed and operation mediately, yet by the immediate power and operation of the Son. After the Holy Spirit he created all other things in heaven and in earth, viſible and inviſible, corporeal and incorporeal, mediately by himſelf, by the power and operation of the Son," &c.

EUNOMIUS, a famous hereſiarch of the 4th century, the diſciple of Elius, but abundantly more ſubtile than his maſter, as well as more bold in propagating the opinions of his ſect, who after him are called EUNOMIANS. He was ordained biſhop of Cyzicus; but gave ſo much diſturbance by the intemperance of his zeal, that he was depoſed more than once. At laſt, tired with being toſſed about, he petitioned to retreat to the place of his birth, Dacora in Cappadocia; where he died very old about the year 374, after experiencing a variety of ſufferings. The greateſt part of his works are loſt. There is, however, beſides two or three ſmall pieces, a confeſſion of his faith remaining, which Cave inſerted in his *Hiſtoria Literaria*, from a manuſcript in archbiſhop Tenniſon's library. See the preceding article.

EUNUCH, a caſtrated perſon. See the article CASTRATION. The word is formed from ευνην εχει, q. d. *lecti curam habet*, "*guardian* or *keeper* of the bed." In Britain, France, &c. eunuchs are never made but in conſequence of ſome diſeaſe, which renders ſuch an operation neceſſary: but in Italy they make great numbers of children, from one to three years of age, eunuchs, every year, to ſupply the operas and theatres of all Europe with ſingers. M. de la Lande, in his *Voyage d'Italie*, aſſerts, that there are public ſhops at Naples where this cruel operation is performed, and that over the door of theſe ſhops is inſcribed *Qui ſi caſtrano ragazzi*. Yet Dr. Burney informs us, that he was not only utterly unable to ſee or hear of any ſuch ſhops during his reſidence in that city, but was conſtantly told, both by the natives and Engliſh ſettled there, that the laws againſt ſuch a practice were ſo numerous and ſevere, that it was never performed but with the utmoſt ſecrecy.

In the eaſtern parts of the world, they make eunuchs in order to be guards or attendants on their women. The ſeraglios of the eaſtern emperors are chiefly ſerved and guarded by eunuchs; and yet, from good authority, we learn, that the rich eunuchs in Perſia and other countries keep ſeraglios for their own uſe. Thoſe who, out of an imprudent zeal to guard themſelves from ſenſual pleaſures, made themſelves eunuchs, were, by the council of Nice, condemned and excluded from holy orders. There are ſeveral ſevere prohibitions in Germany againſt the making of eunuchs; and in France an eunuch muſt not marry, not even with the conſent of the woman.

Though the practice of caſtration is deteſtable in every point of view; yet there appears no real foundation for the injurious opinion generally entertained of eunuchs, viz. that they are all cowards, and devoid of genius for literature or any ſolid ſtudy. "As to genius (ſays the author laſt quoted), I never found thoſe of the firſt claſs in muſic deficient in intellectual abilities for more ſerious ſtudies. Indeed I have ſeen real genius and diſpoſition for literary purſuits, in more than one great opera ſinger; and as for compoſition, and the theory of muſic, not only the beſt ſingers of the Pope's chapel ever ſince the beginning of the laſt century, but the beſt compoſers, are among the ſoprani, in that ſervice." With reſpect to the operation affecting the mind ſo much as to deprive it of all fortitude in times of danger, there is great reaſon to doubt the fact: moſt of the generals of eaſtern monarchs having been at all times of this claſs; and the braveſt ſtand that ever was made againſt Alexander the Great was at Gaza, under the command of one of Darius's generals, who was a eunuch. Ammianus Marcellinus gives an account of Menophilus, a eunuch, to whom Mithridates intruſted his daughter; which proves the poſſibility of ſuch mutilated perſons poſſeſſing a heroiſm equal to that of the moſt determined Stoic.

It is very certain, that the ancients never ſuppoſed eunuchs to have been men of inferior intellects, or that they poſſeſſed leſs vigour of mind than other men. It appears from a paſſage of Herodotus, that in Perſia eunuchs were far from being objects of contempt; and were even frequently promoted to the higheſt honours. This was indeed the caſe with Hermotimus. We find in Agathias, who was one of the Byzantine hiſtorians, that a general in the Roman army, named *Narſes*, was a eunuch. This was in the latter ages. In Plutarch's life of Ariſtides, Themiſtocles is related to have choſen an eunuch, whoſe name was *Arnaces*, from among his priſoners, to ſend on a ſecret embaſſy to Xerxes. This ſurely may ſerve to ſhow, that mental imbecility was not ſuppoſed by the Greeks to be the characteriſtic of eunuchiſm. The ſame ſtory of the confidence placed in Arnaces, who was one of the Perſian king's eunuchs, is related alſo in the life of Themiſtocles. Ariſtotle paid ſuch high reſpect to Hermias, who was a eunuch and governor of Atarnea, which is in Myſia, that he even offered ſacrifices in

honour of him; as Lucian informs us in his Dialogue entitled *Eunuchus*. This regard of Ariſtotle for Hermias has been often celebrated, and is mentioned by Suidas, Harpocratio, and others.

Eunuchs, in church-hiſtory, a ſect of heretics in the third century, who were mad enough to caſtrate, not only thoſe of their own perſuaſion, but even all others they could lay hold of. They took their riſe from the example of Origen, who, miſunderſtanding the following words of our Saviour, "and eunuchs who made themſelves eunuchs for the kingdom of heaven," caſtrated himſelf.

EVOCATI, ſoldiers among the Romans, who having ſerved their full time in the army, went afterwards volunteers at the requeſt of ſome favourite general; on which account they were called by the honourable names of *Emeriti* and *Beneficiarii*.

EVOCATION, *Evocatio*, among the Romans, a religious ceremony always obſerved by them at the undertaking a ſiege, wherein they ſolemnly called upon the gods and goddeſſes of the place to forſake it and come over to them. Without the performance of this ceremony, they either thought that the place could not be taken, or that it would be a ſacrilege to take the gods priſoners. They always took it for granted that their prayer was heard, and that the gods had deſerted the place and come over to them, provided they were able to make themſelves maſters of it.

EUODIA, in botany; a genus of the monogynia order, belonging to the tetrandria claſs of plants. The calyx is a tetraphyllous perianthium; the corolla conſiſts of four ſpathulated, ſharp, and open petals; the ſtamina are four ſubulated filaments as long as the petals; the pericarpium four roundiſh, bivalve, and monoſpermous capſules; the ſeeds ſolitary.

EVOLUTION, in algebra, the unfolding or opening of a curve, and making it deſcribe an evolvent. The word *evolutio* is formed of the prepoſition *e* "out;" and *volvo* "I roll, or wind;" q. d. an *unwinding*, or *unrolling*. The equable evolution of the periphery of a circle, or other curve, is ſuch a gradual approach of the circumference to rectitude, as that its parts do all concur and equally evolve or unbend; ſo that the ſame line becomes ſucceſſively a leſs arc of a reciprocally greater circle; till at laſt they change into a ſtraight line. In the Philoſophical Tranſactions, N°. 260, a new quadratrix to the circle is found by this means, being the curve deſcribed by the equable evolution of its periphery.

Evolution, is alſo uſed for the extraction of roots out of powers; in which ſenſe it ſtands oppoſed to involution. See Algebra, p. 105.

Evolution, in the art of war, the motion made by a body of troops, when they are obliged to change their form and diſpoſition, in order to preſerve a poſt or occupy another, to attack an enemy with more advantage, or to be in a condition of defending themſelves the better. It conſiſts in doublings, counter-marches, converſions, &c. A battalion doubles the ranks, when attacked in front or rear, to prevent its being flanked or ſurrounded; for then a battalion fights with a larger front. The files are doubled, either to accommodate themſelves to the neceſſity of a narrow ground, or to reſiſt an enemy that attacks them in flank. But if the ground will allow it, converſion is much preferable; becauſe, after converſion, the battalion is in its firſt form, and oppoſes the file-leaders, which are generally the beſt men, to the enemy; and likewiſe, becauſe in doubling the files in a new or not well-diſciplined regiment, they may happen to fall into diſorder. See Doubling.

EVOLVULUS, in botany; a genus of the tetragynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 29th order, *Campanaceæ*. The calyx is pentaphyllous; the corolla quinquefid and verticillated; the capſule trilocular; the ſeeds ſolitary.

EUONYMUS, the spindle-tree; a genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 43d order, *Dumoſæ*. The corolla is pentapetalous; the capſule pentagonal, quinquelocular, quinquevalved, and coloured; the ſeeds hooded. There are two ſpecies, 1. The europæus, hath an upright woody ſtem 10 or 15 feet high, garniſhed with oblong oppoſite leaves: from the ſides of the branches proceed ſmall bunches of greeniſh quadrifid flowers, ſucceeded by pentagonous capſules, diſcloſing their ſeeds in a beautiful manner in autumn. 2. The americanus, or evergreen ſpindle tree, hath a ſhrubby ſtem, dividing into many oppoſite branches, riſing ſix or eight feet high, garniſhed with ſpear-ſhaped evergreen leaves growing oppoſite, and from the ſides and ends of the branches. The flowers are quinquefid and whitiſh, and come out in ſmall bunches, ſucceeded by roundiſh, rough, and protuberant capſules, which rarely perfect their ſeeds in this country. Both theſe ſpecies are hardy, and will ſucceed in any ſoil or ſituation. The berries of the firſt ſort vomit and purge very violently, and are fatal to ſheep. If powdered and ſprinkled in the hair, they deſtroy lice. If the wood is cut when the plant is in bloſſom, it is tough and not eaſily broken; and in that ſtate it is uſed by watchmakers for cleaning watches, and for making ſkewers and toothpickers. Cows, goats, and ſheep, eat this plant; horſes refuſe it.

EUPATORIUM, hemp-agrimony; a genus of the polygamia æqualis order, belonging to the ſyngeneſia claſs of plants; and in the natural method ranking under the 49th order, *Compoſitæ*. The receptacle is naked; the pappus feathery; the calyx imbricated and oblong; the ſtyle ſemibifid and long. There are 13 ſpecies, many of them herbaceous flowery perennials, producing annual ſtalks from two to three or five feet high, terminated by cluſters of compound flowers of a red, purple, or white, colour. They are eaſily propagated by ſeeds, or parting the roots in autumn or ſpring. One ſpecies, viz. the cannabinum, or water hemp-agrimony, is a native of Britain. It is found wild by the ſides of rivers and ditches, and has pale red bloſſoms. It has an acrid ſmell, and a very bitter taſte, with a conſiderable ſhare of pungency. The leaves are much recommended for ſtrengthening the tone of the viſcera, and as an aperient; and ſaid to have excellent effects in the dropſy, jaundice, and ſcorbutic diſorders. Boerhaave informs us, that this is the common medicine of the turf-diggers in Holland, againſt ſcurvies, foul ulcers, and ſwellings in the feet, to which they are ſubject. The root of this plant is ſaid to operate as a ſtrong cathartic: but it is hardly uſed in Britain, and has no place in our pharmacopœias.

EUPATRIDÆ, in antiquity, a name given by Theſeus to the nobility of Athens, as diſtinguiſhed from the Geomori and Demiurgi. The Eupatridæ, by Theſeus's eſtabliſhment, had the right of chooſing magiſtrates, teaching and diſpenſing the laws, and interpreting holy and religious myſteries. The whole city, in all other matters, was reduced to an equality. The Geomori were huſbandmen, and inferior to the Eupatridæ, in point of fortune; the Demiurgi were artificers, and fell ſhort of the Eupatridæ in number.

EUPHONY, in grammar, an eaſineſs, ſmoothneſs, and elegance of pronunciation. The word is formed of ευ, *bene*, "well," and φωνη, *vox*, "voice." Quintilian calls *euphonia*, "*vocalitas*;" Scaglier, "*facilis pronunciatio*." Euphonia is properly a kind of figure whereby we ſuppreſs a too harſh letter, or convert it into a ſmoother, contrary to the ordinary rules. There are examples enough in all languages.

EUPHYMISM. See Oratory.

EUPHORBIA, spurge; a genus of the trigynia order, be-

longing to the dodecandria class of plants; and in the natural method ranking under the 38th order, *Tricoccæ*. The corolla is tetrapetalous or pentapetalous, placed on the calyx; the calyx is monophyllous and ventricose; the capsule tricoccous. There are 62 species, six of which are natives of Great Britain. They are mostly shrubby and herbaceous succulents, frequently armed with thorns, having stalks from 10 or 12 inches to as many feet in height, with quadripetalous flowers of a whitish or yellow colour. They are easily propagated by cuttings; but the foreign kinds must be always kept in pots in a stove. If kept dry, they may be preserved for several months out of the ground, and then planted, when they will as readily take root as though they had been fresh. The juice of all the species is so acrid, that it corrodes and ulcerates the body wherever it is applied; so that physicians have seldom ventured to prescribe it internally. Warts, or corns, anointed with the juice, presently disappear. A drop of it put into the hollow of an aching tooth, gives relief, like other corrosives, by destroying the nerve. Some people rub it behind the ears, that it may blister. One of the foreign species, named *esula*, see plate 16, fig. 1, is such a violent corrosive, that if applied to any part of the body, it produces a violent inflammation, which is soon succeeded by a swelling that degenerates into a gangrene and proves mortal. Fig. 2. represents part of the stem and flowers magnified. There is a species at the Cape, which supplies the Hottentots with an ingredient for poisoning their arrows. Their method of making this pernicious mixture, is by first taking the juice extracted from the euphorbia, and a kind of caterpillar peculiar to another plant which has much the appearance of a species of rhus. They mix the animal and vegetable matter; and after drying it, they point their arrows with this composition, which is supposed to be the most effectual poison of the whole country. The euphorbia itself is also used for this purpose, by throwing the branches into fountains of water frequented by wild beasts, which after drinking the water thus poisoned, seldom get 1000 yards from the brink of the fountain before they fall down and expire. This plant grows from about 15 to 20 feet in height, sending out many branches full of strong spines. The natives cut off as many of the branches as they think necessary for the destruction of the animals they intend to poison. They generally conduct the water a few yards from the spring into a pit made for the purpose; after which they put in the euphorbia, and cover the spring, so that the creatures have no choice. No animal escapes which drinks of such water, though the flesh is not injured by the poison.

EUPHORBIUM, in the materia medica, a gum-resin, which exsudes from a large oriental tree, the Euphorbia *officinarum*. It is brought to us immediately from Barbary, in drops of an irregular form; some of which, upon being broken, are found to contain little thorns, small twigs, flowers, and other vegetable matters; others are hollow, without any thing in their cavity. The tears in general are of a pale yellow colour externally, somewhat white withinside: they easily break between the fingers. Lightly applied to the tongue, they affect it with a very sharp biting taste; and upon being held for some time in the mouth, prove vehemently acrimonious, inflaming and exulcerating the fauces, &c. Euphorbium is extremely troublesome to pulverise; the finer part of the powder, which flies off, affecting the head in a violent manner. The acrimony of this substance is so great as to render it absolutely unfit for any internal use. Several correctors have been contrived to abate its virulence; but the best of them are not to be trusted to: and as there seems to be no real occasion for it, unless for some external purposes, we think, with Hoffman and others, that it ought to be expunged from the catalogue of internal medicines. And accordingly it has now no place in the London or Edinburgh pharmacopœias: but it is still retained in most of the foreign ones, and is sometimes used as a sternutatory.

EUPHORBUS, a famous Trojan, son of Panthöus. He was the first who wounded Patroclus, whom Hector killed. He perished by the hand of Menelaus, who hung his shield in the temple of Juno at Argos. Pythagoras, the founder of the doctrine of the metempsychosis or transmigration of souls, affirmed that he had been once Euphorbus, and that his soul recollected many exploits which had been done while it animated that Trojan's body. As a further proof of his assertion, he showed at first sight the shield of Euphorbus in the temple of Juno.

EUPHORION *of* Chalcis, a poet and historian, born in the 126th Olympiad. Suetonius says that Tiberius composed verses in imitation of Euphorion, Rianius, and Parthenius; with whom he was charmed to such a degree, that he ordered their writings and their pictures to be kept in all the public libraries, among the ancient and celebrated authors.

EUPHRASIA, eye-bright; a genus of the angiospermia order, belonging to the didynamia class of plants; and in the natural method ranking under the 40th order, *Personatæ*. The calyx is quadrifid and cylindrical; the capsule bilocular, ovato-oblong; the shorter two antheræ, with the base of the one lobe, terminated by a small spine. There are seven species; two of which, viz. the officinalis and odontites, are natives of Britain. The first of these, which hath blue flowers, is a weak astringent, and was formerly much celebrated in disorders of the eyes; but the present practice hath not only disregarded its internal, but also its external, use. This plant will not grow but when surrounded by others taller than itself. Cows, horses, goats, and sheep, eat it; swine refuse it.

EUPHRATES, one of the most celebrated rivers in the world, and the principal of Turkey in Asia. It has its rise about a day's journey from Erzerum; and another source about two days journey from the same place. They both lie to the eastward, on high mountains covered with snow almost the year round. The plain of Erzerum is inclosed between two fine streams, which, when united, are called the Euphrates, or the Frat. After their junction, three days journey from Erzerum, it begins to be navigable for boats; but the channel is so rocky, that the navigation is not safe. At first it runs S. S. W. then S. till it approaches nearest to Aleppo; when it runs S. E. till it reaches Rakka. It afterwards turns more to the S. till it comes to Meshed; and then passes S. E. again by Anna, Hit, Cubessa, and Felugia; and, not far thence, visits the spot where Babylon stood. It then fetches a compass like a bow, till it runs E. and unites with the Tigris; and, still retaining its name, it runs to Bussarah, and thence into the gulf of Persia, about 50 miles below it. It first divides Armenia from Natolia; then Syria from Diarbeck; after which it runs through Irac Arabia till it meets the Tigris. It is also the north-eastern boundary of the great desert of Arabia.

EUPOLIS, an Athenian comic poet, flourished about the 85th Olympiad. He took the freedom of the ancient comedy in lashing the vices of the people. He lost his life in a sea-fight between the Athenians and Lacedemonians; and his fate was so much lamented, that after his death it was enacted, that no poet should serve in the wars. Some say Alcibiades put him to death for his satirical freedom.

EURE, a department of France, which includes part of the late province of Normandy, and is so named from a river which rises in Perche, in the forest of Logny, and falls into the Seine, above Pont-d'Arche. Evreux is the capital.

Eure and Loire, a department of France, so called from the rivers of that name. It contains the late province of Beauce, and its capital is Chartres.

EVREMOND (Charles de St. Denis), born at St. Denis le Guast in Lower Normandy in 1613, was designed for the gown,

and entered on the ſtudy of the law; but he ſoon quitted that, and was made an enſign before he was 16. A military life did not hinder him from cultivating polite literature, and he ſignalized himſelf by his politeneſs and wit as much as by his bravery. The king made him a mareſchal de camp, and gave him a penſion of 3000 livres per annum. He ſerved under the duke of Candale in the war of Guienne; and in Flanders, till the ſuſpenſion of arms was agreed on between France and Spain: he afterwards accompanied cardinal Mazarine when he went to conclude the peace with Don Lewis de Haro, the king of Spain's firſt miniſter. He wrote, as he had promiſed, a long letter to the marquis de Crequi, of this negotiation; in which he ſhowed, that the cardinal had ſacrificed the honour of France to his own private intereſt, and rallied him in a very ſatirical manner. This letter falling into the hands of the cardinal's creatures ſome time after his death, was repreſented as a ſtate-crime, and he was obliged to fly to Holland. He had too many friends in England (whither he had taken a tour the year before with the count de Soiſſons, ſent to compliment Charles II. upon his reſtoration) to make any long ſtay in Holland; and therefore paſſed over into England, where he was received with great reſpect, and admitted into intimate friendſhip with ſeveral perſons of diſtinction. The king gave him a penſion of 300l. a-year. He had a great deſire to return to his native country; and, after the peace of Nimeguen, wrote a letter in verſe to the king of France to aſk leave, but in vain. Upon the death of king Charles, he loſt his penſion. He did not rely much on king James, though that prince had ſhown himſelf extremely kind to him. The revolution was advantageous to him. King William, who had known him in Holland, gave him ſubſtantial marks of his favour. He died of a ſtrangury in 1703, aged 90; and was interred in Weſtminſter-abbey, where a monument is erected to his memory. His behaviour was engaging, his humour cheerful, and he had a ſtrong diſpoſition to ſatire: he profeſſed the Romiſh religion, in which he was born; but at the bottom was certainly a free-thinker. He always ſpoke of his diſgrace with the reſolution of a gentleman; and whatever ſtrong deſire he had to return to his country, he never ſolicited the favour with meanneſs: therefore, when this leave was ſignified to him unexpectedly in the decline of his life, he replied, that the infirmities of age did not permit him to leave a country where he lived agreeably. There have been many editions of his works: but the beſt is that of Amſterdam in 1726, in 5 vols. 12mo, to which is prefixed his life by Doctor Des Maizeaux; who has alſo given an accurate Engliſh tranſlation of them in 3 vols. 8vo.

EVREUX, an ancient town of France, in the department of Eure and late province of Normandy, with a biſhop's ſee. The cathedral is a handſome ſtructure; and the trade conſiſts in corn, linen, and woollen cloth. It has a manufactory of cotton velvets, and another of tick, which is not inferior to that of Bruſſels. The little wine produced in its neighbourhood is of a bad quality; but the cyder is very good. It is ſeated on the river Iton, 25 miles S. of Rouen, and 55 N. W. of Paris. E. lon. 1. 14. N. lat. 49. 1.

EURIPIDES, one of the Greek poets who excelled in tragedy, was born about 468 B. C. in the iſle of Salamis, whither his father and mother had retired a little before Xerxes entered Attica. He learnt rhetoric under Prodicus, morality under Socrates, and natural philoſophy under Anaxagoras; but at 18 years of age abandoned philoſophy, in order to apply himſelf to dramatic poetry. He uſed to ſhut himſelf up in a cave to compoſe his tragedies, which were extremely applauded by the Greeks. The Athenian army, commanded by Nicias, being defeated in Sicily, the ſoldiers purchaſed their lives and liberties by reciting the verſes of Euripides; ſuch eſteem and veneration had the Sicilians for the pieces written by this excellent poet. Socrates, the wiſeſt of the philoſophers, ſet ſuch a value upon them, that they were the only tragedies he went to ſee acted; and yet his performances ſeldom gained the prize. Euripides frequently interſperſes through them moral ſentences, and ſevere reflections on the fair ſex; whence he was called the *Woman hater*. He was, nevertheleſs, married: but the ſcandalous lives of his two wives drew upon him the raillery of Ariſtophanes, and other comic poets; which occaſioned his retiring to the court of Archelaus, king of Macedon, where he was well received. That prince was fond of learned men, and drew them to him by his liberality. If we may believe Solinus, he made Euripides his miniſter of ſtate, and gave him other extraordinary proofs of his eſteem. He had, however, paſſed but a few years there, when an unhappy accident put an end to his life. He was walking in a wood, and, according to his uſual manner, in deep meditation; when, unfortunately happening upon Archelaus's hounds, he was by them torn in pieces. It is not certain whether his death happened by chance, or through envy of ſome of the great courtiers. However, Archelaus buried him with great magnificence; and the Athenians were ſo much afflicted at his death, that the whole city went into mourning. Of 92 tragedies which he compoſed, only 19 are remaining: the moſt valuable editions of which are thoſe of Aldus, in 1503, 8vo; of Plantin, in 1570, ſexeſimo; of Commelin, in 1597, 8vo; of Paul Stevens, in 1604, 4to; and of Joſhua Barnes, in 1694, folio.

EURIPUS, now the NEGROPONT, a canal or ſtrait which divides the iſland of Eubœa from the continent of Greece. In one place it is ſo narrow, that a galley can ſcarce paſs through it. The agitations of the Euripus were much ſpoken of by the ancients. Some ſay that the canal has a flux and reflux ſix times in 24 hours; others, that it ebbs and flows ſeven times a day; but Livy does not allow this flux and reflux to be ſo regular. In this place, as the ſtory commonly goes, Ariſtotle drowned himſelf out of chagrin, for not being able to account for ſo unuſual a motion.

EURIPUS has ſince become a general name for all ſtraits, where the water is in great motion and agitation. The ancient circuſes had their euripi, which were no other than pits or ditches on each ſide of the courſe, into which it was very dangerous falling with their horſes and chariots as they ran races. The term *euripus* was more particularly applied by the Romans to three canals or ditches which encompaſſed the circus on three ſides, and which were filled occaſionally to repreſent naumachiæ or ſea-battles. The ſame people called their ſmaller fountains or canals in their gardens *euripuſes*; and their largeſt, as caſcades, &c. *niles*.

EUROCLYDON, of Ευρος *eaſt-wind*, and κλυδων *wave*, is a ſpecies of wind, of which we have an account only in Acts xvii. 14. and concerning the nature of which critics have been much divided. Bochart, Grotius, Bentley, and others, ſubſtitute another reading, ſupported by the Alexandrian MS. and the Vulgate, viz. Ευρακυλων, or *Euro-aquilo*; but Mr. Bryant defends the common reading, and conſiders the *Euroclydon*, i. e. Ευρος κλυζων, as an eaſt-wind that cauſes a deep ſea or vaſt inundation. He maintains, in oppoſition to Dr. Bentley's reaſoning, who ſuppoſes that the mariners in the ſhip, the voyage of which is recited in this paſſage, were Romans, that they were Greeks of Alexandria, and that the ſhip was an Alexandrian ſhip employed in the traffic of carrying corn to Italy; and therefore, that the mariners had a name in their own language for the particular typhonic or ſtormy wind here mentioned. He alſo ſhows from the paſſage itſelf, that the tempeſtuous wind called *Euroclydon*, beat (κατέβαλεν) upon the iſland of Crete; and therefore, as this is a relative expreſſion, referring to the ſituation of the perſon who ſpeaks of it, who was at that time to the windward or ſouth of it, the wind blew upon ſhore, and

muſt have come from the ſouth or ſouth-eaſt; which, he adds, is fully warranted by the point where the ſhip was, and the direction it ran in afterwards, which was towards the north and north-weſt.

EUROPA, in fab. hiſt. a daughter of Agenor king of Phœnicia, and Telephaſſa. She was ſo beautiful that Jupiter became enamoured of her; and the better to ſeduce her, he aſſumed the ſhape of a bull and mingled with the herds of Agenor, while Europa, with her female attendants, was gathering flowers in the meadows. Europa careſſed the beautiful animal; and at laſt had the courage to ſit upon his back. The god took advantage of her ſituation; and with precipitate ſteps retired towards the ſhore, croſſed the ſea with Europa on his back, and arrived ſafe in Crete. Here he aſſumed his original ſhape, and declared his love. The nymph conſented, though ſhe had once made vows of perpetual celibacy; and ſhe became mother of Minos, Sarpedon, and Rhadamanthus. After this diſtinguiſhed amour with Jupiter, ſhe married Aſterius king of Crete. This monarch ſeeing himſelf without children by Europa, adopted the fruit of her amours with Jupiter, and always eſteemed Minos, Sarpedon, and Rhadamanthus as his own children. Some ſuppoſe that Europa lived about 1552 years before the Chriſtian era.

EUROPE, called by the people of Aſia, Frankiſtan, one of the four general parts of the world, bounded on the N. by the Frozen Ocean, on the S. by the Mediterranean, on the W. by the Weſtern and Northern oceans, and on the E. by Aſia. It lies between 9. 37. W. and 72. 25. E. lon. and between 35° and 72° N. lat. From Cape St. Vincent to the mouth of the Oby, it is near 3,600 miles in length; and from Cape Matapatam in the Morea, to the N. Cape in Lapland, about 2,200 miles in breadth. It is much leſs than either Aſia or Africa, but ſurpaſſes them in many particulars. It is entirely within the temperate zone, except a ſmall part of Norway and Ruſſia; ſo that there is neither the exceſſive heat, nor the inſupportable cold, of the other parts of the continent. It does not abound in gold and ſilver mines, much leſs in precious ſtones; it produces neither ſugar nor ſpices; nor does it nouriſh jackals, hyænas, lynxes, leopards, tigers, lions, rhinoceroſes, elephants, dromedaries, camels, or crocodiles; but it produces corn, wine, fruits, ſheep, oxen, horſes, and all the neceſſaries of life. It is much more populous, and better cultivated, than either Aſia or Africa. It is fuller of villages, towns, and cities, and the buildings are ſtronger, more elegant and commodious, generally ſpeaking, than in the two former. The inhabitants are all whites, and, for the moſt part, much better made than the Africans, or even the Aſiatics. With regard to arts and ſciences, there is no manner of compariſon; nor yet in trade, navigation, and war. Europe contains Norway, Sweden, Denmark, Great Britain, Ireland, France, Germany, Bohemia, Sileſia, Moravia, Poland, Spain, Italy, Portugal, Hungary, Swiſſerland, and part of Ruſſia and Turkey, beſide ſeveral iſlands in the Mediterranean, and elſewhere. There are three empires; namely, of Germany, Ruſſia, and Turkey. The kings are thoſe of Great Britain and Ireland, Spain, Portugal, Pruſſia, Denmark, Sweden, Sardinia, Bohemia, Hungary, and the Two Sicilies. Beſides, there is an archduke of Auſtria, and a great duke of Tuſcany. There are four conſiderable republics; namely, Venice, the United Provinces, the Swiſs Cantons, and the republic of Genoa. There are four leſs, viz. of Geneva, Lucca, San Marino, and Raguſa. To the republics, at preſent, muſt be added the late kingdom of France. The languages are the Italian, French, Spaniſh, and Portugueſe, which are dialects of the Latin; the German, Flemiſh, Dutch, Swediſh, Daniſh, and Engliſh, which proceed from the Teutonic; the Sclavonian, which reigns (though in diſguiſe) in Poland, Ruſſia, Bohemia, and a great part of Turkey in Europe; the Celtic, of which there are dialects in Wales, the Highlands of Scotland, Ireland, Bretagne in France, and Lapland; the modern Greek, and ſeveral others. The principal rivers are, the Danube, Dnieſter, Dnieper, Viſtula, Volga, Dwina, Bog, Oby, Don, Scheld, Rhine, Rhone, Seine, Loire, Garonne, Groyne, Tajo, Thames, and Severn. The principal lakes are thoſe of Conſtance, Geneva, Lauſanne, Wenner, Ladoga, and Onega. The chief mountains are the Alps, Appenines, and Pyrenees. The prevailing religion is the Chriſtian, divided into the Greek, Romiſh, and Proteſtant churches. There are alſo Jews in every country, and Mahometaniſm is the eſtabliſhed religion of the Turks. See the MAP *of* EUROPE, plate 17.

EURYALE, in mythology, one of the Gorgons, daughter of Phorcys, and ſiſter of Meduſa: ſhe was ſubject neither to old age nor death.

EURYANDRA, in botany; a genus of the tryginia order, belonging to the polyandria claſs of plants. The calyx is a pentaphyllous perianthium, with ſmall, roundiſh, and concave leaves; the corolla conſiſts of three roundiſh hollow petals, longer than the calyx. The ſtamina are very many capillary filaments much dilated at the apex; the pericarpium three egg-ſhaped follicles containing ſeveral ſeeds.

EURYDICE, in fabulous hiſtory, the wife of Orpheus, who, flying from Ariſtæus that endeavoured to raviſh her, was ſlain by a ſerpent. Her huſband went down to the ſhades, and by the force of his muſic perſuaded Pluto and Proſerpine to give him leave to carry back his wife; which they granted, provided he did not look on her till he came to the light; but he breaking the condition, was forced to leave her behind him. See ORPHEUS.

EURYSTHEUS, a king of Argos and Mycenæ, ſon of Sthenelus, and Nicippe the daughter of Pelops. Juno haſtened his birth by two months, that he might come into the world before Hercules the ſon of Alcmena, as the younger of the two was doomed by order of Jupiter to be ſubſervient to the will of the other. This natural right was cruelly exerciſed by Euryſtheus, who was jealous of the fame of Hercules; and who to deſtroy ſo powerful a relation, impoſed upon him the moſt dangerous and uncommon enterpriſes well known by the name of the *twelve labours of Hercules*. The ſucceſs of Hercules in achieving thoſe perilous labours alarmed Euryſtheus in a greater degree, and he furniſhed himſelf with a brazen veſſel, where he might ſecure himſelf a ſafe retreat in caſe of danger. After the death of Hercules, Euryſtheus renewed his cruelties againſt his children, and made war againſt Ceyx king of Trachinia, becauſe he had given them ſupport, and treated them with hoſpitality. He was killed in the proſecution of this war by Hyllus the ſon of Hercules. His head was ſent to Alcmena the mother of Hercules; who, mindful of the cruelties which her ſon had ſuffered, inſulted it, and tore out the eyes with the moſt inveterate fury. Euryſtheus was ſucceeded on the throne of Argos by Atreus his nephew. The death of Euryſtheus happened about 30 years before the Trojan war.

EURYTHMY, in architecture, painting, and ſculpture, is a certain majeſty, elegance, and eaſineſs, appearing in the compoſition of divers members or parts of a body, painting, or ſculpture, and reſulting from the fine proportion of it.

EUSDEN (Laurence), an Iriſh clergyman, rector of Coneſby in Lincolnſhire, and poet laureat after the death of Mr. Rowe. His firſt patron was the eminent lord Halifax; whoſe poem, on the battle of the Boyne, he tranſlated into Latin, and dedicated to his lordſhip. He was eſteemed by the duke of Newcaſtle, who rewarded an epithalamium he wrote on his marriage with the place of poet laureat. He was the author of many poetical pieces, though but little known before his preferment: he died in 1730.

EUSEBIANS, a denomination given to the ſect of Arians,

on account of the favour and countenance which Eusebius, bishop of Cæsarea, showed and procured for them at their first rise. See Arians and Eusebius.

EUSEBIUS, surnamed Pamphilus, a celebrated bishop of Cæsarea in Palestine, and one of the most learned men of his time, was born in Palestine about the latter end of the reign of Gallienus. He was the intimate friend of Pamphilus the martyr; and, after his death, took his name in honour to his memory. He was ordained bishop of Cæsarea in 313. He had a considerable share in the contest relating to Arius; whose cause he, as well as several other bishops of Palestine, defended, being persuaded that Arius had been unjustly persecuted by Alexander bishop of Alexandria. He assisted at the council of Nice in 325; when he made a speech to the emperor Constantine on his coming to the council, and was placed next him on his right hand. He was present at the council of Antioch, in which Eustathius bishop of that city was deposed; but though he was chosen by the bishop and people of Antioch to succeed him, he absolutely refused it. In 335 he assisted at the council of Tyre held against Athanasius; and at the assembly of bishops at Jerusalem, at the time of the dedication of the church there. By these bishops he was sent to the emperor Constantine to defend what they had done against Athanasius; when he pronounced the panegyric made on that emperor during the public rejoicings in the beginning of the 30th year of his reign, which was the last of his life. Eusebius survived the emperor but a short time, for he died in 338. He wrote, 1. An ecclesiastical history, of which Valetius has given a good edition in Greek and Latin: 2. The life of Constantine; 3. A treatise against Hierocles; 4. *Chronicon*; 5. *Preparationes evangelicæ*; 6. *De demonstratione evangelica*; of which there are but 10 books extant out of 20; and several other works, some of which are lost.

EUSTACHIUS (Bartholomew), physician and anatomist at Rome, flourished about the year 1550. His anatomical Plates were discovered there in 1712, and published in 1714.

EUSTATHIANS, a name given to the Catholics of Antioch in the 4th century, on occasion of their refusal to acknowledge any other bishop beside St. Eustathius, deposed by the Arians. The denomination was given them during the episcopate of Paulinus, whom the Arians substituted to St. Eustathius, about the year 330, when they began to hold their assemblies apart. About the year 350, Leontius of Phrygia, called the *eunuch*, who was an Arian, and was put in the see of Antioch, desired the Eustathians to perform their service in his church; which they accepting, the church of Antioch served indifferently both the Arians and Catholics. This, we are told, gave occasion to two institutions, which have subsisted in the church ever since. The first was psalmody in two choirs; though M. Baillet thinks, that if they instituted an alternate psalmody between two choirs, it was between two Catholic choirs, and not by way of response to an Arian choir. The second was the doxology, *Glory be to the Father, and the Son, and the Holy Ghost*. See Doxology. This conduct, which seemed to imply a kind of communion with the Arians, gave great offence to abundance of Catholics, who began to hold separate meetings; and thus formed the schism of Antioch. Upon this, the rest, who continued to meet in the church, ceased to be called *Eustathians*, and that appellation became restrained to the dissenting party. S. Flavianus, bishop of Antioch in 381, and one of his successors, Alexander, in 482, brought to pass a coalition, or reunion, between the Eustathians and the body of the church of Antioch, described with much solemnity by Theodoret, *Eccl.* l. iii. c. 2.

Eustathians were also a sect of heretics in the fourth century, denominated from their founder Eustathius, a monk so foolishly fond of his own profession, that he condemned all other conditions of life. Whether this Eustathius was the same with the bishop of Sebastia and chief of the Semiarians, is not easy to determine. He excluded married people from salvation; prohibited his followers from praying in their houses; and obliged them to quit all they had, as incompatible with the hopes of heaven. He drew them out of the other assemblies of Christians to hold secret ones with him, and made them wear a particular habit: he appointed them to fast on Sundays; and taught them, that the ordinary fasts of the church were needless, after they had attained to a certain degree of purity which he pretended to. He showed great horror for chapels built in honour of martyrs, and the assemblies held therein. Several women, seduced by his reasons, forsook their husbands, and abundance of slaves deserted their masters' houses. He was condemned at the council of Gangra in Paphlagonia, held between the years 326 and 341.

EUSTATHIUS, bishop of Thessalonica, in the 12th century, under the reigns of the emperors Emanuel, Alexander, and Andronicus Comnenus. He was a very eminent grammarian; and wrote commentaries upon Homer and Dionysius the geographer. The best edition of his commentaries on Homer is that of Rome, printed in Greek, in 1542, in four volumes folio. His commentaries on the Periegesis of Dionysius were printed by Mr. Hudson at Oxford, in 1697, 8vo. Eustathius appears to have been alive in the year 1194.

EUSTATIA, St. one of the least of the Leeward Islands in the West Indies, which properly is nothing but a mountain in the form of a sugar-loaf, whose top is hollow. It is strong by situation, and has a good fort. It lies to the N. W. of St. Christopher's, and belongs to the Dutch, from whom it was taken by admiral Rodney in 1781; but was soon after taken by the French, and restored to the Dutch by the peace of 1783. W. long. 63. 5. N. lat. 17. 29.

EUSTYLE, in architecture, a sort of building in which the pillars are placed at the most convenient distance one from another, the intercolumniations being just two diameters and a quarter of the column, except those in the middle of the face, before and behind, which are three diameters distant.

EUTERPE, one of the muses, daughter of Jupiter and Mnemosyne. She presided over music, and was looked upon as the inventress of the flute. She is represented as crowned with flowers and holding a flute in her hands: Some mythologists attributed to her the invention of tragedy, more commonly supposed to be the production of Melpomene.

EUTHYMIA, among the Greeks, signified such a disposition, or state of the mind, as could not be ruffled either by good or bad fortune, by sickness or health, good or evil.

EUTROPIUS (Flavius), a Latin author, in the 4th century, was secretary to Constantine the great, and afterwards bore arms under the emperor Julian, and followed that prince in his expedition against the Persians. He wrote an abridgment of the Roman History, from the foundation of Rome to the reign of Valens; the best edition of which is that of Miss Le Fevre, afterwards Madam Dacier, published at Paris for the use of the Dauphin, in 4to, in the year 1683.

EUTYCHIANS, ancient heretics, who denied the duplicity of natures in Christ; thus denominated from Eutyches, the archimandrite, or abbot of a monastery at Constantinople, who began to propagate his opinion A. D. 448. He did not, however, seem quite steady and consistent in his sentiments: for he appeared to allow of two natures, even before the union; which was apparently a consequence he drew from the principles of the Platonic philosophy, which supposes a pre-existence of souls: accordingly, he believed that the soul of Jesus Christ had been united to the divinity before the incarnation; but then he allowed no distinction of natures in Jesus Christ since his incarnation. This heresy was first condemned in a synod held at

Conſtantinople by Flavian, in 448, approved by the council of Epheſus, called *conventus latronum*, in 449, and re-examined, and fulminated, in the general council of Chalcedon in 451. The legates of Pope Leo, who aſſiſted at it, maintained, that it was not enough to define, that there were two natures in Jeſus Chriſt, but inſiſted ſtrenuouſly, that, to remove all equivocations, they muſt add theſe terms, without being changed, or confounded, or divided. The hereſy of the Eutychians, which made a very great progreſs throughout the eaſt, at length became divided into ſeveral branches. Nicephorus makes mention of no fewer than twelve: ſome called *Schematici*, or *Apparentes*, as only attributing to Jeſus Chriſt a phantom or appearance of fleſh, and no real fleſh; others, *Theodoſians*, from Theodoſius biſhop of Alexandria: others, *Jacobites*, from one James *(Jacobus)*, of Syria; which branch eſtabliſhed itſelf principally in Armenia, where it ſtill ſubſiſts. Others were called *Acephali*, q. d. without head; and *Severians*, from a monk called *Severus*, who ſeized on the ſee of Antioch in 513. Theſe laſt were ſubdivided into five factions, viz. *Agnotæ*, who attributed ſome ignorance to Jeſus Chriſt; the followers of Paul; Μελαινοι, that is, the black *Angelites*, thus called from the place where they were aſſembled; and laſtly, *Adrites*, and *Canonites*

Eutychians was alſo the name of another ſect, half Arian half Eunomian; which aroſe at Conſtantinople in the fourth century. It being then a matter of mighty controverſy among the Eunomians at Conſtantinople, whether or no the Son of God knew the laſt day and hour of the world, particularly with regard to that paſſage in the goſpel of St. Matthew, chap. xxiv. ver. 36. or rather that in St. Mark, xiii. 32. where it is expreſſed, that the Son did not know it, but the Father only; Eutychius made no ſcruple to maintain, even in writing, that the Son did not know it; which ſentiment diſpleaſing the leaders of the Eunomian party, he ſeparated from them, and made a journey to Eunomius, who was then in exile. That heretic acquieſced fully in Eutychius's doctrine, and admitted him to his communion. Eunomius dying ſoon after, the chief of the Eunomians at Conſtantinople refuſed to admit Eutychius; who, upon this, formed a particular ſect of ſuch as adhered to him, called *Eutychians*. This ſame Eutychius, with one Theopronius, as was ſaid in Sozomen's time, were the occaſion of all the changes made by the Eunomians in the adminiſtration of baptiſm; which conſiſted, according to Nicephorus, in only uſing one immerſion, and not doing it in the name of the Trinity, but in memory of the death of Jeſus Chriſt. Nicephorus calls the chief of that ſect, not *Eutychius*, but *Eupſychius*, and his followers *Eunomiaupſychians*.

EUTYCHIUS, patriarch of Alexandria, lived about the ninth age; and wrote annals in the Arabic language, printed at Oxford in 1658, with a Latin verſion by Mr. Pocock. Selden had printed ſomething of his before.

EUXINE or Black Sea, forms part of the boundary betwixt Europe and Aſia. It receives the Nieper, the Danube, and other large rivers; and extends from 28 to 40 degrees of E. lon. and from 40 to 46 of N. lat. The ancients imagined this ſea to have been originally only a lake or ſtanding pool, which broke firſt into the Propontis, and then into the Egean, waſhing away by degrees the earth which firſt kept it within bounds, and formed the two channels of the Boſphorus Thracius and Helleſpont, now the Dardanelles. It was anciently called the *Axenus*, ſuppoſed to be from Aſhkenaz the ſon of Gomer, who is ſaid to have ſettled near it. This original being forgot in length of time, the Greeks explained it by *inhoſpitable*, which the word Axenus literally ſignifies; and therefore, when they came to conſider the inhabitants of theſe coaſts as more civilized and hoſpitable, they changed the name into Euxinus, which it ſtill retains.

EWE, the Engliſh name of a female ſheep. See Ovis.

EWERY, in the Britiſh cuſtoms, an office in the king's houſhold, to which belongs the care of the table linen, of laying the cloth, and ſerving up water in ſilver ewers after dinner.

EX, a river which riſes in the foreſt of Exmoor, in Somerſetſhire, and leaving that county, below Dulverton, proceeds by Tiverton to Exeter, widening from Topſham into an eſtuary, which terminates in the Engliſh channel at Exmouth.

Ex *officio*, among lawyers, ſignifies the power a perſon has, by virtue of his office, to do certain acts without being applied to. Thus a juſtice of peace may *ex officio*, at his diſcretion, take ſurety of the peace, without complaint made by any perſon whatſoever. There was formerly an oath *ex officio*, whereby a ſuppoſed offender was compelled in the eccleſiaſtical court to confeſs, accuſe, or clear himſelf of a crime; but this law is repealed.

Ex *poſt facto*, in law, ſomething done after another: thus an eſtate granted may be good by matter *ex poſt facto*, that was not ſo at firſt, as in caſe of election.

EXACERBATION. See Paroxysm.

EXACTION, in law, a wrong done by an officer, or a perſon in pretended authority, in taking a reward or fee that is not allowed by law. A perſon guilty of exaction may be fined and impriſoned. It is often confounded with Extortion.

EXACUM, in botany; a genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 20th order, *Rotaceæ*. The calyx is tetraphyllous; the corolla quadrifid, with the tube globular; the capſule two-furrowed, bilocular, polyſpermous, and opening at the top.

EXÆRESIS, in ſurgery, the operation of extracting or taking away ſomething that is hurtful to the human body.

EXAGGERATION, in rhetoric, a kind of hyperbole, whereby things are augmented or amplified, by ſaying more than the truth, either as to good or bad.

Exaggeration, in painting, a method by which the artiſt, in repreſenting things, changes them too much, or makes them too ſtrong, either in reſpect of the deſign or colouring. It differs from *caricaturing*, in that the latter perverts or gives a turn to the features of a face, &c. which they had not; whereas exaggeration only heightens or improves what they had.

EXALTATION, or Elevation, is chiefly uſed in a figurative ſenſe, for the raiſing or advancing a perſon to ſome eccleſiaſtical dignity; and particularly to the papacy.

Exaltation *of the Croſs*, is a feaſt of the Romiſh church, held on the 14th of September; in memory, as is generally ſuppoſed, of this, that the emperor Heraclius brought back the true croſs of Jeſus Chriſt on his ſhoulders, to the place on mount Calvary, from which it had been carried away 14 years before by Coſroes king of Perſia, at his taking of Jeruſalem, under the reign of the emperor Phocas. The croſs was delivered up by a treaty of peace made with Siroe, Coſroes' ſon. The inſtitution of this treaty is commonly ſaid to have been ſignalized by a miracle; in that Heraclius could not ſtir out of Jeruſalem with the croſs, while he had on the imperial veſtments enriched with gold and precious ſtones, but bore it with eaſe in a common dreſs. But long before the empire of Heraclius, there had been a feaſt of the ſame denomination obſerved both in the Greek and Latin churches, on occaſion of what our Saviour ſaid in St. John, xii. 32. *And I, if I be* exalted, *or lifted up, will draw all men unto me*. And again, in ch. viii. ver. 28. *When you have* exalted, *or lifted up, the Son of Man, then ſhall ye know that I am he*. The feaſt of the dedication of the temple built by Conſtantine was held, ſays Nicephorus, on the 14th of September, the day on which the temple had been conſecrated, in the year 335; and this feaſt was alſo called the *exaltation of the croſs*, becauſe it was a ceremony therein, for the biſhop of Jeruſalem to aſcend a high place, built by Conſtantine for that purpoſe,

in manner of a pulpit called by the Greeks the *ſacred myſteries of God*, or *the holineſs of God*, and there hoiſt up the croſs, for all the people to ſee it.

Exaltation, in phyſics, denotes the act, or operation, of elevating, purifying, ſubtilizing, or perfecting, any natural body, its principles and parts; alſo the quality or diſpoſition which bodies acquire by ſuch operation. The term *exaltation* has been peculiarly affected by the old chemiſts and alchemiſts; who, imagining it to have ſome extraordinary emphaſis, are employing it on every occaſion.

Exaltation, in aſtrology, is a dignity which a planet acquires in certain ſigns or parts of the zodiac; which dignity is ſuppoſed to give it an extraordinary virtue, efficacy, and influence. The oppoſite ſign, or part of the zodiac, is called the dejection of the planet. Thus the 15th degree of Cancer is the exaltation of Jupiter, according to Albumazor, becauſe it was the aſcendant of that planet at the time of the creation; that of the ſun is in the 19th degree of Aries, and its dejection in Libra; that of the moon is in Taurus, &c. Ptolemy gives the reaſon of this in his firſt book De Quadrup.

EXAMINERS, in chancery, two officers of that court, who examine, upon oath, witneſſes produced in cauſes depending there, by either the complainant or defendant, where the witneſſes live in London or near it. Sometimes parties themſelves, by particular order, are examined. In the country, above 20 miles from London, on the parties joining in commiſſion, witneſſes are examined by commiſſioners, being uſually counſellors or attornies not concerned in the cauſe.

EXAMPLE, in rhetoric, denotes an imperfect kind of induction or argumentation; whereby it is proved, that a thing which happened on ſome other occaſion will happen again on the preſent one, from the ſimilitude of the caſes. As, "The war of the Thebans, againſt their neighbours the Phocians, was ruinous; conſequently, that of the Athenians againſt their neighbours, will likewiſe be fatal."

EXANTHEMA, among phyſicians, denotes any kind of efflorescence or eruption, as the meaſles, purple ſpots in the plague, or malignant fevers, &c.

EXARCH, in antiquity, an appellation given, by the emperors of the eaſt, to certain officers ſent into Italy, in quality of vicars, or rather prefects, to defend that part of Italy which was yet under their obedience; particularly the city of Ravenna againſt the Lombards, who had made themſelves maſters of the greateſt part of the reſt. The reſidence of the exarch was at Ravenna; which city, with that of Rome, were all that was left the emperors. The firſt exarch was the patrician Boetius, famous for his treatiſe, De conſolatione philoſophiæ; appointed in 568 by the younger Juſtin. The exarchs ſubſiſted about 185 years, and ended in Eutychius; under whoſe exarchate the city of Ravenna was taken by the Lombard king Aſtulphus, or Aſtolphus. The emperor Frederic created Heraclius, archbiſhop of Lyons, a deſcendant of the illuſtrious houſe of Montboiſſier, exarch of the whole kingdom of Burgundy; a dignity till that time unknown any where but in Italy, particularly in the city of Ravenna. Homer, Philo, and other ancient authors, give likewiſe the name *exarchus* to the choragus or maſter of the ſingers, in the ancient choruſes, or him who ſung firſt: the word αρχω, or αρχομαι, ſignifying equally *to begin*, and *to command*.

Exarch *of a Dioceſe* was, anciently, the ſame with primate. This dignity was inferior to the patriarchal, yet greater than the metropolitan.

Exarch alſo denotes an officer, ſtill ſubſiſting in the Greek church; being a kind of deputy or legate *à latere* of the patriarch, whoſe office it is to viſit the provinces allotted him, in order to inform himſelf of the lives and manners of the clergy; take cognizance of eccleſiaſtical cauſes; the manner of celebrating divine ſervice; the adminiſtration of the ſacraments, particularly confeſſion; the obſervance of the canons; monaſtic diſcipline; affairs of marriages, divorces, &c. but, above all, to take an account of the ſeveral revenues which the patriarch receives from ſeveral churches; and, particularly, as to what regards the collecting the ſame. The exarch, after having greatly enriched himſelf in his poſt, frequently riſes to the patriarchate itſelf.

Exarch is alſo uſed, in the eaſtern church antiquity, for a general or ſuperior over ſeveral monaſteries; the ſame that we otherwiſe call archimandrite; being exempted, by the patriarch of Conſtantinople, from the juriſdiction of the biſhops; as are now the generals of the Romiſh monaſtic orders.

EXAUCTORATIO, in the Roman military diſcipline, differed from the miſſio, which was a full diſcharge, and took place after they had ſerved in the army 20 years: whereas the exauctoratio was only a partial diſcharge: they loſt their pay indeed, but ſtill kept under their colours or *vexilla*, though not under the *aquila* (or eagle), which was the ſtandard of the legion: whence, inſtead of *Legionarii*, they were called *Subſignani*, and were retained till they had either ſerved their full time, or had lands aſſigned them. The exauctoratio took place after they had ſerved 17 years.

EXCALCEATION, among the Hebrews, was a particular law, whereby a widow, whom her huſband's brother refuſed to marry, had a right to ſummon him to a court of juſtice; and, upon his refuſal, might excalceate him, that is, pull off one of his ſhoes, and ſpit in his face; both of them actions of great ignominy.

EXCELLENCY, a title anciently given to kings and emperors, but now to ambaſſadors, generals, and other perſons who are not qualified for that of *highneſs*, and yet are to be elevated above the other inferior dignities.

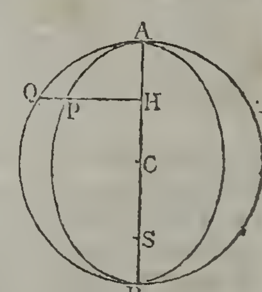
EXCENTRIC, is applied to ſuch figures, circles, ſpheres, &c. as have not the ſame centre; as oppoſed to concentric, which have the ſame centre.

Excentric, or *Excentric Circles* in the ancient Ptolemaic aſtronomy, was the very orbit of the planet itſelf, which it was ſuppoſed to deſcribe about the earth, and which was conceived excentric with it; called alſo the Deferent.

Inſtead of theſe excentric circles round the earth, the moderns make the planets deſcribe elliptic orbits about the ſun; which accounts for all the irregularities of their motions, and their various diſtances from the earth, &c. more juſtly and naturally.

Excentric, or *Excentric Circle*, in the new aſtronomy, is the circle deſcribed from the centre of the orbit of a planet, with half the greateſt axis as a radius; or it is the circle that circumſcribes the elliptic orbit of the planet; as the circle AQB.

Excentric *Anomaly*, or *Anomaly of the Centre*, is an arc AQ of the excentric circle, intercepted between the aphelion A, and the right line QH, drawn through the centre P of the planet perpendicular to the line of the apſes AB.



Excentric *Equation*, in the old aſtronomy, is an angle made by a line drawn from the centre of the earth, with another line drawn from the centre of the excentric, to the body or place of any planet. This is the ſame with the proſthaphereſis; and is equal to the difference, accounted in an arch of the ecliptic, between the real and apparent place of the ſun or planet.

Excentric *Place of a planet*, in its orbit, is the heliocentric place, or that in which it appears as ſeen from the ſun.

Excentric *Place in the ecliptic*, is the point of the ecliptic to which the planet is referred as viewed from the ſun; and which coincides with the heliocentric longitude.

EXCENTRICITY, is the diſtance between the centres of two circles, or ſpheres, which have not the ſame centre.

Excentricity, *in the old aſtronomy*, is the diſtance between the centre of a planet and the centre of the earth.—That the planets have ſuch an excentricity, is allowed on all ſides, and may be evinced from various circumſtances; and eſpecially this, that the planets at ſome times appear larger, and at others leſs; which can only proceed from hence, that their orbits being excentric to the earth, in ſome parts of thoſe orbits the planets are nearer to us, and in others more remote. And as to the excentricities of the ſun and moon, it is thought they are ſufficiently proved, both from eclipſes, from the moon's greater and leſs parallax at the ſame diſtance from the zenith, and from the ſun's continuing longer by 8 days in the northern hemiſphere than in the ſouthern one.

Excentricity, *in the new aſtronomy*, is the diſtance CS between the ſun S and the centre C of a planet's orbit; or the diſtance of the centre from the focus of the elliptic orbit; called alſo the *ſimple* or *ſingle excentricity*.

When the greateſt equation of the centre is given, the excentricity of the earth's orbit may be found by the following proportion; viz.

As the diameter of a circle in degrees,
Is to the diameter in equal parts;
So the greateſt equation of the centre in degrees,
To the excentricity in equal parts. Thus,

Greateſt equat. of the cent. $1^\circ\ 55'\ 33'' = 1^\circ{\cdot}9258333$ &c.
The diam. of a circ. being 1, its circumf. is $3{\cdot}1415926$.
Then $3{\cdot}1415926 : 1 :: 360^\circ : 114^\circ{\cdot}5915609$ diam. in deg.
And $114{\cdot}5915609 : 1 :: 1{\cdot}9258333 : 0{\cdot}016806$. the Ex.
Hence, by adding this to 1, and ſubtracting it from 1,
gives $1.016806 =$ AS the aphelion diſtance,
and $0{\cdot}983194 =$ BS the perihelion diſtance.
See Robertſon's Elem. of Navigation, book 5, page 286.

Otherwiſe, thus: Since it is found that the ſun's greateſt apparent ſemi-diameter is to his leaſt, as $32'\ 43''$ to $31'\ 38''$, or as $1963''$ to $1898''$; the ſun's greateſt diſtance from the earth will be to his leaſt, or AS to SB, as 1963 to 1898; of which,
the half dif. is $32\frac{1}{2} =$ CS,
and half ſum $1930\frac{1}{2} =$ CB; wherefore,
as $1930\frac{1}{2} : 32\frac{1}{2} :: 1 : {\cdot}016835 =$ CS the excentricity to the mean diſtance or ſemi-axis 1; which is nearly the ſame as before.

The excentricities of the orbits of the ſeveral planets, in parts of their own mean diſtances 1000, and alſo in Engliſh miles, are as below, viz. the excentricity of the orbit of

	Parts.	Miles.
Mercury	210	7,730,000
Venus	7	482,000
Earth	17	1,618,000
Mars	93	13,486,000
Jupiter	48	23,760,000
Saturn	55	49,940,000
Georgian	$47\frac{1}{2}$	86,000,000

Double Excentricity, is the diſtance between the two foci of the elliptic orbit, and is equal to double the ſingle excentricity above given.

EXCEPTION, in law, denotes a ſtop or ſtay to an action; and is either dilatory or peremptory, in proceedings at common law; but in chancery it is what the plaintiff alleges againſt the ſufficiency of an anſwer, &c. An exception is no more than the denial of what is taken to be good by the other party, either in point of law or pleading. The counſel in a cauſe are to take all their exceptions to the record at one time, and before the court has delivered any opinion on it.

EXCERPT, in matters of literature. See Extract.

EXCESS, in arithmetic and geometry, is the difference between any two unequal numbers or quantities, or that which is left, after the leſſer is taken from or out of the greater.

EXCHANGE, in *arithmetic*, is the reduction of different coins, or any denominations of money, whether there be real coins anſwering to them, or no, from one to another: or the method of finding how many of one ſpecies, or denomination, are equal in value to a given number of another; in order to which it is neceſſary to know the value of the coins and monies of account of different countries, and their proportion to each other according to the ſettled rate of exchange. The ſeveral operations in this caſe are only different applications of the rule *of three*.

Examp. 1. England exchanges with France on the crown or *ecu* of three livres Tournois, allowing a certain number of pence ſterling, more or leſs according to the rate of exchange, for this crown. Accounts are kept in France in livres, ſols, and deniers. See (on this and all ſubſequent occaſions where the value of any particular coin is required) the article Money. Suppoſe then that a remittance is made from Paris to London of 1006 livres 14 ſols, at 29*d.* ſterling exchange, what is the amount in pounds, &c.? Divide the livres, ſols, and deniers by 3, in order to reduce them into French crowns; then multiply the crowns by 29, the number of pence in a crown, and take the aliquot parts for the fractional parts, according to the ſubdenominations of the integers, or reduce them into decimals, and reduce the pence into ſhillings and pounds as below.

Divide by 3. 1006 . 14
Cr. 335 . 11.4
Mult. by 29
3015
670
$14\frac{1}{2}$
$1\frac{1}{2}$
$\frac{1}{2}$
12|9732
20|811
40*l.* 11*s.*

When ſterling money is to be reduced into French exchange crowns, reduce the ſum given, and price of exchange, into the ſame denomination, and divide the former by the latter; and the crowns may be reduced to livres by multiplying the quotient by 3. The rate of exchange may be had by dividing the number of pence ſterling by the number of French crowns, &c. in the given ſum.

Examp. 2. England exchanges with Holland, Antwerp, and Hamburgh, at ſo many ſchellings, or ſcalins and groots Flemiſh per pound ſterling.

If London draws on, or remits to Amſterdam 852*l.* 12*s.* 6*d.* ſterling, at 34 *ſc.* $4\frac{1}{2}$ *gr.* Flemiſh per £. ſterling, how many guilders, ſtivers, and pennings, muſt be paid or received in bank money in Amſterdam? i. e. if 1*l.* ſterling gives 34 *ſc.* $4\frac{1}{2}$ *gr.* what will 852*l.* 12*s.* 6*d.* give? Reduce the price of exchange to $\frac{1}{2}$ groots, which, multiplied by the pounds ſterling, gives the half groots contained in that ſum; and, for the 12*s.* 6*d.* take 10*s.* as the half of 852, and 2*s.* 6*d.* as the fourth of that quotient; add the whole together, and the ſum total is the number of half Flemiſh groots contained in the ſterling money;

which, being divided by 80, the half groots in a guilder, gives the anſwer in guilders; and the remaining half groots muſt be reduced to ſtivers and pennings. The operation is as follows:

	£.	s.	d.		Sc.	gr.
	852	12	6	at	34	$4\frac{1}{2}$
	825				12	
	4260				412	
	1704				2	
	6816					
10s. =					$412\frac{1}{2}$ half gr. 825=1l. ſterling	
2s. 6d.=	$103\frac{1}{8}$					
8|0)	$70341\|5\frac{5}{8}$					

8792 guilders, 55 half groots $\frac{5}{8}$. But 55 half groots are = $27\frac{1}{2}$ groots = 13 ſtivers 12 pennings and $\frac{5}{8}$ of the half groot = $2\frac{1}{2}$ pennings; therefore the whole ſum will be 8792 guilders 13 ſtivers $14\frac{1}{2}$ pennings bank money—This example may be eaſily reverſed, by reducing the Dutch money, and price of exchange, into one denomination, and dividing the ſum by the price; the quotient will give the anſwer in pounds ſterling.

Examp. 3. England exchanges with Spain upon the piaſtre, or dollar of 8 rials, for an uncertain number of pence ſterling. Suppoſe Cadiz remits to London 3537 dollars, 6 rials, at $40\frac{7}{8}$ per dollar, what will this remittance amount to in England? Multiply the dollars by $40\frac{7}{8}$; take the half of $40\frac{7}{8}$ for 4 rials, and their fourth for 2 rials; add the whole, which will give the ſum in pence: thus,

3537 : 6
$40\frac{7}{8}$
141480
$3094\frac{7}{8}$
$20\frac{7}{16}$
$10\frac{7}{32}$
12) $144605\frac{1}{2}$
2|0) $1205|0.5\frac{1}{2}$

602*l.* 10*s.* $5\frac{1}{2}$*d.* ſterling.

Examp. 4. England exchanges with Portugal on the milrea, and gives pence, more or leſs, for it. Suppoſe that Liſbon, or Oporto, remits to London 4366 milreas, 183 reas, at 5*s.* $5\frac{5}{8}$*d.* exchange, how much ſterling muſt be paid in London for this remittance? The milrea containing 1000 reas, theſe may be conſidered as decimals; then 5*s.* being $\frac{1}{4}$ of a pound, 5*d.* $\frac{1}{12}$ of 5*s.* and $\frac{5}{8}$ the $\frac{1}{8}$ of 5*d.* divide accordingly, and ſum up the whole; then reduce decimals of a pound into ſhillings, &c. The operation is as follows:

		4366,183
5*s.* = $\frac{1}{4}$	-	1091, 54575
5*d.* = $\frac{1}{12}$	-	90,962145, &c.
$\frac{5}{8}$ = $\frac{1}{8}$	-	11,370265, &c.
		£.1193,87815, &c.
		20
		17,563
		12
		6,756
		4
		3,024

The anſwer is 1193*l.* 17*s.* $6\frac{3}{4}$*d.* ſterling.

The foregoing examples illuſtrate the general method of ſettling the *exchange* between England and any other countries to which its commerce extends. But as conſiderable advantages may often be made by *arbitrating the exchanges* between different countries with accuracy, the following examples will explain the method of doing this in all common caſes.

Examp. 5. Suppoſe London exchanges on Amſterdam at $35—2\frac{1}{2}$, and on Paris at $32\frac{1}{8}$. what is the proportional arbitrated price between Amſterdam and Paris?

1 Paris crown = $32\frac{1}{8}$*d.* London.
240*d.* London = $422\frac{1}{2}$ groots. Amſterdam = $35 \times 12 + 2\frac{1}{2}$.
Then if 240*d.* gives $422\frac{1}{2}$ groots, what will $32\frac{1}{8}$*d.* give? But as the multiplication and diviſion of quantities, partly integral and partly fractional, require a knowledge of vulgar and decimal fractions, which ſome men of buſineſs are not poſſeſſed of, there are methods which may be recurred to in practice, that will obviate ſuch difficulties. It is well known, that if equal quantities are multiplied and divided by equal quantities, the number reſulting from ſuch operations will bear the ſame proportion to each other with the numbers firſt given.

Thus in the preceding example, $\frac{422\frac{1}{2}\,gr. \times 32\frac{1}{8}d}{240d.} =$

$$\frac{\times 422\frac{1}{2} \times 8 \times \frac{5}{8}}{= 2 \times 240 \times 8} = \frac{845 \times 257}{240 \times 2 \times 8} = \frac{\frac{845}{5} \times 257}{\frac{240}{5} \times 2 \times 8} = \frac{169 \times 257}{48 \times 2 \times 8}$$

= 56 groots Amſterdam $\frac{425}{768}$.

Examp. 6. Let Paris exchange on London at $32\frac{1}{8}$. On Amſterdam at $56\frac{425}{768}$.

What is the proportional arbitrated price between London and Amſterdam?

1*l.* ſterling = 240*d.*
32*d.* $\frac{1}{8}$ = $56\frac{425}{768}$ groots.

$32\frac{1}{8}d.$: $56\frac{425}{768}$: : 240 : $\frac{240 \times 56\frac{425}{768}}{32\frac{1}{8}}$ = (multiply numerator and denominator by 768 and 8) $\frac{240 \times 8 \times 43433}{257 \times 768}$ = (dividing both by 8 and 48) $\frac{43433 \times 5}{257 \times 2} = 422\frac{1}{2}$ groots $= 35 - 2\frac{1}{2}$

Examp. 7. Let Amſterdam exchange on Paris at $56\frac{425}{768}$. On London at $35—2\frac{1}{2}$.

What is the proportional arbitrated price between London and Paris?

1 Paris crown = $56\frac{425}{768}$ groots.
$422\frac{1}{2}$ groots = 240*d.* ſterling.

$$422\frac{1}{2}\,gr. : 240d. : : 56\frac{425}{768}\,gr. \;\frac{240 \times 56\frac{425}{768}}{422\frac{1}{2}} =$$

$$\frac{\frac{240}{5} \times 56\frac{425}{768} \times 768 \times 2}{\frac{422\frac{1}{2} \times 2}{5} \times 768} = \frac{96 \times 43433}{169 \times 78} = \frac{\frac{96}{96} \times 43433}{169 \times \frac{768}{96}} = \frac{43433}{169 \times 8}$$

$= 32\frac{1}{2}d.$ ſterling.

Examp. 8. Suppoſe that 100*l.* ſterling is circulated from London to Amſterdam at the price of exchange in the preceding examples, viz. at $35—2\frac{1}{2}$, how many guilders of Holland will this ſum produce? 100*l.* ſterling, at $422\frac{1}{2}$ groots Amſt. per £. ſterling, will produce 1056—10 guilders of Amſterdam, by *Examp.* 2. Theſe 1056—10 guilders circulated from Amſterdam to Paris, will produce at the arbitrated price of exchange, viz. $56\frac{425}{768}$ groots per French crown, 747 crowns —1—$7\frac{1}{2}$ of France; and thoſe crowns drawn home to London, at the above exchange of $32\frac{1}{8}$*d.* ſterling, per French crown, will produce the ſame 100*l.* ſterling. Whence it follows

that if the real price of exchange, at the time when these computations are made, is more or less between Amsterdam and Paris than the exact arbitrated price, in example 5, you may draw home more or less than your 100*l.* sterling.

In all transactions of this kind, the skilful merchant will watch the occasion to buy bills of exchange when they are cheapest, in order to dispose of them at such places, where, at the same time, they are dearest. See the next article.

Exchange, *Permutation,* in *Commerce,* an agreement, whereby one thing is trucked or given for another. The first commerce carried on among men, was by exchange; people furnished each other mutually with what things they wanted; but such exchanges were clogged with two considerable difficulties. 1. On account of the unequal values of commodities; and, 2. Because every body had not just what might accommodate the person with whom he would exchange. To remove these inconveniencies, money was invented for a common medium; and instead of exchanging, buying and selling were introduced. Yet there are nations among whom the primitive way of exchange still obtains; and even among the most civilized people, there are frequent occasions, in which they have recourse to this method. Such, for instance, is the trade of several cities of the North, and Baltic Sea, where the French exchange their wines and brandies for woods, metals, hemp, and furs.

The commerce of bills of exchange is, itself, a mere trading by exchange; a truck of money for money. Exchange, therefore, properly denotes the business, or trade of money, as carried on between one place and another, by means of bills of exchange, i. e. by giving money in one city, and receiving a bill to entitle the giver to receive the value in another city. See Bill *of Exchange.*

There is also another species, called *dry exchange, cambium siccum,* or *usurer's exchange,* which consists in giving money at one place, to be repaid it after a certain time in the same place, with a certain sum over, which is usually more than common interest. The ceremony of a real exchange is observed in this fictitious kind, which is only a method of borrowing money. The borrower draws a bill of exchange on any imaginary person, perhaps at Amsterdam, at the price the exchange then goes at, and delivers it to the lender. After the time fixed, comes a protest from Amsterdam for non-payment, with the re-exchange of the money from thence to London; all which, with costs, besides a deduction perhaps at the making of the bargain, the borrower must pay.

Exchange is also used for the profit which a merchant, negociant, or broker makes of a sum of money received, and for which a bill *of exchange* is drawn, payable in some other place, and by some other person, for the interest of his money, and the reward of his negociation. This profit is exceedingly various; being sometimes 2, sometimes 3, 4, or even 10 and 15 per cent, according as the alloy of the species differs, or as money is more or less plentiful, or bills of exchange more or less scarce, in the places. This kind is ordinarily called *real exchange,* and sometimes *mercantile* or *mixed exchange.*

The price of exchange is regulated according to the course of the place where the bill is drawn, or that of the place where the remittance is to be made. The word exchange, according to some, is derived from that perpetual alteration observed in the price of this exchange, which is sometimes higher and sometimes lower; there being occasionally somewhat to get by it, and sometimes to lose; and sometimes nothing to be either got or lost; as is the case, when the exchange is at par.

From this diversity in the price of exchange, arises that common proverb, "*The* exchange *and the wind are often varying.*" But the more natural way of deriving the word exchange is from this, that a man here exchanges his money for a bill; or that he changes present money for absent money; or changes his debtor.

Exchange is not to be looked on as a loan, from which it differs: because in the one, the risque, or danger, lies on the person who borrows; and in the other, on him who lends. It likewise differs from interest, because exchange is not paid in proportion to the time, as *interest* is.

Exchange is also used in some places to denote the profit allowed for exchanging one sort or species of money for another. This is particularly called *small exchange, natural exchange, pure exchange,* &c.

Exchange is sometimes also used for the agio, or profit allowed for the monies advanced in any one's behalf. Thus it is a fixing of the actual and momentary value of money. Silver as a metal has a value like all other merchandise; and an additional value, as it is capable of becoming the sign of other merchandise. If it was no more than a mere merchandise, it would perhaps lose much of its nominal value. As a money, silver has a value which the prince in some respects can fix, but in others he cannot. The prince establishes a proportion between a quantity of silver, as metal, and the same quantity, as money. He fixes the proportion between the several metals made use of as money; he establishes the weight and standard of every piece of money; in fine, he gives to every piece that ideal value already spoken of. We shall call the value of money in these four respects, its positive value, because it may be fixed by law.

The coin of every state has, besides this, a relative value as it is compared with the money of other countries. This relative value is established by the *exchange,* and greatly depends on its positive value. It is fixed by the current course of commerce, and by the general opinion and consent of merchants, but never by the decrees of the prince, because it is liable to incessant variations, depending on the accidental circumstances of trade, the money transactions between nations, and the state of public credit, &c. The several nations in fixing this relative value, are chiefly guided by that country which possesses the greatest quantity of specie. If she has as much specie as all the others together, it is then most proper for the others to regulate theirs by her standard; and this regulation between all the others will nearly agree with the regulation made with this principal nation. The relative abundance or scarcity of specie in different countries, forms what is called the course of *exchange,* and this plenty or scarcity, on which the mutability of the course of *exchange* depends, is not real but relative: *e. g.* when France has greater occasion for funds in Holland than the Dutch of having funds in France, specie is said to be common in France, and scarce in Holland; and *vice versâ.*

We may observe, in general, that there is much specie in a place, when there is more specie than paper; there is little, when there is more paper than specie; and in order to judge of the scarcity or plenty of specie we must know, for example, that if there are more bills from Holland than there are from France, then specie is scarce in France, and common in Holland; and therefore it becomes necessary that the *exchange* should rise, and the Dutch give more for specie of the same value in France, than the French for that of an equivalent value in Holland. When money of the same standard and weight in France yields money of the same standard and weight in Holland, the *exchange* is then said to be at par. Thus in the year 1744, the par was nearly at 54 gros to the French crown of three livres; when the *exchange* is above 54 gros, the French would say it is high; when below 54 gros, they say it is low. When the *exchange* is below par between one country and another, the former loses as debtor and buyer, and gains as creditor and seller. Thus if France owes Holland a certain number of gros, the more of these there are in a crown, the more crowns she has to pay; and as there must be the same number of gros to buy the same quantity of merchandise, while the *ex-*

change is low, every French crown is worth fewer gros. On the contrary, if France is creditor for a certain number of gros, the leſs of them there are in a crown, the more crowns ſhe will receive; and if France ſells her merchandiſe in Holland for a certain number of gros, the more crowns will ſhe receive, in proportion as each crown contains fewer of theſe gros. The ſame reaſoning will apply, *mutatis mutandis*, to the commercial intercourſe of other countries, and to any par of *exchange*. It is evident, that a merchant may ſend his ſtock into a foreign country, when the *exchange* is below par, without injuring his fortune; becauſe, when it returns, he recovers what he had loſt; but a prince, who ſends only ſpecie into a foreign country, which can never return, is always a loſer. When merchants have great dealings in any country, the *exchange* there infallibly riſes, on account of their numerous engagements, buying great quantities of merchandiſe, and drawing on foreign countries to pay for them. The *Arbitration of exchanges* is an article of great importance in the diſcuſſion of this ſubject: this is a kind of truck, which two bankers or merchants mutually make of their bills upon different parts, at a conditional price and courſe of *exchange*.

In order to underſtand this branch of commerce, it is neceſſary to know how to reduce the ſterling money of England into the foreign monies of *exchange* and of account of all places through Europe, according to the direct courſes of *exchange* eſtabliſhed for theſe purpoſes, and *vice verſa*; and alſo thoſe of other places, with which England has no direct eſtabliſhed courſes of *exchange*, but is under the neceſſity of making uſe of the intermediate changes of other places. The nature of the AGIOS, and the manner of converting bank monies into current, and the reverſe, ſhould likewiſe be well underſtood. The method of reducing the foreign monies of Europe into thoſe of every other diſtant country, according to the direct or intermediate *exchange*, ſhould be thoroughly known: beſides, it is neceſſary to know the intrinſic value of foreign monies, according to the moſt accurate aſſays that have been made for that purpoſe; and alſo the general natural cauſes of the riſe and fall of the courſes of *exchange* between one nation and one city, and another; which depend on the balance of trade being either in favour of or againſt ſuch trading nation or city. By an accurate obſervation and compariſon of the courſes of *exchange* between various countries and cities, the merchant will have an opportunity of profit, which ſhould not eſcape his cognizance. He will find that they ſeldom ebb and flow in an exact equality of proportion, ſince the balance of trade differs between different nations. The greateſt profit may be made by ſeizing the opportunity of drawing and remitting to certain places preferably to others. Farther, when the *exchange* is lower than the ſpecie of a country, a profit may be made by ſending it abroad; when it is higher, there is a profit in cauſing it to return; but there is a caſe in which profit may be made, by ſending the ſpecie out of the kingdom, when the *exchange* is at par; that is, by ſending it into a foreign country, to be received; when it returns, an advantage may be made of it, whether it be circulated in the country, or paid for foreign bills. See farther on this ſubject, Poſtlethwaite's Dict. of Trade and Com. articles ARBITRATION and EXCHANGE.

EXCHANGE ſignifies alſo a place in moſt conſiderable trading cities, wherein the merchants, negociants, agents, bankers, brokers, interpreters, and other perſons concerned in commerce, meet on certain days, and at certain times thereof, to confer and treat together of matters relating to exchanges, remittances, payments, adventures, aſſurances, freights, and other mercantile negociations, both by ſea and land.

In Flanders, Holland, and ſeveral cities of France, theſe places are called *burſes*; at Paris and Lyons, *places de change*; and in the Hanſe towns, *colleges of merchants*. Theſe aſſemblies are held with ſo much exactneſs, and merchants and negociants are ſo indiſpenſably required to attend at them, that a perſon's abſence alone makes him be ſuſpected of a failure or bankruptcy. The moſt conſiderable exchanges in Europe, are that of Amſterdam; and that of London, called the *Royal Exchange*.

Even in the time of the ancient Romans, there were places for the merchants to meet, in moſt of the conſiderable cities of the empire. That ſaid by ſome to have been built at Rome in the year of the city 259, 493 years before our Saviour, under the conſulate of Appius Claudius and Publius Servilius, was called *collegium mercatorum*; whereof it is pretended there are ſtill ſome remains, called by the modern Romans *loggia*, the lodge; and now, uſually, the Place of St. George. This notion of a Roman exchange is ſuppoſed to be founded on the authority of Livy, whoſe words are as follow; viz. *Certamen conſulibus inciderat, uter dedicaret Mercurii ædem. Senatus a ſe rem ad populum rejecit: utri eorum dedicatio juſſu populi data eſſet, eum præeſſe annonæ, mercatorium collegium inſtituere juſſit.* Liv. lib. ii. But it muſt be here remarked, that *collegium* never ſignified a building for a ſociety in the purer ages of the Latin tongue; ſo that *collegium mercatorum inſtituere* muſt not be rendered to build an exchange for the merchants, but to incorporate the merchants into a company. As Mercury was the God of traffic, this *ædes Mercurii* ſeems to have been chiefly deſigned for the devotions of this company or corporation.

EXCHEQUER. See BARONS *of the* EXCHEQUER.

Black Book of the EXCHEQUER, is a book under the keeping of the two chamberlains of the exchequer; ſaid to have been compoſed in 1175 by Gervais of Tilbury, nephew of king Henry II. and divided into ſeveral chapters. Herein is contained a deſcription of the court of England, as it then ſtood, its officers, their ranks, privileges, wages, perquiſites, power, and juriſdiction; and the revenues of the crown, both in money, grain, and cattle. Here we find, that for one ſhilling, as much bread might be bought as would ſerve 100 men a whole day; that the price of a fat bullock was only 12 ſhillings, and a ſheep four, &c.

Chancellor of the EXCHEQUER. See CHANCELLOR.

EXCHEQUER-*Bills*. By ſtatute 5 Ann c. 13, the lord-treaſurers may cauſe exchequer-bills to be made of any ſums not exceeding 1,500,000l. for the uſe of the war; and the duties upon houſes were made chargeable with 4l. 10s. *per cent. per annum* to the bank for circulating them. The bank not paying the bills, actions to be brought againſt the company, and the money and damages recovered: and if any exchequer-bills be loſt, upon affidavit of it before a baron of the exchequer, and certificate from ſuch baron, and ſecurity to pay the ſame if found, duplicates are to be made out: alſo when bills are defaced, new ones ſhall be delivered. The king, or his officers in the exchequer, by former ſtatutes, might borrow money upon the credit of bills, payable on demand, with intereſt after the rate of 3d. *per diem* for every 100l. bill. And by 8 & 9 W. 3. c. 20. an intereſt of 5d. a-day was allowed for every 100l. But 12 W. 3. c. 1. lowered the intereſt on theſe bills to 4d. a-day *per cent.* And by 12 Ann. c. 11. it was ſunk to 2d. a day.—Forging exchequer bills, or the indorſements thereof, is felony.

EXCISE, from the Belgic *acciiſſe*, tributum, "tribute," an inland duty or impoſition, paid ſometimes upon the conſumption of a commodity, or frequently upon the wholeſale, which is the laſt ſtage before the conſumption. This is doubtleſs, impartially ſpeaking, the moſt œconomical way of taxing the ſubject; the charges of levying, collecting, and managing the exciſe-duties, being conſiderably leſs in proportion than in other branches of the revenue. It alſo renders the commodity cheaper to the conſumer, than charging it with cuſtoms to the ſame amount would do; for the reaſon juſt now given, becauſe ge-

nerally paid in a much later ſtage of it. But, at the ſame time, the rigour and arbitrary proceedings of exciſe-laws ſeem hardly compatible with the temper of a free nation. For the frauds that might be committed in this branch of the revenue, unleſs a ſtrict watch is kept, make it neceſſary, wherever it is eſtabliſhed, to give the officers a power of entering and ſearching the houſes of ſuch as deal in exciſeable commodities, at any hour of the day, and, in many caſes, of the night likewiſe. And the proceedings, in caſe of tranſgreſſions, are ſo ſummary and ſudden, that a man may be convicted in two days time in the penalty of many thouſand pounds, by two commiſſioners or juſtices of the peace; to the total excluſion of the trial by jury, and diſregard of the common law. For theſe reaſons, though lord Clarendon tells us, that to his knowledge the earl of Bedford (who was made lord treaſurer by king Charles I. to oblige his parliament) intended to have ſet up the exciſe in England, yet it never made a part of that unfortunate prince's revenue; being firſt introduced, on the model of the Dutch prototype, by the parliament itſelf after its rupture with the crown. Yet ſuch was the opinion of its general unpopularity, that when in 1642 "aſperſions were caſt by malignant perſons upon the houſe of commons, that they intended to introduce exciſes, the houſe for its vindication therein did declare, that theſe rumours were falſe and ſcandalous, and that their authors ſhould be apprehended and brought to condign puniſhment." Its original eſtabliſhment was in 1643, and its progreſs was gradual; being at firſt laid upon thoſe perſons and commodities where it was ſuppoſed the hardſhip would be leaſt perceivable, viz. the makers and venders of beer, ale, cyder, and perry; and the royaliſts at Oxford ſoon followed the example of their brethren at Weſtminſter, by impoſing a ſimilar duty: both ſides proteſting, that it ſhould be continued no longer than to the end of the war, and then be utterly aboliſhed. But the parliament at Weſtminſter ſoon after impoſed it on fleſh, wine, tobacco, ſugar, and ſuch a multitude of other commodities, that it might be fairly denominated *general:* in purſuance of the plan laid down by Mr. Pymme (who ſeems to have been the father of the exciſe), in his letter to Sir John Hotham, ſignifying, "that they had proceeded in the exciſe to many particulars, and intended to go on farther; but that it would be neceſſary to uſe the people to it by little and little." And afterwards, when the nation had been accuſtomed to it for a ſeries of years, the ſucceeding champions of liberty boldly and openly declared "the impoſt of exciſe to be the moſt eaſy and productive levy that could be laid upon the people;" and accordingly continued it during the whole uſurpation. Upon king Charles's return, it having then been long eſtabliſhed and its produce well known, ſome part of it was given to the crown, in 12 Car. II. by way of purchaſe for the feudal tenures and other oppreſſive parts of the hereditary revenue. But, from its firſt original to the preſent time, its very name has been odious to the people. It has, nevertheleſs, been impoſed on abundance of other commodities in the reigns of king William III. and every ſucceeding prince, to ſupport the enormous expences occaſioned by our wars on the continent. Thus brandies and other ſpirits are now exciſed at the diſtillery; printed cottons and linens, at the printer's; ſtarch and hair powder, at the maker's; gold and ſilver wire, at the wiredrawer's; all plate whatſoever, firſt in the hands of the vender, who pays yearly for a licence to ſell it, and afterwards in the hands of the occupier, who alſo pays an annual duty for having it in his cuſtody; and coaches and other wheel-carriages, for which the occupier is exciſed; though not with the ſame circumſtances of arbitrary ſtrictneſs with regard to plate and coaches as in the other inſtances. To theſe we may add coffee and tea, chocolate and cocoa paſte, for which the duty is paid by the retailer; all artificial wines, commonly called *ſweets*; paper and paſteboard, firſt when made, and again if ſtained or printed; malt, as before mentioned; vinegars; and the manufacture of glaſs; for all which the duty is paid by the manufacturer; hops, for which the perſon that gathers them is anſwerable: candles and ſoap, which are paid for at the maker's; malt liquors brewed for ſale, which are exciſed at the brewery; cyder and perry at the venders; leather and ſkins, at the tanner's; and, lately, tobacco, at the manufacturer's: a liſt, which no friend to his country would wiſh to ſee farther increaſed.

The exciſe was formerly farmed out; but is now managed for the king by commiſſioners in both kingdoms, who receive the whole product of the exciſe, and pay it into the exchequer. Theſe commiſſioners are nine in number in England, and five in Scotland. The former have a ſalary of 1000l. a-year, the latter 600l. They are obliged by oath to take no fee or reward but from the king himſelf; and from thence there lies an appeal to five other commiſſioners called *commiſſioners of appeals.*

EXCISION, in ſurgery, the cutting out, or cutting off, any part of the body.

EXCISION, in a ſcripture ſenſe, means the cutting off of a perſon from his people, by way of puniſhment for ſome ſin by him committed. The Jews, Selden informs us, reckon up 36 crimes, to which they pretend this puniſhment is due. The rabbins reckon three kinds of exciſion; one, which deſtroys only the body; another, which deſtroys the ſoul only; and a third, which deſtroys both body and ſoul. The firſt kind of exciſion they pretend is an untimely death; the ſecond is an utter extinction of the ſoul; and the third, a compound of the two former: thus, making the ſoul mortal or immortal, ſays Selden, according to the degrees of miſbehaviour and wickedneſs of the people.

EXCLAMATION. See ORATORY.

EXCLUSION, or *Bill of* EXCLUSION, a bill propoſed about the cloſe of the reign of king Charles II. for excluding the duke of York, the king's brother, from the throne, on account of his being a Papiſt.

EXCOECARIA, in botany; a genus of the triandria order, belonging to the diœcia claſs of plants; and in the natural method ranking under the 38th order, *Tricoccæ.* The male amentum is naked; there is no calyx nor corolla; there are three ſtyles, and a tricoccous capſule. There is but one ſpecies, the agallocha, or aloes-wood, a native of China and ſome of the Indian iſlands, about the ſame height and form as the olive tree. Its trunk is of three colours, and contains three ſorts of wood: the heart is that of tambac or calombac, which is dearer in the Indies than even gold itſelf. It ſerves to perfume clothes and apartments; and is eſteemed a ſovereign cordial in fainting fits, a reſtorative in the palſy, and a cure for aſcarides in children. It is burnt as incenſe in the Chineſe and Indian temples; and it is alſo uſed to ſet the moſt precious jewels that are worked in the Indies.

The aloes-wood is very highly valued; and ſtrange fables were invented as to the origin of the tree that yields it; ſome pretending that it grew in Paradiſe, and was only conveyed to us by means of the rivers overflowing their banks and ſweeping off the trees in their way; others affirming that it grew on inacceſſible mountains, where it was guarded by certain wild beaſts, &c. The Siameſe ambaſſadors to the court of France in 1686, who brought a preſent of this wood from their emperor, firſt gave the Europeans any conſiſtent account of it. See XYLO-*Aloes.*

EXCOMMUNICATION, an eccleſiaſtical penalty or cenſure, whereby ſuch perſons as are guilty of any notorious crime or offence, are ſeparated from the communion of the church, and deprived of all ſpiritual advantages. Excommunication is founded on a natural right which all ſocieties have, of excluding out of their body ſuch as violate the laws thereof; and it was originally inſtituted for preſerving the purity of the church;

but ambitious ecclefiaftics converted it by degrees into an engine for promoting their own power, and inflicted it on the moft frivolous occafions.

The power of excommunication, as well as other acts of ecclefiaftical difcipline, was lodged in the hands of the clergy, who diftinguifhed it into the *greater* and *leffer*. The leffer excommunication, fimply called *aphorifmos*, "feparation or fufpenfion," confifted in excluding men from the participation of the eucharift, and the prayers of the faithful. But they were not expelled the church; for they had the privilege of being prefent at the reading of the fcriptures, the fermons, and the prayers of the catechumens and penitents. This excommunication was inflicted for leffer crimes; fuch as neglecting to attend the fervice of the church, mifbehaviour in it, and the like.

The greater excommunication, called *panteles aphorifmos*, "total feparation and anathema," confifted in an abfolute and entire exclufion from the church and the participation of all its rites. When any perfon was thus excommunicated, notice was given of it by circular letters to the moft eminent churches all over the world, that they might all confirm this act of difcipline, by refufing to admit the delinquent to their communion. The confequences of this latter excommunication were very terrible. The excommunicated perfon was avoided in civil commerce and outward converfation. No one was to receive him into his houfe, nor eat at the fame table with him; and when dead, he was denied the folemn rites of burial.

The Romifh pontifical takes notice of three kinds of excommunication, 1. The minor, incurred by thofe who have any correfpondence with an excommunicated perfon. 2. The major, which falls upon thofe who difobey the commands of the holy fee, or refufe to fubmit to certain points of difcipline; in confequence of which they are excluded from the church militant and triumphant, and delivered over to the devil and his angels. 3. Anathema, which is properly that pronounced by the pope againft heretical princes and countries. In former ages, thefe papal fulminations were moft terrible things; but at prefent, they are formidable to none but a few petty ftates of Italy.

Excommunication, in the Greek church, cuts off the offender from all communion with the 318 fathers of the firft council of Nice, and with the faints; configns him over to the devil and the traitor Judas; and condemns his body to remain after death as hard as a flint or piece of fteel, unlefs he humbles himfelf and makes atonement for his fins by a fincere repentance. The form abounds with dreadful imprecations; and the Greeks affert, that if a perfon dies excommunicated, the devil enters into the lifelefs corpfe; and therefore, in order to prevent it, the relations of the deceafed cut his body in pieces, and boil them in wine. It is a cuftom for the patriarch of Jerufalem annually to excommunicate the pope and the church of Rome; on which occafion, together with a great deal of idle ceremony, he drives a nail into the ground with a hammer, as a mark of malediction.

The form of excommunication in the church of England anciently ran thus: "By the authority of God the Father Almighty, the Son and Holy Ghoft, and of Mary the bleffed mother of God, we excommunicate, anathematize, and fequefter from the pale of holy mother church," &c. The caufes of excommunication in England are, contempt of the bifhop's court, herefy, neglect of public worfhip and the facraments, incontinence, adultery, fimony, &c. It is defcribed to be twofold. The lefs is an ecclefiaftical cenfure, excluding the party from the participation of the facraments: the greater proceeds farther, and excludes him not only from thefe, but from the company of all Chriftians. But if the judge of any fpiritual court excommunicates a man for a caufe of which he hath not the legal cognizance, the party may have an action againft him at common law, and he is alfo liable to be indicted at the fuit of the king.

Heavy as the penalty of excommunication is, confidered in a ferious light, there are, notwithftanding, many who would defpife the *brutum fulmen* of mere ecclefiaftical cenfures, efpecially when pronounced by a petty furrogate in the country, for railing or contumelious words, for non-payment of fees or cofts, or other trivial caufe. The common law, therefore, compaffionately fteps in to their aid, and kindly lends a fupporting hand to an otherwife tottering authority. Imitating herein the policy of the ancient Britons, among whom, according to Cefar, whoever were interdicted by the druids from their facrifices, "In numero impiorum ac fceleratorum habentur: ab iis omnes decedunt, aditum eorum fermonemque defugiunt, ne quid ex contagione incommodi accipiant: neque iis petentibus jus redditur, neque honos ullus communicatur." And fo with us, by the common law, an excommunicated perfon is difabled to do any act that is required to be done by one that is *probus et legalis homo*. He cannot ferve upon juries; cannot be a witnefs in any court; and, which is the worft of all, cannot bring an action, either real or perfonal, to recover lands or money due to him. Nor is this the whole; for if, within 40 days after the fentence has been publifhed in the church, the offender does not fubmit and abide by the fentence of the fpiritual court, the bifhop may certify fuch contempt to the king in chancery. Upon which there iffues out a writ to the fheriff of the county, called from the bifhop's certificate a *fignificavit*; or from its effect, a writ *de excommunicato capiendo*: and the fheriff fhall thereupon take the offender and imprifon him in the county jail, till he is reconciled to the church, and fuch reconciliation certified by the bifhop; upon which another writ *de excommunicato liberando*, iffues out of chancery to deliver and releafe him.

Excommunication was alfo practifed among the Jews, who ufed to expel from their fynagogue fuch as had committed any grievous crime. See the Gofpel according to St. John, ix. 22. xii. 42. xvi. 2. And Jofeph. Antiq. Jud. lib. ix. cap. 22. and lib. xvi. cap. 2. Godwyn, in his *Mofes and Aaron*, diftinguifhes three degrees, or kinds, of excommunication among the Jews. The firft he finds intimated in John ix. 22. The fecond in 1 Cor. v. 5. And the third in 1 Cor. xvi. 22. See Niddui. The rule of the Benedictines gives the name *excommunication* to the being excluded from the oratory, and the common table of the houfe, in our inns of court called *difcommoning*. This was the punifhment of fuch monks as came too late.

Excommunication, or a being fecluded from a participation in the myfteries of religion, was alfo in ufe under paganifm. Such as were thus excommunicated were forbidden to affift or attend at the facrifices, or to enter within the temples; and were afterwards delivered over to the demons and furies of hell, with certain imprecations; which was called among the Romans *diris devovere*. See Execration. The Druids among the antient Britons and Gauls, likewife, made ufe of excommunication againft rebels; and interdicted the communion of their myfteries to fuch as refufed to acquiefce in their decifions. See Druids.

EXCORIATION, in furgery, the galling, or rubbing off of the cuticle; frequently happening to the parts between the thighs and about the anus. In adults, it is occafioned by riding, or any violent exercife, and may be cured by various fimple applications, fuch as wafhing with brandy and water, or with a weak folution of vitriolated zinc. In children there is often an excoriation, not only of the parts near the pudenda, chiefly of the groin and fcrotum, but likewife in the wrinkles of the neck, under the arms, and in other places; proceeding from the acrimony of urine and fweat; and occafioning itching and reftleffnefs. To remedy this, the parts affected may be often wafhed

with cold water, and ſprinkled with drying powders, as common hair powder, or lapis calaminaris: but the practice with ſome nurſes, of uſing ceruſe in the ſame way, is exceedingly dangerous.

EXCREMENT, whatever is diſcharged out of the body of an animal after digeſtion; or the fibrous part of the aliment, mixed with the bile, ſaliva, and other fluids. Urine and fæces and the matter of perſpiration, are the groſs excrements that are diſcharged out of the body. Some have thought proper to conſider as *excrements*, thoſe ſecretions from the blood, which anſwer very important ends in the animal economy; ſuch as the ſaliva, bile, pancreatic juice, ſemen, and even the hair and nails. There is, however, a marked diſtinction between the *ſecretions*, and the excrements, of the body; ſince the former are of the higheſt utility, whilſt the latter are expelled as no longer capable of rendering the animal any ſervice, but on the contrary, if longer retained, muſt be injurious.

EXCRESCENCE, in ſurgery, denotes every preternatural tumour which ariſes upon the ſkin, either in the form of a wart or tubercle. If theſe are born with a perſon, as they frequently are, they are called *nævi materni*, or marks from the mother; but if the tumour is large, ſo as to depend from the ſkin, like a fleſhy maſs, it is then called a *ſarcoma*. See SURGERY.

EXCRETION, or SECRETION, in phyſiology, a ſeparation of ſome fluid from the blood, by means of the glands.

EXCRETORY, in anatomy, a term applied to certain little ducts or veſſels, deſtined for the reception of a fluid, ſecreted in certain glandules, and other viſcera, for the excretion of it in the appropriated places.

EXCUBIÆ, in antiquity, the watches and guards kept in the day by the Roman ſoldiers. They are contradiſtinguiſhed from the *vigiliæ*, which were kept in the night. The *excubiæ* were placed either at the gates and entrenchments, or in the camp; for the latter there was allowed a whole *manipulus* to attend before the *prætorium*, and four ſoldiers to the tent of every *tribune*. The *excubiæ* at the gates of the camp, and at the entrenchments, were properly called *ſtationes*. One company of foot and one troop of horſe were aſſigned to each of the four gates every day. To deſert their poſt, or abandon their corps of guards, was an unpardonable crime. The *triarii*, as the moſt honourable order of ſoldiers, were excuſed from the ordinary watches; yet being placed oppoſite to the *equites*, they were obliged to have an eye over them.

EXCUSATI, in church hiſtory, a term uſed to denote ſlaves, who flying to any church for ſanctuary, were excuſed and pardoned by their maſters; but theſe were obliged to take an oath to that purpoſe before they could have them again; and, if they broke the oath, they were puniſhed and fined as perſons guilty of perjury.

EXEAT, in church diſcipline, a Latin term, uſed for a permiſſion which a biſhop grants a prieſt to go out of his dioceſe; or an abbot to a religious to go out of his monaſtery. The word is alſo uſed in ſeveral great ſchools for leave given a ſcholar or ſtudent to go out. His maſter has given him an *exeat*.

EXECRATION, in antiquity, a kind of puniſhment, conſiſting of direful curſes and marks of infamy: ſuch was that uſed againſt Philip king of Macedon by the Athenians. A general aſſembly of the people being called, they made a decree, that all the ſtatues and images of that king, and of all his anceſtors, ſhould be demoliſhed, and their very name razed; that all the feſtivals, ſacred rites, prieſts, and whatever elſe had been inſtituted in honour of him, ſhould be profaned; that the very places where there had been any monument or inſcription to his honour, ſhould be deteſtable; that nothing ſhould be ſet up, or dedicated in them, which could be done in clean places; and, laſtly, that the prieſts, as often as they prayed for the Athenian people, allies, armies, and fleets, ſhould as many times deteſt and execrate Philip, his children, kingdom, land and ſea forces, and the whole race and name of the Macedonians. At the taking and demoliſhing of cities, it was uſual amongſt the Jews, Greeks, and Romans, to pronounce curſes upon, and load with direful execrations, the rebuilders of them.

EXECUTION, in a general ſenſe, the act of accompliſhing, finiſhing, or achieving any thing.

EXECUTION, in law, the completing or finiſhing ſome act, as of a judgment, deed, &c. and it uſually ſignifies the obtaining poſſeſſion of any thing recovered by judgment of law.

Sir Edward Coke obſerves, that there are two ſorts of executions: the one final; and the other a quouſque, that tends to an end. An execution final, is that which makes money of the defendant's goods; or extends to his lands, and delivers them to the plaintiff, who accepts the ſame in ſatisfaction; and this is the end of the ſuit, and the whole that the king's writ requires to be done. The writ of execution with a quouſque, though it tends to an end, yet is not final, as in the caſe of a *capias ad ſatisfac.* where the defendant's body is to be taken, in order that the plaintiff may be ſatisfied for his debt. See CAPIAS.

Executions are either in perſonal, real, or mixed actions. In a perſonal action, the execution may be made three ways, viz. by the writ of *capias ad ſatisfaciendum*, againſt the body of the defendant; *fieri facias*, againſt his goods; or *elegit*, againſt his lands. See FIERI *Facias* and ELEGIT.

In a real and mixed action, the execution is by writ of *habere facias ſaſinam*, and *habere poſſeſſionem*. See HABERE. Writs of execution bind the property of goods only from the time of delivery of the writ to the ſheriff; but the land is bound from the day of the judgment obtained: and here the ſale of any goods for valuable conſideration, after a judgment, and before the execution awarded, will be good. It is otherwiſe as to lands, of which execution may be made, even on a purchaſe after the judgment, though the defendant ſell ſuch land before execution. Likewiſe, ſheriffs may deliver in execution all the lands whereof others ſhall be ſeiſed in truſt for him againſt whom execution is had on a judgment, &c.

When any judgment is ſigned, the execution may be taken out immediately thereon; but if it be not iſſued within a year and a day after, where there is no fault in the defendant, as in the caſe of an injunction, writ of error, &c. there muſt be a *ſcire facias*, to revive the judgment; though, if the plaintiff ſues out any writ of execution within the year, he may continue it after the year is expired. After judgment againſt the defendant, in an action wherein ſpecial bail is given, the plaintiff is at liberty to have execution againſt ſuch defendant, or againſt his bail: but this is underſtood where the defendant does not render himſelf, according to law, in ſafeguard of the bail: and execution may not regularly be ſued forth againſt a bail, till a default is returned againſt the principal: alſo if the plaintiff takes the bail, he ſhall never take the principal. It is held that an execution may be executed after the death of the defendant: for his executor, being privy thereto, is liable as well as the teſtator. The executor is an entire thing, ſo that he who begins muſt end it: therefore, a new ſheriff may diſtrain an old one, to ſell the goods ſeized on a diſtringas, and to bring the money into court.

EXECUTION, in criminal caſes, the completion of human puniſhment. This follows JUDGMENT; and muſt in all caſes, capital as well as otherwiſe, be performed by the legal officer, the ſheriff or his deputy; whoſe warrant for ſo doing was anciently by precept under the hand and ſeal of the judge, as it is ſtill practiſed in the court of the lord high ſteward, upon the execution of a peer: though, in the court of the peers in parliament, it is done by writ from the king. Afterwards, it was eſtabliſhed, that in caſe of life, the judge may command exe-

cution to be done without any writ. And now the ufage is, fays Blackftone, for the judge to fign the calendar or lift of all the prifoners' names, with their feparate judgments in the margin, which is left with the fheriff. As, for a capital felony, it is written oppofite to the prifoner's name, "let him be hanged by the neck;" formerly, in the days of Latin and abbreviation, "*fuf. per coll.*" for "*fufpendatur per collum.*" And this is the only warrant that the fheriff has for fo material an act as taking away the life of a culprit. It may certainly afford matter of fpeculation, that in civil caufes there fhould be fuch a variety of writs of execution to recover a trifling debt, iffued in the king's name, and under the feal of the court, without which the fheriff cannot legally ftir one ftep; and yet that the execution of a man, the moft important and terrible tafk of any, fhould depend upon a marginal note.

The fheriff, upon receipt of his warrant, is to do execution within a convenient time; which in the country is alfo left at large. In London, indeed, a more folemn and becoming exactnefs is ufed, both as to the warrant of execution and the time of executing thereof: for the recorder, after reporting to the king in perfon the cafes of the feveral prifoners, and receiving his royal pleafure, that the law muft take its courfe, iffues his warrant to the fheriffs, directing them to do execution on the day, and at the place affigned. And in the court of king's bench, if the prifoner be tried at the bar, or brought there by *habeas corpus*, a rule is made for his execution; either fpecifying the time and place, or leaving it to the difcretion of the fheriff. And, throughout the kingdom, by ftatute 25 Geo. II. c. 37. it is enacted, that, in cafe of murder, the judge fhall in his fentence direct execution to be performed on the next day but one after fentence paffed. But, otherwife, the time and place of execution are by law no part of the judgment. It has been well obferved, that it is of great importance that the punifhment fhould follow the crime as early as poffible; that the profpect of gratification or advantage, which tempts a man to commit the crime, fhould inftantly awake the attendant idea of punifhment. Delay of execution ferves only to feparate thefe ideas; and then the execution itfelf affects the minds of the fpectators rather as a terrible fight, than as the neceffary confequence of tranfgreffion.

The fheriff cannot alter the manner of the execution, by fubftituting one death for another, without being guilty of felony himfelf. It is held alfo by Sir Edward Coke and Sir Matthew Hale, that even the king cannot change the punifhment of the law, by altering the hanging or burning into beheading; though, when beheading is part of the fentence, the king may remit the reft. And, notwithftanding fome examples to the contrary, Sir Edward Coke ftoutly maintains, that *judicandum eft legibus, non exemplis*. But others have thought, and more juftly, that this prerogative, being founded in mercy, and immemorially exercifed by the crown, is part of the common law. For hitherto, in every inftance, all thefe exchanges have been for more merciful kinds of death; and how far this may alfo fall within the king's power of granting conditional pardons (viz. by remitting a fevere kind of death, on condition that the criminal fubmits to a milder) is a matter that may bear confideration. It is obfervable, that when lord Stafford was executed for the popifh plot in the reign of king Charles II. the then fheriffs of London, having received the king's writ for beheading him, petitioned the houfe of lords for a command or order from their lordfhips, how the faid judgment fhould be executed: for, he being profecuted by impeachment, they entertained a notion (which is faid to have been countenanced by lord Ruffel), that the king could not pardon any part of the fentence. The lords refolved, that the fcruples of the fheriffs were unneceffary; and declared, that the king's writ ought to be obeyed. Difappointed of raifing a flame in that affembly, they immediately fignified to the houfe of commons by one of the members, that they were not fatisfied as to the power of the faid writ. That houfe took two days to confider of it; and then fullenly refolved, that the houfe was *content* that the fheriff do execute lord Stafford by fevering his head from his body. It is further related, that when afterwards the fame lord Ruffel was condemned for high treafon upon indictment, the king, while he remitted the ignominious part of the fentence, obferved, "that his lordfhip would now find he was poffeffed of that prerogative, which in the cafe of lord Stafford he had denied him." One can hardly determine (at this diftance from thofe turbulent times), which moft to difapprove of, the indecent and fanguinary zeal of the fubject, or the cool and cruel farcafm of the fovereign.

To conclude: it is clear, that if, upon judgment to be hanged by the neck till he is dead, the criminal be not thoroughly killed, but revives, the fheriff muft hang him again. For the former hanging was no execution of the fentence; and, if a falfe tendernefs were to be indulged in fuch cafes, a multitude of collufions might enfue. Nay, even while abjurations were in force, fuch a criminal, fo reviving, was not allowed to take fanctuary and abjure the realm; but his fleeing to fanctuary was held an efcape in the officer.

EXECUTIVE POWER. The fupreme executive power of thefe kingdoms is vefted by our laws in a fingle perfon, the king or queen for the time being. See the article KING. The executive power, in this ftate, hath a right to a negative in parliament, *i. e.* to refufe affent to any acts offered; otherwife the other two branches of legiflative power would, or might, become defpotic.

EXECUTOR, a perfon nominated by a teftator, to take care to fee his will and teftament executed or performed, and his effects difpofed of according to the tenor of the will. See LAW.

EXECUTORY, in law, is where an eftate in fee, that is made by deed or fine, is to be executed afterwards by entry, livery, or writ. Leafes for years, annuities, conditions, &c. are termed *inheritances executory*.

EXEDRÆ, in antiquity, denoted halls with many feats, where the philofophers, rhetoricians, and men of learning, met for difcourfe and difputation. The word occurs in ecclefiaftical writers as a general name for fuch buildings as were diftinct from the main body of the churches, and yet within the limits of the church taken in its largeft fenfe. Among the exedræ the chief was the BAPTISTERY.

EXEGESIS, a difcourfe by way of explanation or comment upon any fubject. In the Scotch univerfities, there is an exercife among the ftudents in divinity, called an *exegefis*, in which a queftion is ftated by the refpondent, who is then oppofed by two or three other ftudents in their turns; during which time the profeffor moderates, and folves the difficulties which the refpondent cannot overcome.

EXEGETES, formed of ἐξηγέομαι "I explain," among the Athenians, perfons learned in the laws, whom the judges ufed to confult in capital caufes.

EXEGETICA, in algebra, the art of finding, either in numbers or lines, the roots of the equation of a problem, according as the problem is either numerical or geometrical.

EXEMPLAR, a model, or original, to be imitated, or copied. See MODEL. EXEMPLAR alfo denotes the idea, or image, conceived or formed in the mind of the artift, whereby he conducts his work. Such is the idea of Cæfar, which a painter has in his mind when he goes to make a picture of Cæfar.

EXEMPLIFICATION *of letters patent*, denotes an exampler, or copy of letters patent, made from the inrolment thereof, and fealed with the great feal of England. Such ex-

emplifications are as effectual to be ſhowed, or pleaded, as the letters patent themſelves.

EXEMPTION, in law, a privilege to be free from ſome ſervice or appearance: thus, barons and peers of the realm are, on account of their dignity, exempted from being ſworn upon inqueſts; and knights, clergymen, and others, from appearing at the ſheriff's turn. Perſons of 70 years of age, apothecaries, &c. are alſo by law exempted from ſerving on juries; and juſtices of the peace, attorneys, &c. from pariſh-offices.

EXERCISE, among phyſicians, ſuch an agitation of the body as produces ſalutary effects in the animal economy. Thoſe exerciſes of the body are more eſpecially ſerviceable which give delight to the mind at the ſame time, as tennis, fencing, &c.; for which reaſon, the wiſdom of antiquity appointed rewards for thoſe who excelled in theſe gymnaſtic exerciſes, that by this means the bodies of their youth might be hardened for warlike toils. But as nothing is more conducive to health than moderate exerciſe, ſo violent exerciſe lowers the ſpirits, weakens the body, deſtroys the elaſticity of the fibres, and exhauſts the fluid parts of the blood. According to the ſtrength of the party uſing it, the exerciſe choſen ſhould be either active, ſuch as walking, hunting, dancing, &c. or paſſive, as riding in a coach or on horſeback, ſailing, &c. A very eligible ſort of exerciſe for conſumptive perſons is *ſwinging*, from whence very ſtriking good effects have in ſome inſtances been produced. In this caſe the motion ſhould be very gently applied, and the patient placed ſo ſecurely as to feel no apprehenſions of falling.

The exerciſe of a ſoldier in camp, conſidered as conducive to health, Dr. Pringle diſtinguiſhes into three heads; the firſt relating to his duty, the ſecond to his living more commodiouſly, and the third to his diverſions. The firſt, conſiſting chiefly in the exerciſe of his arms, will be no leſs the means of preſerving health than of making him expert in his duty: and frequent returns of this, early, and before the ſun grows hot, will be made more advantageous than repeating it ſeldom, and ſtaying out long at a time; for a camp affording little convenience for refreſhment, all unneceſſary fatigue is to be avoided. As to the ſecond article, cutting boughs for ſhading the tents, making trenches round them for carrying off the water, airing the ſtraw, cleaning their clothes and accoutrements, and aſſiſting in the buſineſs of the meſs, ought to be no diſagreeable exerciſe to the men for ſome part of the day. Laſtly, as to diverſions, the men muſt be encouraged to them either by the example of their officers, or by ſmall premiums to thoſe who ſhall excel in ſuch kind of ſports as ſhall be judged moſt conducive to health: but herein great caution is neceſſary, not to allow them to fatigue themſelves too much, eſpecially in hot weather or ſickly times: but above all, that their clothes be kept dry, wet clothes being the moſt frequent cauſe of camp-diſeaſes.

Exercise, in military affairs, is the ranging a body of ſoldiers in form of battle, and making them perform the ſeveral motions and military evolutions with different management of their arms, in order to make them expert therein. See alſo Words *of Command*.

Exercise, in the royal navy, is the preparatory practice of managing the artillery and ſmall arms, in order to make the ſhip's crew perfectly ſkilled therein, ſo as to direct its execution ſucceſsfully in the time of battle. The exerciſe of the great guns was, till lately, very complicated, and abounding with ſuperfluities, in our navy, as well as all others. The following method was then ſucceſsfully introduced by an officer of diſtinguiſhed abilities. 1. Silence. 2. Caſt looſe your guns. 3. Level your guns. 4. Take out your tompions. 5. Run out your guns. 6. Prime. 7. Point your guns. 8. Fire. 9. Sponge your guns. 10. Load with cartridge. 11. Shot your guns. 12. Put in your tompions. 13. Houſe your guns. 14. Secure your guns.

Upon beat-to-arms (every body having immediately repaired to their quarters) the midſhipman commanding a number of guns, is to ſee that they are not without every neceſſary article, as, (at every gun) a ſponge, powder-horn, with its priming wires, and a ſufficient quantity of powder, crow, hand-ſpike, bed, quoin, train-tackle, &c. ſending without delay for a ſupply of any thing that may be miſſing; and for the greater certainty of not overlooking any deficiency, he is to give ſtrict orders to each captain under him, to make the like examination at his reſpective gun, and to take care that every requiſite is in a ſerviceable condition, which he is to report accordingly. And (beſides the other advantages of this regulation) for the ſtill more certain and ſpeedy account being taken upon theſe occaſions, the midſhipman is to give each man his charge at quarters (as expreſſed in the form of the monthly report), who is to ſearch for his particular implements, and, not finding them, is immediately to acquaint his captain, that, upon his report to the midſhipman, they may be replaced.

The man who takes care of the powder is to place himſelf on the oppoſite ſide of the deck from that of the engagement, except when fighting both ſides at once, when he is to be amid-ſhip. He is not to ſuffer any other man to take a cartridge from him but he who is appointed to ſerve the gun with that article, either in time of a real engagement or at exerciſe. Lanterns are not to be brought to quarters in the night, until the midſhipman gives his orders for ſo doing to the perſon he charges with that article.

Exercise, may alſo be applied with propriety to the forming our fleets into orders of ſailing, lines of battle, &c. an art which the French have termed *evolutions*, or *tactiques*. In this ſenſe exerciſe may be defined, the execution of the movements which the different orders and diſpoſition of fleets occaſionally require, and which the ſeveral ſhips are directed to perform by means of ſignals. See Tactics.

Exercises, are alſo underſtood of what young gentlemen learn in the academies and riding-ſchools, ſuch as fencing, drawing, riding the great horſe, &c. How uſeful and agreeable ſoever ſtudy may be to the mind, it is very far from being equally ſalutary to the body. Every one obſerves, that the Creator has formed an intimate connection between the body and the mind; a perpetual action and reaction, by which the body inſtantly feels the diſorders of the mind, and the mind thoſe of the body. The delicate ſprings of our frail machines loſe their activity and become enervated, and the veſſels are liable to obſtructions when we totally deſiſt from exerciſe, and the conſequences neceſſarily affect the brain: a very ſtudious and ſedentary life is therefore equally prejudicial to the body and the mind. The limbs likewiſe become ſtiff; we contract an awkward conſtrained manner; a certain diſguſtful air attends all our actions, and we are very near being as diſagreeable to ourſelves as to others. An inclination to ſtudy is highly commendable; but it ought not, however, to inſpire us with an averſion to ſociety. The natural lot of man is to live among his fellows: and whatever may be the condition of our birth, or our ſituation in life, there are a thouſand occaſions where a man muſt naturally deſire to render himſelf agreeable; to be active and adroit; to dance with grace; to command the fiery ſteed; to defend himſelf againſt a brutal enemy; to preſerve his life by dexterity; as by leaping, ſwimming, &c. Many rational cauſes have therefore given riſe to the practice of particular exerciſes; and the moſt ſagacious and benevolent legiſlators have inſtituted, in their academies and univerſities, proper methods of enabling youth, who devote themſelves to ſtudy, to become expert alſo in athletic exerciſes.

EXERGESIA. See ORATORY.

EXERGUM, among antiquarians, a little ſpace around or without the figures of a medal, left for the inſcription, cipher, device, date, &c.

EXETER, a city of Devonſhire, with two markets, on Wedneſday and Friday. It is ſeated on the river Ex, whence it took its name, and over which is a handſome ſtone bridge. With its ſuburbs, it contains 15 pariſh-churches, and four chapels of eaſe, beſide the cathedral. Ships of burden formerly came up to this city; but the navigation was almoſt deſtroyed by one of the Courtenays earls of Devon, and, though repaired, in ſome degree, could never be reſtored to its former ſtate. The port of Exeter, therefore, is properly at Topſham, five miles below. It is, however, the principal city, for ſize and conſequence, in the W. of England, the reſidence of many genteel families, and the ſeat of an extenſive foreign and domeſtic commerce; and, particularly, it has a ſhare in the fiſheries of Newfoundland and Greenland. It is governed by a mayor, recorder, 24 aldermen, &c. and ſends two members to parliament. It is 68 miles S. W. of Briſtol, and 173 miles W. by S. of London. W. lon. 3. 29. N. lat. 50. 44.

EXFOLIATION, a term uſed by ſurgeons for the ſcaling of a bone, or its riſing and ſeparating into thin laminæ, which are afterwards thrown off from the living bone.

EXHALATION, a fume or ſteam exhaling, or iſſuing from a body, and diffuſing itſelf in the atmoſphere.

The terms exhalation and vapour are often uſed indifferently; but the more accurate writers diſtinguiſh them, appropriating the term vapour to the moiſt fumes raiſed from water and other liquid bodies; and the term exhalation to the dry ones emitted from ſolid bodies; as earth, fire, minerals, &c. In this ſenſe, exhalations are dry and ſubtle corpuſcles, or effluvia, looſened from hard terreſtrial bodies, either by the heat of the ſun, or the action of the air, or ſome other cauſe: being emitted upwards to a certain height in the atmoſphere, where, mixing with the vapours, they help to conſtitute clouds, and return back in dews, miſts, rains, &c.

Sir Iſaac Newton thinks, that true and permanent air is formed from the exhalations raiſed from the hardeſt and moſt compact bodies.

EXHAUSTIONS, or the *Method of* EXHAUSTIONS, a method of demonſtration founded upon a kind of exhauſting a quantity by continually taking away certain parts of it.

The method of exhauſtions was of frequent uſe among the ancient mathematicians; as Euclid, Archimedes, &c. It is founded on what Euclid ſays in the 10th book of his Elements; viz, that thoſe quantities are equal, whoſe difference is leſs than any aſſignable quantity. Or thus, two quantities A and B are equal, when, if to or from one of them as A, any other quantity as d be ſubtracted, however ſmall it be, then the ſum or difference is reſpectively greater or leſs than the other quantity B: viz, d being an indefinitely ſmall quantity,

if $A + d$ be greater than B,
and $A - d$ leſs than B,

then is A equal to B.

This propoſition is uſed in the 1ſt prop. of the 10th book, which imports, that if from the greater of two quantities be taken more than its half, and from the remainder more than its half, and ſo on; there will at length remain a quantity leſs than either of thoſe propoſed. On this foundation it is demonſtrated, that if a regular polygon of infinite ſides be inſcribed in a circle, or circumſcribed about it; then the ſpace, which is the difference between the circle and the polygon, will by degrees be quite exhauſted, and the circle become ultimately equal to the polygon. And in this way it is that Archimedes demonſtrates, that a circle is equal to a right-angled triangle, whoſe two ſides about the right angle are equal, the one to the ſemidiameter, and the other to the perimeter of the circle. Prop. 1, de dimenſione Circuli.

Upon the method of exhauſtions depends the method of indiviſibles introduced by Cavalerius, which is but a ſhorter way of expreſſing the method of exhauſtions; as alſo Wallis's arithmetic of infinites, which is a farther improvement of the method of indiviſibles; and hence alſo the methods of increments, differentials, fluxions, and infinite ſeries. See ſome account of the method of exhauſtions in Wallis's Algebra, chap. 73, and in Ronayne's Algebra, part 3, page 395.

EXHEREDATION, in the civil law, with us ordinarily called *diſinheriting*, is the father's excluding his ſon from inheriting his eſtate. There are 14 cauſes of exheredation expreſſed in Juſtinian's novel; without ſome one of which cauſes, he decrees the exheredation null, and the teſtament inofficious, as the civilians call it. Indeed, by the ancient Roman law, the father might pronounce exheredation without any cauſe; but the rigour of this law was reſtrained and moderated by Juſtinian.

EXHIBIT, in law, is where a deed, or other writing, being produced in a chancery ſuit to be proved by witneſſes, the examiner, or commiſſioner appointed for the examination of any ſuch, certifies on the back of the deed or writing, that the ſame was ſhown to the witneſs at the time of his examination, and by him ſworn to.

EXHIBITION, in law, a producing, or ſhowing, of titles, authorities, and other proofs, of a matter in conteſt. Anciently they uſed the phraſe, *exhibition* of a tragedy, comedy, or the like; but now we ſay *repreſentation* in lieu thereof.

EXHIBITION, in our old writers, is uſed for an allowance of meat and drink, ſuch as was cuſtomary among the religious appropriators of churches, who uſually made it to the depending vicar. The benefaction ſettled for the maintaining of ſcholars in the univerſities, not depending on the foundation, are alſo called *exhibitions*.

EXHORTATION, in rhetoric, differs only from *ſuaſion*, in that the latter principally endeavours to convince the underſtanding, and the former to work on the affections.

EXHUMATION, of *ex* "out of," and *humus* "ground," the act of digging up a body interred in holy ground, by the authority of the judge. In France, the exhumation of a dead body is ordered, upon proof that he was killed in a duel; and by the former French laws, a perſon had a right to demand the exhumation of the body of one of his pariſhioners, when interred out of the pariſh without his conſent.

EXIGENCE, or EXIGENCY, that which a thing requires, or which is expedient and ſuitable thereto.

EXIGENT, in law, a writ which lies where the defendant in a perſonal action cannot be found, nor any effects of his within the county, by which he may be attached or diſtrained.

EXIGENTERS, four officers in the court of common-pleas, who make all exigents and proclamations, in all actions where proceſs of outlawry lies. Writs of ſuperſedeas, as well as the prothonotaries, upon exigents, were likewiſe drawn up in their office.

EXILE. See BANISHMENT. Among the Romans the word *exilium* properly ſignified an interdiction or excluſion from water and fire; the neceſſary conſequence of which was, that the interdicted perſon muſt betake himſelf into ſome other country, ſince there was no living without fire and water. Thus Cicero, *ad Herenn.* obſerves, that the form of the ſentence did not expreſs *exilium*, but only *aquæ & ignis interdictio*. The ſame author remarks, that exile was not properly a puniſhment, but a voluntarily flying or avoiding the puniſhment decreed: *Exilium non eſſe ſupplicium, ſed perfugium, portuſque ſupplicii.* He adds, that there was no crime among the Romans, as among other

nations, puniſhed with exile; but exile was a ſource to which people flew voluntarily, in order to avoid chains, ignominy, ſtarving, &c. The Athenians frequently ſent their generals and great men into exile, out of envy of their merits, or diſtruſt of their too great authority. See Ostracism.

EXISTENCE, that whereby any thing has an actual eſſence, or is ſaid to *be*. See the article Metaphysics.

EXIT, properly expreſſes the departure of a player from off the ſtage, when he has acted his part. The word is alſo uſed in a figurative ſenſe, to expreſs any kind of departure, even death.

EXITERIA, in antiquity, oblations or prayers to any of the gods for a proſperous expedition or journey. There were alſo feaſts under this denomination, which were celebrated by the Greeks with ſacrifices and prayers, when their generals undertook expeditions againſt any enemy.

EXOCOETUS, or the Flying-Fish, in ichthyology, a genus belonging to the order of abdominales. See plate 16. The head is ſcaly, and it has no teeth; it has 10 radii in the branchioſtege membrane; the body is whitiſh, and the belly is angular: the pectoral fins, the inſtruments of flight, are very large. When purſued by any other fiſh, it raiſes itſelf from the water by means of theſe long fins, and flies in the air to a conſiderable diſtance, till the fins dry, and then it falls down into the water. It is a fiſh that ſeems to lead a moſt miſerable life. In its own element, it is perpetually haraſſed by the dorados and other fiſh of prey. If it endeavours to avoid them by having recourſe to the air, it either meets its fate from the gulls or the albatroſs, or is forced down again into the mouth of the inhabitants of the water, who, below, keep pace with its aerial excurſions. This fiſh is caught in the Mediterranean and ſome other ſeas. It is moſt common between the tropics, and there its enemies are more particularly numerous. In theſe climates the flying fiſhes ſpring out of the water by hundreds, to eſcape the rapacity of the dolphins, ſharks, &c. When in the air, they have many formidable enemies to encounter with in that element, viz. the pelican, eagle, diomeda, &c. and frequently throw themſelves on board the ſhips to eſcape their purſuit. Their fleſh is ſaid to ſupply a palatable and nouriſhing food.

EXODIARY, in the ancient Roman tragedy, was the perſon who, after the drama or play was ended, ſung the Exodium.

EXODIUM, in the ancient Greek drama, one of the four parts or diviſions of tragedy, being ſo much of the piece as included the cataſtrophe and unravelling of the plot, and anſwering nearly to our fourth and fifth acts.

Exodium, among the Romans, conſiſted of certain humorous verſes rehearſed by the exodiary at the end of the Fabulæ Atellanæ.

Exodium, in the Septuagint, ſignifies the end or concluſion of a feaſt. Particularly it is uſed for the eighth day of the feaſt of tabernacles, which, it is ſaid, had a ſpecial view to the commemoration of the *exodus* or departure out of Egypt.

EXODUS, a canonical book of the Old Teſtament; being the ſecond of the pentateuch, or five books of Moſes. It is ſo called from the Greek εξοδος, the "going out," or departure of the children of Iſrael from the land of Egypt; the hiſtory of which is delivered in this book, together with the many miracles wrought on that occaſion.

EXOMPHALOS, in ſurgery, called alſo *omphalocele*, and *hernia umbilicalis*, is a preternatural tumour of the abdomen, at the navel, from a rupture or diſtenſion of the parts which inveſt that cavity.

EXORCISM, the expelling of devils from perſons poſſeſſed, by means of conjurations and prayers. The Jews made great pretences to this power. Joſephus tells ſeveral wonderful tales of the great ſucceſs of ſeveral exorciſts. One Eleazer, a Jew, cured many dæmoniacs, he ſays, by means of a root ſet in a ring. This root, with the ring, was held under the patient's noſe, and the devil was forthwith evacuated. The generality of conjurors of this claſs were impoſtors, each pretending to a ſecret noſtrum or charm which was an overmatch for the devil. Our Saviour communicated to his diſciples a real power over dæmons, or perhaps over the diſeaſes ſaid to be occaſioned by dæmons. See Dæmoniac.

Exorciſm makes a conſiderable part of the ſuperſtition of the church of Rome, the rituals of which forbid the exorciſing any perſon without the biſhop's leave. The ceremony is performed at the lower end of the church, towards the door. The exorciſt firſt ſigns the poſſeſſed perſon with the ſign of the croſs, makes him kneel, and ſprinkles him with holy water. Then follow the litanies, pſalms, and prayer; after which the exorciſt aſks the devil his name, and adjures him by the myſteries of the Chriſtian religion not to afflict the perſon any more: then, laying his right hand on the dæmoniac's head, he repeats the form of exorciſm, which is this: "I exorciſe thee, unclean ſpirit, in the name of Jeſus Chriſt: tremble, O Satan! thou enemy of the faith, thou foe of mankind, who haſt brought death into the world; who haſt deprived men of life, and haſt rebelled againſt juſtice; thou ſeducer of mankind, thou root of evil, thou ſource of avarice, diſcord, and envy." The Romaniſts likewiſe exorciſe houſes and other places, ſuppoſed to be haunted by unclean ſpirits; and the ceremony is much the ſame with that of perſons poſſeſſed.

EXORCISTS, in church-hiſtory, an order of men, in the ancient church, whoſe employment it was to exorciſe or caſt out devils. See the preceding article.

EXORDIUM, in oratory, is the preamble or beginning, ſerving to prepare the audience for the reſt of the diſcourſe. Exordiums are of two kinds; either juſt and formal, or vehement and abrupt. The laſt are moſt ſuitable on occaſions of extraordinary joy, indignation, or the like. See Oratory.

EXOSTOSIS, from εξ *out*, and οςεον *a bone*, in anatomy, an acute eminence or excreſcence, puſhing preternaturally above the level ſurface of the bone.

EXOTERIC and Esoteric, are terms denoting *external* and *internal*, and applied to the double doctrine of the ancient philoſophers: the one was public or *exoteric*; the other ſecret, or *eſoteric*. This firſt was that which they openly profeſſed and taught to the world; the latter was confined to a ſmall number of choſen diſciples. This method was derived originally from the Egyptians; who, according to the united teſtimony of Herodotus, Diodorus Siculus, Strabo, Plutarch, &c. had a twofold philoſophy, one ſecret and ſacred, another public and common. The ſame practice alſo obtained among the Perſian Magi, the Druids of the Gauls, and the Brachmans of India. The Egyptian prieſts, with whom it originated, ſuſtained the character of judges and magiſtrates, and probably introduced this diſtinction with a view to the public welfare, and to ſerve the purpoſes of legiſlation and government. Clement of Alexandria informs us, that they communicated their myſteries principally to thoſe who were concerned in the adminiſtration of the ſtate; and Plutarch confirms the ſame declaration. However, others have ſuppoſed that they invented the fables of their gods and heroes, and the other external ceremonies of their religion, to diſguiſe and conceal natural and moral truths; but whatever was the motive of their practice, it was certainly applied to political purpoſes.

EXOTIC, a term properly ſignifying *foreign* or *extraneous*, i. e. brought from a remote or ſtrange country. In that ſenſe

we fometimes fay *exotic* or *barbarous terms* or *words*, &c. The word is derived from the Greek εξω, εξωθεν *extra*, "without, on the outfide." The term *exotic* is chiefly applied to plants which are natives of foreign countries, particularly thofe brought from the Eaft and Weft Indies, and which do not naturally grow in Europe. The generality of exotics, or exotic plants, do not thrive in England without fome peculiar care and culture; they require the warmth of their own climates; whence the ufe of hot-beds, glafs-frames, green-houfes, &c. See GREEN-*Houfe* and STOVE.

EXPANSION, among metaphyficians, denotes the idea we have of lafting diftance, all whofe parts exift together.

EXPANSION, is the dilating, ftretching, or fpreading out of a body; whether from any external caufe, as the caufe of rarefaction, or from an internal caufe, as elafticity. Bodies naturally expand by heat beyond their dimenfions when cold; and hence it happens that their dimenfions and fpecific gravities are different in different temperatures and feafons of the year. Air compreffed or condenfed, as foon as the compreffing or condenfing force is removed, expands itfelf by its elaftic power to its former dimenfions.

In fome few cafes indeed bodies feem to expand as they grow cold, as water in the act of freezing: but it feems this is owing to the extrication of a number of air bubbles from the fluid at a certain time; and is not at all a regular and gradual expanfion like that of metals, &c. by means of heat. Mr. Boyle, in his Hiftory of Cold, fays that ice takes up one 12th part more fpace than water; but by Major Williams's experiments on the force of freezing water, it is proved to occupy but about the 17th or 18th part more fpace. See Tranfac. of the R. Soc. of Edinb. vol. 2, p. 28. In certain metals alfo, an expanfion takes place when they pafs from a fluid to a folid ftate: but this is not to be accounted any proper effect of cold, but of the arrangement of the parts of the metal in a certain manner; and is therefore to be accounted a kind of cryftallization, rather than any thing elfe.

The expanfion of different bodies by heat is very various; and many experiments upon it are to be met with in the volumes of the Philof. Tranf. and elfewhere. In the 48th volume in particular, Mr. Smeaton has given a table of the expanfion of many different fubftances, as determined by experiment, from which the following particulars are extracted. Here it is to be noted, that the quantities of expanfion which anfwer to 180 degrees of Fahrenheit's thermometer, are expreffed in ten-thoufandth parts of an Englifh inch, each fubftance being 1 foot or 12 inches in length.

White glafs barometer tube	100
Martial regulus of antimony	130
Bliftered fteel	138
Hard fteel	147
Iron	151
Bifmuth	167
Copper hammered	204
Copper 8 parts, mixed with 1 of tin	218
Caft brafs	225
Brafs 16 parts, with tin 1	229
Brafs wire	232
Speculum metal	232
Spelter folder, viz. brafs 2 parts, zink 1	247
Fine pewter	274
Grain tin	298
Soft folder, viz. lead 2, tin 1	301
Zink 8 parts, tin 1, a little hammered	323
Lead	344
Zink or Spelter	353
Zink hammered ½ an inch per foot	373

By other experiments too it has been found, that, for each degree of heat of the thermometer, mercury, water, and air, expand by the following parts of their own bulk, viz.

Mercury	the 9600th	part of its bulk.
Water	the 6666th	
Air	the 435th	

From the foregoing table it appears, that there is no general rule for the degree of expanfion to which bodies are fubject by the fame degree of heat, either from their fpecific gravity or otherwife. Zink, which is much lighter than lead, expands more with heat; while glafs, which is lighter than either, expands much lefs; and copper, which is heavier than a mixture of brafs and tin, expands lefs.

It feems too that metals obferve a proportion of expanfion in a fluid ftate, quite different from what they do in a folid one: for regulus of antimony feemed to fhrink in fixing, after being melted, confiderably more than zink.

But of all known fubftances, thofe of the aërial kind expand moft by an equal degree of heat; and in general the greater quantity of latent heat that any fubftance contains, the more eafily is it expanded; though even here no general rule can be formed. It is indeed certain that the denfeft fluids, fuch as mercury, oil of vitriol, &c. are lefs expanfible than water, fpirit of wine, or ether; which laft is fo eafily expanded, that were it not for the preffure of the atmofphere, it would be in a continual ftate of vapour. And indeed this is the cafe, in fome meafure, with perhaps all fluids; as it has been found, by experiments with the beft air-pumps, that water, and other fluids, afcend in vapours the more as the exhauftion is the more perfect; from which it would feem that water would wholly rife in vapour in any temperature, if the preffure of the atmofphere was entirely taken off.

After bodies are reduced to a vaporous ftate, their expanfion feems to go on without any limitation, in proportion to the degree of heat applied; though it may be impoffible to fay what would be the ultimate effects of that principle upon them in this way. The force with which thefe vapours expand on the application of high degrees, is very great; nor does it appear that any obftacle whatever is infuperable by them.

On this principle depend the fteam engines, fo much ufed in various mechanical operations; likewife fome hydraulic machines; and the inftruments called manometers, which fhew the variation of gravity in the external atmofphere, by the expanfion or condenfation of a fmall quantity of air confined in a proper veffel. On this principle alfo, perpetual movements might be conftructed fimilar to thofe invented by Mr. Coxe, on the principle of the barometer. And a variety of other curious machines may be conftructed on the principle of aërial expanfion; an account of fome of which is given under HYDROSTATICS and PNEUMATICS.

On the principle of the expanfion of fluids are conftructed thermometers. And for the effects of the different expanfions of metals in correcting the errors of machines for meafuring time, fee the article PENDULUM.

The expanfion of folid bodies is meafured by an inftrument called the PYROMETER; and the force with which they expand is ftill greater than that of aërial vapours; the flame of a farthing candle produces an expanfion in a bar of iron capable of counteracting a weight of 500 pounds. The quantity of expanfion however is fo fmall, that it has never been applied to the movement of any mechanical engine.

EXPECTANCY, ESTATES IN, are of two forts; one created by act of the parties, called a *remainder*; the other, by act of law, called a *reverfion*.

EXPECTATION, in the doctrine of chances, is applied to any contingent event, upon the happening of which fome bene-

ſit, &c. is expected. This is capable of being reduced to the rules of computation: for a ſum of money in expectation when a particular event happens, has a determinate value before that event happens. Thus, if a perſon is to receive any ſum, as 10l. when an event takes place, which has an equal chance or probability of happening and failing, the value of the expectation is half that ſum, or 5l.: but if there are 3 chances for failing, and only 1 for its happening, or one chance only in its favour out of all the 4 chances; then the probability of its happening is only 1 out of 4, or $\frac{1}{4}$, and the value of the expectation is but $\frac{1}{4}$ of 10l. which is only 2l. 10s. or half the former ſum. And in all caſes, the value of the expectation of any ſum is found by multiplying that ſum by the fraction expreſſing the probability of obtaining it. So the value of the expectation on 100l. when there are 3 chances out of 5 for obtaining it, or when the probability of obtaining it is $\frac{3}{5}$, is $\frac{3}{5}$ of 100l. which is 60l. And if s be any ſum expected on the happening of an event, b the chances for that event happening, and f the chances for its failing; then, there being b chances out of $f + b$ for its happening, the probability will be $\frac{b}{f+b}$, and the value of the expectation is $\frac{b}{f+b} \times s$. See Simpſon's or De Moivre's Doctrine of Chances.

Expectation *of Life*, in the Doctrine of Life Annuities, is the ſhare, or number of years of life, which a perſon of a given age may, upon an equality of chance, expect to enjoy.

By the expectation or ſhare of life, ſays Mr. Simpſon (Select Exerciſes, p. 273), is not here to be underſtood that particular period which a perſon hath an equal chance of ſurviving; this laſt being a different, and more ſimple conſideration. The expectation of a life, to put it in the moſt familiar light, may be taken as the number of years at which the purchaſe of an annuity, granted upon it, without diſcount of money, ought to be valued. Which number of years will differ more or leſs from the period abovementioned, according to the different degrees of mortality to which the ſeveral ſtages of life are incident. Thus it is much more than an equal chance, according to the table of the probability of the duration of life (p. 254 ut ſupra), that an infant, juſt come into the world, arrives not to the age of 10 years; yet the expectation or ſhare of life due to it, upon an average, is near 20 years. The reaſon of which wide difference, is the great exceſs of the probability of mortality in the firſt tender years of life, above that reſpecting the more mature and ſtronger ages. Indeed if the numbers that die at every age were to be the ſame, the two quantities above ſpecified would alſo be equal; but when the ſaid numbers become continually leſs and leſs, the expectation muſt of conſequence be the greater of the two.

Mr. Simpſon has given a table and rule for finding this expectation, pages 255 and 273 as above. Thus:

A Table of the Expectations *of Life in London.*

Age	Expectation	Age	Expectation	Age	Expectation
1	27·0	10	34·8	19	29·5
2	32·0	11	34·3	20	28·9
3	34·0	12	33·7	21	28·3
4	35·6	13	33·1	22	27·7
5	36·0	14	32·5	23	27·2
6	36·0	15	31·9	24	26·6
7	35·8	16	31·3	25	26·1
8	35·6	17	30·7	26	25·6
9	35·2	18	30·1	27	25·1

Age	Expectation	Age	Expectation	Age	Expectation
28	24·6	46	17·4	64	10·8
29	24·1	47	17·0	65	10·5
30	23·6	48	16·7	66	10·1
31	23·1	49	16·3	67	9·8
32	22·7	50	16·0	68	9·4
33	22·3	51	15·6	69	9·1
34	21·9	52	15·2	70	8·8
35	21·5	53	14·9	71	8·4
36	21·1	54	14·5	72	8·1
37	20·7	55	14·2	73	7·8
38	20·3	56	13·8	74	7·5
39	19·9	57	13·4	75	7·2
40	19·6	58	13·1	76	6·8
41	19·2	59	12·7	77	6·4
42	18·8	60	12·4	78	6·0
43	18·5	61	12·0	79	5·5
44	18·1	62	11·6	80	5·0
45	17·8	63	11·2		

For example, if it be required to find the expectation or ſhare of life, due to a perſon of 30 years old. Oppoſite the given age in the firſt column of the table, ſtands 23·6 in the ſecond column, for the years in the expectation ſought.

See De Moivre's Doctrine of Chances applied to the Valuation of Annuities, p. 288; or Dr. Price's Obſervations on Reverſionary Payments, p. 168, 364, 374, &c.; or Philoſ. Tranſ. vol. 59, p. 89.

EXPECTORANTS, in pharmacy, medicines which promote *expectoration.* Such are the ſtimulating gums and reſins, ſquills, &c.

EXPECTORATION, the act of evacuating or bringing up phlegm or other matters out of the trachea, lungs, &c. by coughing, hauking, ſpitting, &c.

EXPEDITATION, in the foreſt-laws, ſignifies a cutting out the balls of a dog's fore-feet for the preſervation of the king's game. Every one that keeps any great dog not expeditated forfeits three ſhillings and fourpence to the king. In maſtiffs, not the ball of the feet, but the three claws, are to be cut to the ſkin. Inſtit. part iv. p. 308. This expeditation was to be performed once in every three years, and was done to every man's dog who lived near the foreſt, and even the dogs of the foreſters themſelves.

EXPEDITION, the march of an army to ſome diſtant place, with a view of hoſtilities. Such were the expeditions of Cyrus againſt Xerxes, and of Bacchus and Alexander into the Indies. Expeditions for the recovery of the Holy Land were called CROISADES.

EXPERIENCE, a kind of knowledge acquired by long uſe without any teacher. It conſiſts in the ideas of things we have ſeen or read, which the judgment has reflected on, to form for itſelf a rule or method. Authors make three kinds of experience: the firſt is the ſimple uſes of the external ſenſes, whereby we perceive the phenomena of natural things without any direct attention thereto, or making any application thereof. The ſecond is, when we premeditatedly and deſignedly make trials of various things, or obſerve thoſe done by others, attending cloſely to all effects and circumſtances. The third is that preceded by a foreknowledge, or at leaſt an apprehenſion of the event, and determines whether the apprehenſion were true or falſe; which two latter kinds, eſpecially the third, are of great ſervice in philoſophy.

EXPERIMENT, in philoſophy, is the trial of the reſult or effect of the applications and motions of certain natural bodies, in order to diſcover ſomething of their motions and relations, whereby to certain ſome of their phenomena or cauſes.

EXPERIMENTAL PHILOSOPHY,

IS that which proceeds on experiments, or which deduces the laws of nature and the properties and powers of bodies, and their actions upon each other, from fenfible experiments and obfervations.

Experiments are of the utmoft importance in philofophy; and the great advantages the modern phyfics have over the ancient, is chiefly owing to this, viz, that we abound much more in experiments, and that we make more ufe of the experiments we have. The method of the ancients, was chiefly to begin with the caufes of things, and thence argue to the phenomena and effects; on the contrary, that of the moderns proceeds from experiments and obfervations, from whence the properties and laws of natural things are deduced, and general theories are formed.

Several of the ancients indeed thought as highly of experiments as the moderns, and practifed them alfo. Plato omits no occafion of fpeaking of the advantages of them; and Ariftotle's hiftory of animals bears ample teftimony for *him*. Democritus's great employment was to make experiments; and even Epicurus himfelf owes part of his fame to the fame caufe.

Among the moderns, the making of experiments was chiefly begun by Friar Bacon, in the 13th century, who it feems fpent a great deal of money and labour in this way. After him, the lord chancellor Bacon is looked upon as the founder of the prefent mode of philofophifing by experiments. And his method has been profecuted with laudable emulation by the Academy del Cimento, the Royal Society, the Royal Academy at Paris; by Mr. Boyle, and, above all, by Sir Ifaac Newton, as well as by many other illuftrious philofophers.

Indeed, experiments, within the laft century, are come fo much into vogue, that nothing will pafs in philofophy, but what is either founded on experiments, or confirmed by them; fo that the new philofophy is almoft wholly experimental.

Yet there are fome, even among the learned, who fpeak of experiments in a different manner, or perhaps rather of the abufe of them, and in derifion of the pretenders to this practice. Thus, though Dr. Keil allows that philofophy has received very confiderable advantages from the makers of experiments; yet he complains of their difingenuity, in too often wrefting and diftorting their experiments and obfervations to favour fome darling theories they had efpoufed. Nay more, M. Hartfoeker, in his Recueil de plufieurs Pieces de Phyfique, undertakes to fhew, that fuch as employ themfelves in the making of experiments, are not properly philofophers, but as it were the labourers or operators of philofophers, who work under them, and for them, furnifhing them with materials to build their fyftems and hypothefes upon. And the learned M. Dacier, in the beginning of his difcourfe on Plato, at the head of his tranflation of the works of that philofopher, deals ftill more feverely with the makers of experiments. He breaks out with a kind of indignation at a tribe of idly curious people, whofe fole employment confifts in making experiments on the gravity of the air, the equilibrium of fluids, the loadftone, &c. and yet arrogate to themfelves the noble title of philofophers. But his honeft indignation would have exceeded all bounds, had he lived to fee the contemptible fall of one of the principal focieties above mentioned.

"The object of experimental philofophy," fays Dr. Prieftley, "is the knowledge of nature in general, or, more ftrictly, that of the properties of natural fubftances, and of the changes of thofe properties in different circumftances. This knowledge can only be obtained by experiment, or obfervation; as that clay is capable of becoming hard by means of fire, and thereby being made into bricks, and that by the fame means limeftone can be converted into quick-lime, and, by the addition of water and fand, make mortar. It is by obfervation alfo that we difcover that ftones and other heavy bodies fall to the ground, and that a magnet will attract iron. In other words, experimental philofophy is an inveftigation of the wifdom of God in the works and the laws of nature, fo that it is one of the greateft objects to the mind of man, and opens a field of inquiry which has no bounds; every advance we make fuggefting new doubts and fubjects of farther inquiry.

"The uniformity we difcover in the properties of natural fubftances enables us to lay down general rules, or principles, which, being invariable, we call the laws of nature; and by our knowledge of thefe laws we are able to predict, and at our own pleafure to produce, particular refults; and this is the fource of all the powers of man. It is the direction we acquire of the powers of nature; fo that, as lord Bacon obferved, knowledge is power.

"All arts and manufactures are derived from fcience. Thus the doctrine of mechanics is an application of the law of gravitation. Every thing we are capable of doing by means of the fteam-engine is derived from our knowledge of the properties of water in fteam; and all the great effects of gunpowder we owe to our knowledge of the compofition, and chemical properties, of that fubftance.

"Every new appearance in nature is preceded by fome new circumftance; and to this, or rather to fomething always attending it, we fay that the appearance is owing. This circumftance we therefore call the caufe, and the new appearance the effect of that caufe. Thus we fay that the union of phlogifton to a particular kind of earth is the caufe of its becoming a metal.

"It is one of the principal rules of philofophizing to admit no more caufes than are neceffary to account for the effects. Thus, if the power of gravity, by which heavy bodies fall to the earth, be fufficient to retain the planets in their orbits, we are authorized to reject the Cartefian vortices. In other words, we muft make no more general propofitions than are neceffary to comprehend all the particulars contained in them. Thus, after having obferved that iron confifts of a particular kind of earth united to phlogifton, and that it is foluble in acids; and that the fame is true of all other metallic fubftances, we fay, univerfally, that all metals confift of a peculiar earth and phlogifton, and that they are all foluble in fome acid.

"Of the circumftances which occafion a change in the properties of bodies, fome are the addition of what are properly called fubftances, or things that are the objects of our fenfes, being vifible, tangible, or having weight, &c. Thus the addition of an acid changes an alkali into a neutral falt. But other changes are occafioned either by a change of texture in the fubftance itfelf, or the addition of fomething that is not the object of any of our fenfes. Thus, a piece of fteel becomes a magnet by the touch of another magnet, and a drop of glafs acquires the property of flying afunder by a fmall fracture, in confequence of falling when red hot into cold water. Such alfo, in the opinion of fome, is the difference between hot and cold fubftances.

"Till the nature of the caufe be afcertained, it is convenient to make ufe of the term *principle*, as including both of the above-mentioned caufes of the change of properties in bodies. Thus, whatever be the real caufe of gravity, or of inflammability, we may fpeak of the principle of gravity, or of inflammability; whether, with Newton, we fuppofe gravity to be

occaſioned by a fluid pervading the whole univerſe, which he termed æther, and whether inflammability be cauſed by the preſence of a real ſubſtance called phlogiſton, or not. In this manner we uſe the letters x and y to denote unknown quantities in algebra.

"When changes are made in ſubſtances by the addition of other ſubſtances, they make what is called a chemical union; and in this caſe the properties of the compound cannot with any certainty be deduced from thoſe of the component parts, but muſt be aſcertained by freſh experiments. Thus, from the ſpecific gravities, or the degrees of fuſibility, of two metals, thoſe of the compound cannot be predicted. Neither water nor acid of vitriol will ſeparately diſſolve iron, ſo as to produce inflammable air, but both together will do it. However, the properties of ſimilar compounds are ſimilar to one another. Thus, all metals diſſolved in acids are precipitated by mild alkalis. This chemical union of two ſubſtances we aſcribe to a certain elective attraction, or affinity that ſubſiſts between them, in conſequence of which they unite with one another whenever a proper opportunity offers, in preference to thoſe ſubſtances to which they were before united. Thus the vitriolic acid, having a ſtronger affinity with the vegetable alkali which is the baſis of nitre, will unite with that alkali, and with it form another compound, called vitriolated tartar, while the acid of nitre, being detached from its baſe, is collected ſeparately.

"When two ſubſtances compoſe one liquid, and a third, which has a ſtronger affinity with either of the two parts than they have with each other, is added to them, it will unite with that part, and take its place in the ſolution, while the other will in many caſes be precipitated, and may be collected. Thus the earth of alum is precipitated from a ſolution of alum, by ſalt of tartar. This is the caſe of ſimple affinity.

"When both the ſubſtances are compounds, the component parts of which have a weaker affinity with each other than they have with thoſe of the other compound, two new combinations are formed, and this is called a caſe of double affinity. Thus, when phlogiſticated alkali is poured into a ſolution of green vitriol, the acid of the vitriol unites with the alkali, while the phlogiſton joining the calx of iron makes Pruſſian blue. See the article ELECTIVE ATTRACTION.

"All nature lying open to our inveſtigation, we muſt conſider the different parts in ſome order. But it is not very material which we adopt, becauſe, begin where we will, the properties of the ſubſtances we firſt treat of, will be connected with thoſe which muſt be particularly conſidered afterwards, the changes in one ſubſtance being occaſioned by its union with another. It will be impoſſible, for example, to explain the properties of metals without conſidering the acids, becauſe by their union with acids very important changes are made in their properties.

"There have been three principal methods of arranging natural ſubſtances. One is according to the three kingdoms, as they are called, into which they have been diſtributed, viz. the mineral, the vegetable, and the animal. Another is according to the elements which enter into their compoſition, and a third according to the form in which they are uſually found, viz. aërial, fluid, or ſolid. Upon the whole this laſt appears to be the moſt convenient, eſpecially as it is eaſy to intermix general obſervations concerning the other diviſions when they are particularly wanted. The following appear to be the elements which compoſe all natural ſubſtances, viz. dephlogiſticated air, or the acidifying principle; phlogiſton, or the alkaline principle; the different earths, and the principles of heat, light, and electricity. Beſides theſe, there are the following principles which have not been proved to be ſubſtances, viz. attraction, repulſion, and magnetiſm. By the help of theſe principles we are able, according to the preſent ſtate of natural knowledge, to explain all the appearances that have yet occurred to us."

§ 1. All the material ſubſtances of which the univerſe is compoſed are called *natural bodies*. What we perceive uniform and invariable in theſe ſubſtances we call their properties. Some of theſe are general and common to all matter, as extenſion; others are proper to particular ſubſtances, for inſtance fluidity; while ſome appear to be compounded of the general and particular properties, and thus belong to a ſtill ſmaller number; as the properties of air, which are derived from the general property of extenſion combined with thoſe of fluidity, elaſticity, &c.

§ 2. In taking a particular review of the properties of bodies, we naturally begin with that of *extenſion*. This manifeſts itſelf by the three dimenſions of length, breadth, and thickneſs. Hence proceeds the diviſibility of matter; which the preſent ſyſtem ſuppoſes to reach even to infinity: but though this propoſition be ſupported by mathematical demonſtrations, it is impoſſible we can either have any diſtinct idea of it, or of the oppoſite doctrine, which teaches that matter is compoſed of exceſſively minute particles called *atoms*, which cannot be divided into ſmaller ones. The ſubtilty indeed to which ſolid bodies may be reduced by mechanical means is very ſurpriſing; and in ſome caſes is ſo great, that we might be tempted to ſuppoſe that a farther diviſion is impoſſible. Thus, in grinding a ſpeculum, the inequalities of its ſurface are ſo effectually worn off, that the whole becomes in a certain degree inviſible, ſhowing not itſelf by the light which falls upon it, but the image of other bodies; but the ſmalleſt ſcratch which diſturbs the equality of the ſurface is at once diſtinctly viſible.

§ 3. From the arrangement of theſe ultimate particles of matter, whatever we ſuppoſe them to be, ariſe the various *figures* of bodies: and hence figure is a property of all bodies no leſs univerſal than extenſion, unleſs we chooſe to ſpeak of the ultimate particles of matter, which, as they are ſuppoſed to be deſtitute of parts, muſt conſequently be equally deſtitute of figure; and the ſame conſequence will follow whether we adopt this ſuppoſition or the other. The figures of bodies are ſo extremely various and diſſimilar, that it is impoſſible to find any two perfectly alike. It is indeed the next thing to impoſſible to find two in which the diſſimilarity may not be perceived by the naked eye; but if it ſhould ſeem otherwiſe, the microſcope will quickly diſcover the imbecility of our ſenſes in this reſpect. Solidity is another property eſſential to all matter. By this we mean that property which one quantity of matter has of excluding any other from the ſpace which itſelf occupies at that time. Hence ariſes what we call *reſiſtance*, which is always an indication of ſolidity; and no leſs ſo in thoſe bodies which we call *fluid* than in thoſe which are the moſt ſolid. This may at firſt ſeem to be a contradiction; but fluids yield only when they can get away from the preſſure; in all other caſes they reſiſt as violently as the moſt ſolid bodies. Thus water confined in a tube will as effectually reſiſt the impreſſion of a piſton thruſt down upon it as though it were the moſt ſolid ſubſtance. Air indeed will yield for a certain time; but this, as appears from ſeveral experiments, is entirely owing to a more ſubtile fluid, viz. that of elementary fire being preſſed out from among its particles. As long as this fluid can be forced out, either from among the particles of air, water, or any other more groſs fluid ſubſtance, the latter will be found compreſſible, as a heap of wet ſand would be by ſqueezing the water out from it: but when we come to the moſt ſubtile of all elements, ſuch as we ſuppoſe that of fire to be, there cannot be any poſſibility of compreſſing it, even though we had a veſſel ſo cloſe as to prevent it from eſcaping through its ſides; becauſe its parts are already as near each other as they can be.

§ 4. The diſtance of the parts of bodies from each other is

what we call their *porosity*, and was formerly suppofed to be owing to a vacuum interfperfed between them; but now it is generally allowed that the pores of folid bodies as well as of fluids are filled with an extremely fubtile matter which pervades all nature. The porofity of bodies with regard to one another may be thus explained. Wood, or a fponge, is porous with regard to water; but water itfelf is porous with regard to air, which it abforbs in confiderable quantity. Both air and water are porous with regard to the element of fire, which produces very confiderable changes upon them, according to the quantity of it they contain, or the manner it acts in their pores. This element itfelf, however, is not porous with regard to any other fubftance. Its pores, therefore, if it has any, muft be abfolute vacuities deftitute of any matter whatever. Vacuities of this kind indeed are fuppofed to be abfolutely neceffary to motion: for though we may fay, matter being divifible almoft *ad infinitum*, that a body or fubftance more folid may move in another fubftance that is more fubtile, and that will give way to its motion, we muft neverthelefs have recourfe to a laft refort, and admit of an ultimate vacuum, which will give room fufficient to the leaft corpufcle, that its part *A* may take the place of its part *B* without the leaft refiftance: befides, it is not to be imagined, that nature, in fact, admits of that infinite divifibility which our imagination can conceive, and that every thing which is poffible in idea, is at all times practicable. All that exifts is poffible, but all that is poffible, does not however exift. By denfity, is underftood the proportion between the extenfion and folidity of a body; one body therefore is more denfe than another, when, under the fame degree of extenfion, it contains more folid matter: and this quality arifes from condenfation and compreffion. Elafticity is nothing more than that effort by which certain bodies, when comprefled, endeavour to reftore themfelves to their former ftate; and this property fuppofes them compreffible. As all thefe natural properties of bodies are of great utility in explaining the principles of phyfics and in applying them to all the arts, experimental philofophy proves their reality by a thoufand examples.

§ 5. We difcover ftill other properties in bodies; fuch as *mobility*, which we muft not here confound with motion. This mobility arifes from certain difpofitions which are not in an equal degree in all bodies: from whence it comes that fome are more eafily moved than others: and this proceeds from the refiftance to motion which is perceived in all bodies, having regard merely to their maffes; and this refiftance is called *vis inertiæ*, or *inert force*. A body is faid to be in motion when it is actually moving from one place to another; or, whenever a body changes its fituation with regard to the objects that furround it, either nearly or remotely, it is faid to be in motion. There are three principal matters to be confidered in a moving body; its direction, its velocity, and the quantity of its motion: and here phyfics explain the force or moving power; it likewife diftinguifhes between fimple and compound motion. Simple motion is that which arifes from only one force, or which tends to only one point. It defcribes the laws, and explains the refiftance of mediums; the refiftance of friction; the difficulties of a perpetual motion; the alteration of direction occafioned by the oppofition of a fluid matter; reflected or reverberated motion; the communication of motion by the fhock of bodies, &c. Compound motion is that of a body impelled to move by feveral caufes or powers which act according to their different directions. Phyfics here likewife inveftigates the laws of motion; and is particularly applied to the explaining, under this head, what are called the *central forces*, which produce a motion that is either circular or in a curve line, and which inceffantly urge the moving body either to approach or recede from the centre. To diftinguifh thefe from each other, the former is called the *centripetal force*, and the latter the *centrifugal force*.

§ 6. The powers of *attraction* and *repulfion* feem to be common to all matter, and the component parts of all fubftances are kept in their places by the due balance of thofe oppofite powers. If, by any means, the particles of any fubftance be removed beyond their fphere of mutual attraction, they repel one another, as thofe of water when it becomes fteam. Of the different kinds of attraction, that of *gravitation* feems to extend to the greateft poffible diftance; but that which keeps together the parts of the fame fubftance, thence called the *attraction of cohefion*, and the different kinds of chemical attractions, called *affinities*, only act at a fmall diftance. Of the caufes of thefe attractions we are entirely ignorant. See the article ATTRACTION.

§ 7. By *gravity*, or ponderofity, is to be underftood that force which occafions bodies to pafs from a higher to a lower place, when nothing oppofes their courfe, or when the obftacles are not fufficient to ftop them. Speculative philofophy inveftigates its caufe, and perhaps in vain. Experimental philofophy contents itfelf with defcribing the phenomena, and teaching the laws of gravity, which are thoroughly eftablifhed by a thoufand reiterated experiments. In order properly to underftand this fubject, we muft take care not to confound the term *gravity* with that of *weight*. By the former, we underftand that force which urges bodies to defcend through a certain fpace in a given time. By the latter, is meant the quantity of a heavy body that is contained under the fame bulk. The phenomena are explained by the experiments themfelves, and by inferences deduced from them.

§ 8. *Hydroftatics* is a fcience of which the object is the gravity and equilibrium of fluids in particular. Though the gravity of thefe bodies is the fame with that of others, and is fubject to the fame laws, yet their ftate of fluidity gives rife to particular phenomena, which it is of confequence to know But as hydroftatics cannot be fuccefsfully treated on without the affiftance of calculation, it has been ranked among the mathematical fciences.

§ 9. We fay the fame with regard to *mechanics*; which is the art of employing, by the aid of machines, the motion of bodies, in conformity to its properties and laws, as well with regard to folids as fluids, either more commodioufly or more advantageoufly.

§ 10. After it has made the moft accurate experiments, and the moft judicious obfervations, on all thefe different fubjects, and the properties of bodies in particular, experimental philofophy paffes to the examination of the air, the water, fire, the wind, colours, &c. The *air* is a fluid with which we are furrounded from the inftant of our birth, and without which we cannot exift. It is by the properties and the influences of the air, that nature gives increafe and perfection to all that it produces for our wants and conveniencies; it is the fpirit of navigation: found, voice, fpeech itfelf, are nothing more than percuffions of the air: this globe that we inhabit is completely furrounded by air; and this kind of coverture, which is commonly called the *atmofphere*, has fuch remarkable functions, that it evidently appears to concur to the mechanifm of nature. Experimental phyfics, therefore, confiders the air, 1. of itfelf, independent of its bulk, and the figure of its whole body: it examines its effential properties; as its gravity, denfity, fpring, &c. The air pump is here of indifpenfable ufe; and by this machine phyfics examines in what manner fpace, or a vacuum, is made. It likewife fhows the neceffity of air to the prefervation of animal life; the effect it has on found, fire, and gunpowder, *in vacuo*; and a hundred other experiments of various degrees of curiofity. 2. It confiders the air as the terreftrial atmofphere,

ſometimes as a fluid at reſt, and ſometimes as in motion. And by theſe means it accounts for the variation of the mercury in the barometer, and why it ſinks in proportion as the height of the atmoſphere diminiſhes; as alſo for the figure, the extent, and weight of the atmoſphere: it ſhows the method of determining the height of mountains, the nature of ſound in general, of its propagation, and of ſonorous bodies. The late diſcoveries of Dr. Prieſtley and others have added a new and very conſiderable branch to experimental philoſophy in this reſpect, of which an account is given under the article AEROLOGY.

§ 11. It is here alſo, that experimental philoſophy conſiders the nature of the *wind*; which is nothing more than agitated air, a portion of the atmoſphere that moves like a current, with a certain velocity and determinate direction. This fluid, with regard to its direction, takes different names according to the different points of the horizon from whence it comes, as eaſt, weſt, north, and ſouth. Winds are likewiſe diſtinguiſhed into three ſorts; one of which is called *general* or *conſtant*, as the trade-winds which continually blow between the tropics: another is the *periodical*, which always begin and end within a certain time of the year, or a certain hour of the day, as the monſoons, the land-breezes and ſea-breezes, which ariſe conſtantly in the morning and evening; and laſtly, ſuch as are *variable*, as well with regard to their direction as their velocity and duration.

According to M. Mariotte, the velocity of the moſt impetuous wind is at the rate of 32 feet in a ſecond, but Mr. Derham makes it 66 feet in the ſame time. The firſt, doubtleſs, meant the wind of the greateſt velocity that had then come to his knowledge. The invention of aeroſtatic machines has tended more to ſhow the real velocity of the wind than any other invention as yet made public: but all of them move ſlower than the aerial current; ſo that the real velocity of the wind remains yet undetermined.

The force of the wind, like that of other bodies, depends on its velocity and maſs; that is, the quantity of air which is in motion: ſo the ſame wind has more or leſs force on any obſtacle that oppoſes it, in proportion as that obſtacle preſents a greater or a leſs ſurface: for which reaſon it is that they ſpread the ſails of a veſſel more or leſs, and place the wings of a wind-mill in different directions. The machines by which the winds are meaſured, are called *anemometers*. They ſhow the direction, the velocity, and the duration of winds. It is by the agitations of the wind that the air is purified; that the ſeeds of trees and herbs are conveyed through the foreſts and fields; that ſhips are driven from one pole to the other; that our mills turn upon their axis, &c.; and art, by imitating nature, ſometimes procures us artificial winds, by which we refreſh our bodies, invigorate our fires, purify our corn, &c.

§ 12. *Water* is an univerſal agent, which nature employs in all her productions. It may be conſidered as in three ſtates, 1. as a liquid; 2. as a vapour; 3. as ice. Theſe three different ſtates do not in any manner change its eſſence, but make it proper to anſwer different ends. The natural ſtate of water would be that of a ſolid body, as fat, wax, and all thoſe other bodies which are only fluid when heated to a certain degree: for water would be conſtantly ice, if the particles of fire, by which it is penetrated in the temperate climates, did not render it fluid by producing a reciprocal motion among its parts; and, in a country where the cold is continually ſtrong enough to maintain the congelation, the aſſiſtance of art is neceſſary to make it fluid in the ſame manner as we do lead, &c. Water, when not in ice, is a fluid that is inſipid, tranſparent, without colour, and without ſmell, and that eaſily adheres to the ſurface of ſome bodies, that penetrates many, and extinguiſhes fire. Experimental philoſophy inveſtigates the origin of fountains; the cauſe of the ſaltneſs of the ſea; the means of purifying water; what is its weight, and what are its effects when heated, &c. It likewiſe examines this fluid in the ſtate of vapour; and finds that a drop of water, when in vapour, occupies a ſpace vaſtly greater than it did before. It explains the *æolipile* and its effects; fire engines; and the force of vapours that give motion to immenſe machines in mines and elſewhere, &c. and laſtly, it conſiders water in the ſtate of ice. Ice conſequently is more cold than water; and its coldneſs increaſes if it continue to loſe that matter, already too rare, or too little active, to render it fluid. Experimental phyſics endeavours to inveſtigate the cauſes of the congelation of water, and why ice is lighter than water; from whence it derives that expanſive force by which it breaks the containing veſſel; the difference there is between the congelation of rivers and that of ſtanding waters; why ice becomes more cold by the mixture of ſalts; and many other ſimilar phenomena.

§ 13. The nature of *fire* is yet very much unknown to the moſt learned philoſophers. As objects when at a great diſtance are not perceptible to our ſenſes, ſo when we examine them too nearly, we diſcern them but confuſedly. It is ſtill diſputed whether fire be a homogene, unalterable matter, deſigned, by its preſence, or by its action, to produce heat, inflammation, and diſſolution, in bodies; or if its eſſence conſiſts in motion only, or in the fermentation of thoſe particles which we call *inflammable*, and which enter as principles, in greater or leſs quantities, in the compoſition of mixed bodies. The moſt learned inquirers into nature incline to the former opinion; and to have recourſe to a matter which they regard as the principle of fire. They ſuppoſe that there is in nature a fluid adapted to this purpoſe, created ſuch from the beginning, and that nothing more is neceſſary than to put it in action. The numberleſs experiments which are daily made in electricity ſeem to favour this opinion, and to prove that this matter, this fluid, this elementary fire, is diffuſed through all nature, and in all bodies, even ice itſelf. We cannot ſay to what important knowledge this great diſcovery of electricity may lead if we continue our inquiries concerning it. It appears, however, that we may believe, without any inconvenience or abſurdity, that fire and light, conſidered in their firſt principle, are one and the ſame ſubſtance differently modified.

Be this matter however as it may, experimental philoſophy is employed in making the moſt ingenious and moſt uſeful reſearches concerning the nature of fire, its propagation, and the means by which its power may be excited or augmented; concerning the phoſphorus and its inflammation; fire excited by the reflection of the ſun's rays from a mirror; and on the effects of fire in general; concerning lightning and its effects; the fuſion of metals; gunpowder and its exploſion; flame and the aliments of fire; and an infinity of like objects which it explains, or concerning which it makes new diſcoveries, by the aid of experiments.

§ 14. By the word *light*, we underſtand that agent by which nature affects the eye with that lively and almoſt conſtantly pleaſing ſenſation, which we call *ſeeing*, and by which we diſcern the ſize, figure, colour, and ſituation of objects, when at a convenient diſtance. All philoſophers agree, that the light which is diffuſed in any place is a real body. But what this body is, and by what means it enters that place where it is perceived, is a queſtion about which philoſophers are divided. Experimental philoſophy therefore is applied in diſcovering or proving, by an infinity of experiments, what is the nature of light, in what manner it is propagated, what its velocity and progreſſive motion. It alſo inveſtigates and explains the principles of *optics* properly ſo called, and ſhows the directions which light obſerves in its motions. From thence it proceeds to

examine the principles of catoptrics, and defcribes the laws and effects of reflected light. It next treats of the principles of dioptrics, and explains the laws of refracted light; and laftly, it teaches, from the principles of natural and artificial vifion, the conftruction of optical inftruments, as lenfes, concave mirrors, prifms, telefcopes, &c. &c. and the ufes to which they are applied.

§ 15. By refolving or feparating the rays of light, philofophy has obtained true and clear difcoveries of the nature of *colours*. We are naturally led to imagine that colours, and their different degrees, make a part of the bodies that prefent them to our fight; that white is inherent in fnow, green in leaves and grafs, and red in a ftuff dyed of that colour. But this is far from being true. If an object, which prefents any colour to our fight, be not illuminated, it prefents no colour whatfoever. In the night all is black. Colours therefore depend on light; for without that we could form no idea of them: but they depend alfo on bodies; for of feveral objects prefented to the fame light, fome appear white, others red, blue, &c. But all thefe matters being feparate from our own bodies, we fhould never acquire any ideas of them, if the light, tranfmitted or reflected by thefe objects, did not make them fenfible to us, by ftriking upon the organs of our fight, and if thefe impreffions did not revive in us thofe ideas which we have been ufed to exprefs by certain terms. For thefe reafons philofophy confiders colours from three points of view, 1. as in the light; 2. in bodies, as being coloured; and, 3. from the relation they have to our vifual faculties, which they particularly affect, and by which we are enabled to diftinguifh them.

It is unneceffary in this place to fay more either on colour in particular or experimental philofophy in general. The different fubjects of this collective article are particularly treated under their proper heads: the reader will therefore turn, as he has occafion, to ACOUSTICS, CATOPTRICS, CHROMATICS, DIOPTRICS, HYDROSTATICS, MECHANICS, OPTICS, PNEUMATICS, ELECTRICITY, MAGNETISM, &c. &c. &c. Alfo AEROLOGY, AEROSTATION, ATMOSPHERE, BURNING *Glafs*, COLD, COLOUR, FREEZING, EVAPORATION, FIRE, FLUIDITY, HEAT, IGNITION, LIGHT, SOUND, STEAM, WATER, WIND, &c.

EXPERIMENTUM CRUCIS, a capital, leading, or decifive experiment; thus termed, either on account of its being like a crofs, or direction-poft placed in the meeting of feveral roads, guiding men to the true knowledge of the nature of that thing they are inquiring after; or, on account of its being a kind of torture, whereby the nature of the thing is as it were extorted by force.

EXPHORESIS. See ORATORY.

EXPIATION, a religious act, by which fatisfaction or atonement is made for the commiffion of fome crime, the guilt done away, and the obligation to punifhment cancelled. Expiations among the Heathens were of feveral kinds; as facrifices and religious wafhings. They were ufed for effacing a crime, averting any calamity, and on numberlefs other occafions, as purifying towns, temples, and facred places, and armies before and after battle. And they were performed for whole cities as well as particular perfons. The method of expiation among the Jews was chiefly by facrifice, whether for fins of ignorance, or to purify themfelves from certain pollutions.

Feaft of EXPIATION among the Jews, called by our tranflators the *day of atonement*, was held on the tenth day of Tifri, or the feventh month of the Jewifh year, anfwering to part of our September and October. It was inftituted by God himfelf, Levit. xxiii. 27, &c. On that day the high-prieft, the figure or type of Jefus Chrift, entered into the moft holy place, and confeffed his fins; and, after feveral ceremonies, made an atonement for all the people to wafh them from their fins. Lev. chap. xvi.

EXPIATION, in a figurative fenfe, is applied by divines to the pardon procured to the fins of the penitent, by the merit of Chrift's death. See the article CHRISTIANITY.

EXPIRATION, in medicine. See EXSPIRATION.

EXPIRATION is alfo ufed, figuratively, for the end of a term or time granted, agreed on, or adjudged.

EXPLICIT, in the fchools, fomething clear, diftinct, formal, and unfolded.

EXPLOSION, in natural philofophy, a fudden and violent expanfion of an aërial or other elaftic fluid, by which it inftantly throws off any obftacle that happens to be in the way, fometimes with incredible force, and in fuch a manner as to produce the moft aftonifhing effects upon the neighbouring objects. Explofion differs from *expanfion*, in that the latter is a gradual and continued power, acting uniformly for fome time; whereas the former is always fudden, and only of momentary duration. The expanfions of folid fubftances do not terminate in violent explofions, on account of their flownefs, and the fmall fpace through which the metal, or other expanding fubftance, moves; though their ftrength may be equally great with that of the moft active aërial fluids. Thus we find, that though wedges of wood, when wetted, will cleave folid blocks of ftone, they never throw them to any diftance, as is the cafe with gun-powder. On the other hand, it is feldom that the expanfion of any elaftic fluid burfts a folid fubftance, without throwing the fragments of it to a confiderable diftance, the effects of which are often very terrible. The reafons of this may be comprifed in the two following particulars: 1. the immenfe velocity with which the aërial fluids expand, when affected by a confiderable degree of heat; and, 2. their celerity in acquiring heat and being affected by it, which is much fuperior to that of folid fubftances. Thus air, heated as much as iron when brought to a white heat, is expanded to four times its bulk; but the metal itfelf will not be expanded the 500th part of that fpace. In the cafe of gun-powder, which is a violent and well-known explofive fubftance, the velocity with which the flame moves is calculated by Mr. Robins, in his Treatife upon Gunnery, to be no lefs than 7000 feet in a fecond, or little lefs than 79 miles per minute. Hence the impulfe of the fluid is inconceivably great, and the obftacles on which it ftrikes are hurried off with vaft velocity, though much lefs than that juft mentioned; for a cannon ball, with the greateft charge of powder that can be conveniently given, does not move at a greater rate than 2400 feet per fecond, or little more than 27 miles per minute. The velocity of the ball again is promoted by the fudden propagation of the heat through the whole body of air, as foon as it is extricated from the materials of which the gunpowder is made; fo that it is enabled to ftrike all at once, and thus greatly to augment the momentum of the ball. It is evident that this contributes very much to the force of the explofion, by what happens when powder is wetted or mixed with any fubftance, which prevents it from taking fire all at once. In this cafe the force of the explofion, even when the fame quantity of powder is made ufe of, is not to be compared to that of dry powder.

We may conclude, upon thefe principles, that the force of an explofion depends, 1. on the quantity of elaftic fluid to be expanded; 2. on the velocity it acquires by a certain degree of heat; and, 3. on the celerity with which the degree of heat affects the whole of the expanfile fluid. Thefe three take place

in the greateſt perfection where the electric fluid is concerned; as in caſes of lightning, earthquakes, and volcanoes. This fluid, as is ſhown in many parts of this work, differs not from elementary fire or the light of the ſun; it pervades the whole ſyſtem of nature; its expanſion is nothing elſe than its motion from a centre towards a circumference, for it does not ſeem capable of any proper expanſion by a ſeparation of its parts like any other fluid. Hence, when it begins to expand in this manner, the motion is propagated through it, with a velocity far exceeding that of any other fluid whatever. Thus, even when the quantity is exceſſively ſmall, as when an electric ſpark is ſent through a glaſs full of water or of oil, the expanſion is ſo violent as to diſſipate the glaſs into innumerable fragments with great danger to the by-ſtanders. See farther under the article Electricity. In violent lightning, when the electric fluid collects itſelf into balls, the ſtrength of the exploſion is proportionable to the quantity. Every one has heard of the prodigious effects of lightning when it happens to ſtrike buildings, trees, or even the moſt ſolid rocks; and in ſome caſes, where the quantity of electricity is ſtill greater than in any flaſh of lightning, we hear of ſtill more tremendous conſequences enſuing. Dr. Prieſtley gives an inſtance of a large fire-ball (undoubtedly a quantity of electric matter) rolling on the ſurface of the ſea, which after riſing up to the top-maſt of a ſhip of war, burſt with ſuch violence, that the exploſion reſembled the diſcharge of hundreds of cannon fired at once. Great damage was done by it; but there is not the leaſt doubt that moſt of its force was ſpent on the air, or carried down to the ſea by the maſt and iron-work of the ſhip. Indeed, conſidering that in all caſes a great part of the force of electric exploſions is diſſipated in this manner, it may juſtly be doubted whether they can be meaſured by any method applicable to the menſuration of other forces. Even in artificial electricity the force is prodigiouſly great; inſomuch that Dr. Van Marum calculated that of the great battery belonging to the machine in Teyler's muſeum to be upwards of 900 pounds.

Whenever the electrical fluid acts like common fire, the force of the exploſions, though exceedingly great, is capable of menſuration by comparing the diſtances to which the bodies are thrown with their weight. This is moſt evident in volcanoes, where the projections of the burning rocks and lava manifeſt the greatneſs of the power, at the ſame time that they afford a method of meaſuring it. Theſe exploſions, as is ſhown under the article Volcano, are owing to extrication of aerial vapours, and their refraction by intenſe heat. In all of them the air is originally in a ſtate of decompoſition, viz. its inviſible and ſolid part is joined with ſome terreſtrial ſubſtance. Thus, when fixed air, for inſtance, is expoſed to any pure earth which attracts it, as calcined magneſia, a decompoſition inſtantly takes place. All theſe vapours are compoſed of elementary fire and ſome inviſible ſubſtance capable of aſſuming a ſolid form. The decompoſition juſt mentioned is therefore eaſily explained; the ſolid part of the air joins itſelf to the magneſia, while the elementary fire or latent heat is diſſipated, and paſſes through the ſides of the veſſel. Were it now in our power ſuddenly to reſtore the latent heat to the whole of the fixed air, ſo that it would at once aſſume its former expanſion, a violent exploſion would follow. This ſeems to be preciſely the caſe with the volcanic exploſions. An immenſe quantity of the fixed part of different aerial fluids is united to the various ſubſtances found below the ſurface of the earth. By means of the electric fire which kindles the volcanoes, the aerial fluids are ſuddenly reſtored to their elaſtic ſtate; and not only ſo, but their natural elaſticity is greatly augmented, ſo that the exploſions take place with great violence. The caſe is the ſame with gunpowder; only that the condenſed air in this caſe is at firſt of the dephlogiſticated kind, but is quickly phlogiſticated by reaſon of the combuſtible matters mixed with the nitre, while the heat produced by the inflammation augments the elaſticity of the generated air to four times what it uſually is, ſo that the whole force of the exploſion is calculated at 1000 times the preſſure of the common atmoſphere. Thus the exploſions of gunpowder and of volcanoes are eſſentially the ſame. The reaſon of the extreme quickneſs of thoſe of gunpowder is, that it takes fire ſo readily by the intimate mixture and combuſtibility of all the materials. In volcanoes the exploſions likewiſe follow one another very quickly, and are by no means inferior in ſtrength to thoſe of gunpowder: but here the quantity of vapour makes up for the comparative ſlowneſs with which it is affected by the heat. Thus, though we could not by any means contrive to fire cannon in quick ſucceſſion by means of calcareous earth as we can do with gunpowder, yet in the huge furnace of a volcano the elaſtic matter is ſupplied in ſuch quantities, that the exploſions are in a manner unremitting; and even in ordinary experiments the confinement of aerial vapours has often occaſioned violent exploſions in chemical veſſels. In one caſe too the extrication of fixed air adds exceſſively to the force of an exploſion, viz. in that of pulvis fulminans. This is compounded of ſulphur, ſaltpetre, and ſalt of tartar. The latter we know contains much fixed air: and it is probable that the violence of the exploſion is occaſioned by this air; for the greater quantity of it that the alkaline ſalt contains, the greater force does it explode with. Fulminating gold emits a quantity of phlogiſticated air, to which its exploſive power is ſuppoſed to be owing, as is explained under the article Chemistry; but that of fulminating ſilver is ſo extraordinary, that ſcarce any force of aerial vapour that can be extricated is likely to produce it, and it ſeems probable that electricity itſelf has ſome ſhare in the exploſion.

Next in ſtrength to the aerial vapours are thoſe of aqueous and other liquids. The moſt remarkable effects of theſe are obſerved in ſteam-engines; but there is one particular caſe from which it has been inferred that aqueous ſteam is vaſtly ſtronger than the flame of gunpowder. This is when water is thrown upon melted copper: for here the exploſion is ſo ſtrong as almoſt to exceed imagination; and the moſt terrible accidents have been known to happen from ſuch a ſlight cauſe as one of the workmen ſpitting in the furnace where copper was melting. Here, however, it is moſt probable that a decompoſition of the water takes place. That this element can be decompoſed or reſolved into an aerial and a ſolid ſubſtance, is extremely probable from the experiments of Dr. Prieſtley, as well as thoſe of the French philoſophers. The poſition is indeed denied by the phlogiſtians; but their arguments appear not to be concluſive; nor is it a fact which militates in the leaſt againſt their principles. On the ſuppoſition that the water is decompoſed in the preſent caſe, however, the phenomenon in queſtion is eaſily ſolved. The water being thrown in ſubſtance upon the melted copper, is decompoſed by the violent heat; and one part of it adheres to the metal, thus converting it into a kind of calx, while the other is converted into inflammable or ſome other kind of air, which expanding ſuddenly, throws the melted metal all about with the greateſt violence by means of its re-action.

In order to underſtand the manner in which this is accompliſhed, we muſt conſider ſome of the principles of Gunnery laid down by Mr. Robins, and related under that article. One of theſe is, that though the air, in caſes of ordinary velocity, makes no great reſiſtance, it is far otherwiſe where the velocity of the moving body becomes very great. In all caſes of exploſion alſo there is in the firſt inſtance a vacuum made by the exploding fluid; and conſequently the weight of the atmoſphere is to be overcome, which amounts to about 15 pounds on every ſquare inch of ſurface. Suppoſing the ſurface of the exploding fluid, then, on that of melted copper to contain an area of 4

ſquare inches, it meets with a reſiſtance of 60 pounds from the atmoſphere, and conſequently communicates an equal preſſure to the fluid metal. Even this muſt of conſequence throw it about, unleſs the ſame preſſure was exactly diffuſed over every part of the ſurface. But much more muſt this effect be increaſed by the immenſe velocity with which the fluid moves, and by which the reſiſtance of the atmoſphere is augmented in a prodigious degree, as is explained under the article Gunnery. The elaſtic fluid generated is then confined not only by the fluid metal and ſides of the furnace, but by the air itſelf, which cannot get out of the way; ſo that the whole reſembles a cannon cloſed at the mouth, and filled with inflamed gunpowder. Hence not only the melted metal, but the furnace itſelf and the adjacent walls of the building, are hurried off as they would be by the firing of a great quantity of gunpowder in a ſmall ſpace, and which is well known to produce analogous effects.

Dr. Black in explaining the phenomenon in queſtion, ſuppoſes that the mere heat of the metal applied to the aqueous ſteam produces the exploſion; and in proof of this alleges, that copper imbibes a greater quantity of heat during fuſion than any other metal. Aqueous ſteam, however, ſeems to be too ſlow for producing ſuch ſudden and violent effects. Exploſions, it is true, will be occaſioned by it, but then it muſt be confined for a very conſiderable time; whereas the effects of water thrown upon melted copper are inſtantaneous.

It may now be aſked, Why ſuch exploſions do not take place with any other metal, iron for inſtance, when water is thrown upon its ſurface in fuſion? In anſwer to this we muſt obſerve, That though water is decompoſed by being applied to red-hot iron in the form of ſteam, yet there is a poſſibility, that when the ſame element is applied in ſubſtance to the fluid metal, no decompoſition may enſue. Something like this indeed happens with copper itſelf; for, notwithſtanding the violent effects which take place on the contact of water in ſubſtance with the melted metal, no exploſion happens though aqueous ſteam be blown upon its ſurface. On the contrary, the upper part of the metal is thus cooled, and forms itſelf into cakes, which are afterwards taken off, and new ones formed in the ſame manner; neither does aqueous ſteam affect red-hot copper in the manner that it does iron in the ſame ſtate. A deciſive proof that the exploſion is not occaſioned by the mere heat of the aqueous ſteam may be deduced from the example of melted glaſs, which produces no exploſion though we pour water upon it in that ſtate; and yet the heat of melted glaſs is undoubtedly equal at leaſt to that of melted copper. It muſt be obſerved, however, that in all caſes where a very hot body is thrown upon a ſmall quantity of water in ſubſtance, an exploſion will follow; but here the water is confined and ſuddenly rarefied into ſteam, which cannot get away without throwing off the body which confines it. Examples of this kind frequently occur where maſons or other mechanics are employed in faſtening cramps of iron into ſtones; where, if there happens to be a little water in the hole into which the lead is poured, the latter will fly out in ſuch a manner as ſometimes to burn them ſeverely. Terrible accidents of this kind have ſometimes happened in foundries, when large quantities of melted metal have been poured into wet moulds. In theſe caſes, the ſudden expanſion of the aqueous ſteam has thrown out the metal with violence; and if any decompoſition has taken place at the ſame time, ſo as to convert the aqueous into an aerial vapour, the exploſion muſt be ſtill greater.

To this laſt kind of exploſion we muſt refer that which takes place on pouring cold water into boiling or burning oil or tallow. Here the caſe is much the ſame whether we pour the oil on the water, or the water on the oil. In the former caſe, the water which lies at the bottom is rarefied into ſteam and explodes; in the latter, it ſinks down through the oil by its ſuperior ſpecific gravity, and explodes as it paſſes along. In either caſe, however, the quantity of aqueous fluid muſt be but ſmall in proportion to that of the oil: a very great quantity would put out the flame, or deſtroy the heat, in whatever way we applied it.

Another kind of exploſion is that which takes place in ſolid ſubſtances, where we can ſcarce ſuppoſe either aqueous or aerial vapours to be concerned. The moſt remarkable of theſe are the *volcanic bombs* mentioned by Sir William Hamilton in the great eruption of Veſuvius in 1779. They were large pieces of lava which burſt in pieces like bombs as they fell to the ground; but he does not inform us whether their burſting was attended with any great violence or not. Indeed, amidſt ſuch ſcenes of horror, and the continual tremendous exploſions of the volcano, ſmaller phenomena of this kind would probably be overlooked. Other examples are the Glass *Tears*, of which an account is given under that article; the burſting of electrical globes, when put in motion; of other glaſs-veſſels ſpontaneouſly, and ſeemingly without any cauſe; and laſtly, the burſting of large caſt-metal veſſels in the act of cooling. Theſe are all ſo ſimilar to one another, that it is probable they depend on one general cauſe. All of them agree in this reſpect, that the extreme parts of them are conſiderably cooled, while the internal remain very hot. Thus, in the volcanic bombs, the current of air, formed by their ſwift paſſage through it in falling, neceſſarily carries off a great quantity of heat from the parts which are in contact with it, while the reſt are ſcarce at all cooled. The glaſs-tears are artificially cooled on the outſide by dropping them upon water; and in conſequence of this, their exploſion is probably more violent in proportion to their bulk than that of the volcanic bombs. Glaſs-veſſels only burſt ſpontaneouſly when they have not been well annealed; and we know that this bad annealing conſiſts only in applying cold too ſuddenly to the outſide. Something like this probably takes place when caſt-iron veſſels explode; and we are certain it does ſo with electrical globes, for theſe laſt are not apt to burſt if they have been well annealed. In all caſes, therefore, there is a remarkable contraction of the outward ſurface by the cold, while the internal parts remain as much expanded as ever. In this caſe there muſt be a continual effort of that ſubtile fluid called *elementary fire*, from the internal to the external part, as the contraction gradually proceeds the contrary way. Thus, when a volcanic bomb, for inſtance, is cooled on the outſide, its parts are conſolidated ſo that the internal fluid has not ſuch an eaſy paſſage through it as is neceſſary. In conſequence of this it makes a greater effort, which is ſtill farther augmented by the cooling and contraction of the internal parts ſqueezing the fluid out from among themſelves, and forcing it to recoil upon that in the centre, as well as to exert itſelf againſt the external part; from which united operation the effect already mentioned at laſt takes place. This explanation, however, does not hold with reſpect to electrical globes, glaſs-tears, or ill-annealed glaſs: but in order to accommodate it to all theſe, we have only to remember, that *fire*, and the electric fluid acting from a centre to a circumference, are not in the leaſt different; ſo that from whatever cauſe the electric matter is diſpoſed to act in this manner, the ſame effect will follow, *i. e.* an exploſion will take place if the ſubſtance does not afford an equally ready paſſage through all its parts, and that whether any ſenſible heat is felt in it or not.

The only other kind of exploſion we have to take notice of, is that produced by inflammable and dephlogiſticated air, when mixed together and ſet on fire. This differs from any of thoſe hitherto conſidered, becauſe in reality there is an abſolute condenſation rather than an expanſion throughout the whole of the

operation; and could the airs be made to take fire throughout their whole ſubſtance abſolutely at the ſame inſtant, there would be no exploſion, but only a ſudden production of heat. From this cauſe alſo is derived a very ſingular phenomenon taken notice of by Dr. Prieſtley in his late experiments on that ſubject, recorded in the Phil. Tranſ. Having incloſed ſeveral quantities of inflammable and dephlogiſticated air in a copper veſſel, firing them afterwards by the electric ſparks, he found that the force of the exploſion was directed more towards one part of the veſſel than another; leaſt on that part where the electrical diſcharge was made, and moſt upon that which was fartheſt from it. This inequality was very conſiderable; inſomuch that he could not repeat his experiments any number of times without injuring the veſſel in that part which was fartheſt from the diſcharge. The reaſon he gives for this is, that the mixture was not fired at the ſame inſtant, but firſt at the place where the diſcharge was made. This firſt exploſion would have acted equally upon all parts of the veſſel, had it not been for the intervention of the air. By the firſt momentary exploſion, however, the air in the fartheſt part of the veſſel was condenſed, ſo that the next exploſion was made ſtronger, while the copper in the forepart of the veſſel had the whole of this ſtrong exploſion to reſiſt, the hinder part being but little concerned, as the air in it was condenſed and reduced almoſt to a vacuum.

Though the phenomena of exploſions are ſometimes very deſtructive, they are likewiſe of conſiderable uſe in life, by removing obſtacles which could ſcarcely be got the better of by any mechanical power whatever. The principal of theſe are the blowing up of rocks, the ſeparating of ſtones in quarries, and other purpoſes of that kind. The deſtruction occaſioned by them in times of war, and the machines formed upon the principle of exploſion for the deſtruction of the human race, are well known; and if we cannot call theſe *uſeful*, ſome take them at leaſt to be neceſſary evils. For the production of exploſions, gunpowder is the only ſubſtance that has yet been found to anſwer; nevertheleſs, as its uſe is attended with conſiderable expence, ſeveral attempts have been made to find out a cheap ſubſtitute for it. One of the moſt remarkable of theſe was by mixing ſmall quantities of water incloſed in little bladders or ſome eaſily deſtructible vehicles along with a charge of powder. By this contrivance it was hoped that the water, being converted into vapour when the powder was inflamed, would augment the force of the exploſion: but inſtead of this, it was found greatly to diminiſh it. The reaſon was evident, viz. that the converſion of the water into ſteam required ſo much of the latent heat of the inflamed gunpowder, that enough was not left to give the neceſſary expanſion to the aerial fluid produced. A mixture of inflammable and dephlogiſticated air has alſo been tried; but the exploſion here has always been found too weak. In mines, indeed, very terrible effects are produced by ſuch a mixture, but in theſe the quantity is immenſe; ſo that the comparative weakneſs of the mixture cannot be diſcovered. Electricity therefore ſeems to be the only reſource we have; except by adding ingredients to gunpowder which may increaſe the ſtrength of it. There can be no doubt indeed that the electric fluid is poſſeſſed of ſufficient ſtrength to perform every thing we could deſire; and electricians have ſuppoſed, perhaps juſtly enough, that a cannon charged with water might, by means of electricity, become more dangerous than one charged with gunpowder: but this fluid is ſo exceedingly capricious, ſo imperceptible and unmanageable, that the uſe of it cannot as yet be thought practicable, nor in all probability ever will be ſo.

The effects of exploſions, when violent, are felt at a conſiderable diſtance, by reaſon of the concuſſions they give to the atmoſphere; for, as it has been already hinted, all of them act upon the atmoſpherical fluid with the very ſame force they exert upon terreſtrial ſubſtances ſubjected to their action. Sir William Hamilton relates, that at the exploſions of Veſuvius in 1767, the doors and windows of the houſes at Naples flew open if unbolted, and one door was burſt open though it had been locked. A great quantity of gunpowder being put into the ditch of a fortified city, and ſet on fire, deſtroyed part of the wall, and broke down one of the gates. The blowing up of powder-magazines or powder-mills will deſtroy buildings and kill people, though certainly without the reach of the flame, and untouched by any part of the ſhattered magazine or mill. But the moſt curious effect is, that they electrify the air and even glaſs-windows at a conſiderable diſtance. This is always obſervable in firing the guns of the Tower at London: and ſome years ago, after an exploſion of ſome powder-mills in the neighbourhood of that city, a great number of people were alarmed by a rattling and breaking of their china-ware; which by the vulgar was taken for a ſupernatural phenomenon, but undoubtedly was owing to ſome commotion in the electrical fluid from the violent concuſſion of the atmoſphere. In this reſpect, however, the effects of electrical exploſions themſelves are moſt remarkable, though not in the uncommon way juſt mentioned; but it is certain, that the influence of a flaſh of lightning is diffuſed for a great way round the place where the exploſion happens, producing many very perceptible changes both on the animal and vegetable creation.

EXPONENT *of a Power*, in arithmetic and algebra, denotes the number or quantity expreſſing the degree or elevation of the power, or which ſhows how often a given power is to be divided by its root before it be brought down to unity or 1. Thus, the exponent or index of a ſquare number, or the 2d power, is 2; of a cube 3; and ſo on; the ſquare being a power of the 2d degree; the cube, of a 3d, &c. It is otherwiſe called the index.

Exponents, as now uſed, are rather of a modern invention. Diophantus, with the Arabian and the firſt European authors, denoted the powers of quantities by ſubjoining an abbreviation of the name of the power; though with ſome variation, and difference from one another. The names of the powers, and the marks for denoting them, according to Diophantus, are as follow: viz.

Names,	*μονας*,	*αριθμος*,	*δυναμις*,	*κυβος*,	*δυναμοδυναμις*,	
Marks,	μ^{o},	ς,	δ^{υ},	κ^{υ},	$\delta^{\upsilon}\delta^{\upsilon}$,	
			δυναμοκυβος,	*κυβοκυβος*,	&c. ;	
			$\delta^{\upsilon}\kappa^{\upsilon}$	$\kappa^{\upsilon}\kappa^{\upsilon}$		

which we denote by

$$1,\ a,\ a^2,\ a^3,\ a^4,\ a^5,\ a^6,\ \&c.$$

F. Lucas Paciolus, or De Burgo, for the root, ſquare, cube, &c. uſes the terms *coſa, cenſo, cubo, relato (primo, ſecundo, tertio*, &c.), or the abreviations *co. ce. cu.*; and ℞ for root or radicality.

Cardan uſed the Latin contractions of the names of the powers; and other contemporary, as well as ſucceeding, authors, eſpecially the Germans, as Stifelius, Schcubelius, Pelitarius, &c. uſed the like contractions, but ſomewhat varied, as thus:

	ϑ,	ꝶ,	ʒ,	ꝯ,	ʒʒ,	ʃʒ,	ʒꝯ,	&c.
or	1,	ꝶ,	ʒ,	ꝯ,	ʒʒ,	ʃs,	ʒꝯ,	&c.
or	1,	℞,	*q*,	ꝯ,	*qq*,	ʃs,	*q*ꝯ,	&c.
Exp.	0,	1,	2,	3,	4,	5,	6,	&c.

But beſides that way, the ſame authors alſo made uſe of the numbers as in the laſt line here above, and it was Stifelius who firſt called them by the name *exponent*.

Bombelli, whoſe Algebra was publiſhed in 1579, denotes the *res*, or unknown quantity, by this mark ◡, and the powers by numeral exponents ſet over it, thus: $\overset{1}{\smile}$, $\overset{2}{\smile}$, $\overset{3}{\smile}$, &c. Likewiſe Stevinus, who publiſhed his Arithmetic in 1585, and his Algebra ſoon afterwards, has ſuch another method, but inſtead

of – he uſes a ſmall circle ○, within which he places the numeral exponent of the power; thus ⓪, ①, ②, ③, &c: and in this way he extends his notation to fractional exponents, and even to radical ones; thus $\left(\frac{1}{2}\right)$, $\left(\frac{1}{3}\right)$, $\left(\frac{1}{4}\right)$, $\left(\frac{2}{3}\right)$, &c.

Vieta after this uſed words again to denote the powers. Afterwards Harriot denoted the powers by a repetition of the root; as *a*, *aa*, *aaa*, for the 1ſt, 2d, and 3d powers. Inſtead of which, Des Cartes again reſtored the numeral exponents, placing them after the root, when the power is high, to avoid a too frequent repetition of the letter of the root; as a^5 a^4, &c. as at preſent. Alſo Albert Girard, in 1629, uſed the exponents to roots, thus; $\surd$, $\sqrt[2]{}$, $\sqrt[3]{}$, &c.

The notation of powers and roots by the preſent way of exponents, has introduced a new and general arithmetic of exponents or powers; for hence powers are multiplied by only adding their exponents, divided by ſubtracting the exponents, raiſed to other powers, or roots of them extracted, by multiplying or dividing the exponent by the index of the power or root.

So $a^2 \times a^3 = a^5$, and $a^{\frac{1}{2}} \times a^{\frac{1}{4}} = a^{\frac{3}{4}}$;
$a^5 \div a^3 = a^2$, and $a^{\frac{3}{4}} \div a^{\frac{1}{2}} = a^{\frac{1}{4}}$;
the 2d power of a^3 is a^6,
and the 3d root of a^6 is a^2.

This algorithm of powers led the way to the invention of logarithms, which are only the indices or exponents of powers: and hence the addition and ſubtraction of logarithms anſwer to the multiplication and diviſion of numbers; while the raiſing of powers, and extracting of roots, is effected by multiplying the logarithm by the index of the power, or dividing the logarithm by the index of the root.

Exponent *of a Ratio*, is, by ſome, underſtood as the quotient ariſing from the diviſion of the antecedent of the ratio by the conſequent: in which ſenſe, the exponent of the ratio of 3 to 2 is $\frac{3}{2}$; and that of the ratio of 2 to 3 is $\frac{2}{3}$.

But others, and thoſe among the beſt mathematicians, underſtand logarithms as the exponents of ratios; in which ſenſe they coincide with the idea of meaſures of ratios, as delivered by Kepler, Mercator, Halley, Cotes, &c.

EXPONENTIAL *Calculus*, the method of differencing, or finding the fluxions of, exponential quantities, and of ſumming up thoſe differences, or finding their fluents. See Calculus, Fluxions, and Fluents.

Exponential *Curve*, is that whoſe nature is defined or expreſſed by an exponential equation; as the curve denoted by $a^x = y$, or by $x^x = y$.

Exponential *Equation*, is one in which is contained an exponential quantity: as the equation $a^x = b$, or $x^x = ab$, &c. Exponential equations are commonly beſt reſolved by means of logarithms, viz, firſt taking the log. of the given equation: thus, taking the log. of the equation $a^x = b$, it is $x \times$ log. of $a =$ log. of b; and hence $x = \dfrac{\log.\ b}{\log.\ a}$.

Alſo, the log. of the equation $x^x = ab$, is $x \times$ log. of $x =$ log. ab; and then x is eaſily found by trial and error, or the double rule of poſition.

Exponential *Quantity*, is that whoſe power is a variable quantity; as the expreſſion a^x, or x.

Exponential quantities are of ſeveral degrees, and orders, according to the number of exponents or powers, one over another. Thus,

a^x is an exponential of the firſt order,
a^{x^y}, is one of the ſecond order,
$a^{x^{y^z}}$ is one of the 3d order, and ſo on.

See Bernoulli Opera tom. 1, page 182, &c.

EXPORTATION, the ſhipping and carrying out of the kingdom, wares and commodities for other countries. See the articles Commerce, Trade, and Shipping.

EXPOSING, the act of ſetting a thing to public view. In the Romiſh church, the ſacrament is ſaid to be *expoſed* when it is ſhewn in public uncovered on feſtival days, and during the time of plenary indulgences. Expoſing is alſo uſed with a farther latitude: thus we ſay, It is prohibited to expoſe falſe and clipped money. Such a houſe ſtands very high, and has a delicious proſpect; but it is expoſed to all the four winds. Such a city being on the frontiers and not fortified, is expoſed to the inſults of every party of forces.

Exposing *of Children*, a barbarous cuſtom practiſed by moſt of the ancients excepting the Thebans, who had an expreſs law to the contrary, whereby it was made capital to expoſe children; ordaining at the ſame time, that ſuch as were not in a condition to educate them ſhould bring them to the magiſtrates, in order to be brought up at the public expence. Among the other Greeks, when a child was born, it was laid on the ground; and if the father deſigned to educate his child, he immediately took it up; but if he forbore to do this, the child was carried away and expoſed. The Lacedemonians indeed had a different cuſtom: for with them all new-born children were brought before certain triers, who were ſome of the graveſt men in their own tribe, by whom the infants were carefully viewed; and if they were found luſty and well-favoured, they gave orders for their education, and allotted a certain proportion of land for their maintenance; but if weakly or deformed, they ordered them to be caſt into a deep cavern in the earth, near the mountain Taygetus, as thinking it neither for the good of the children themſelves nor for the public intereſt, that defective children ſhould be brought up. Many perſons expoſed their children only becauſe they were not in a condition to educate them, having no intention that they ſhould periſh. It was the unhappy fate of daughters eſpecially to be thus treated, as requiring more expence to educate and ſettle them in the world than ſons.

The parents frequently tied jewels and rings to the children they expoſed, or any other thing whereby they might afterwards diſcover them, if providence took care for their ſafety. Another deſign in adorning theſe infants was either to encourage ſuch as found them to nouriſh and educate them, if alive; or to give them human burial if dead. The places where it was uſual to expoſe children were ſuch as people frequented moſt. This was done in order that they might be found, and taken up by compaſſionate perſons who were in circumſtances to be at the expence of their education. With this intention the Egyptians and Romans choſe the banks of rivers, and the Greeks the highways.

EXPOSITION, in general, denotes the ſetting a thing open to public view. See Exposing. In a literary ſenſe, this term denotes the explaining an author, paſſage, writing, or the like, and ſetting their meaning in an obvious and clear light.

EXPOSITOR, or Expository, a title which ſome writers have given to a leſſer kind of dictionaries or vocabularies, ſerving to expound or explain the meaning of the obſcure or difficult words of a language. It is alſo uſed in the ſame ſenſe with commentary and paraphraſe.

EXPOSTULATION, in rhetoric, a warm addreſs to a perſon who has done another ſome injury, repreſenting the wrong in the ſtrongeſt terms, and demanding redreſs.

EX POST-FACTO, in law, denotes ſomething done after a thing that was committed before. An eſtate granted may be made good by matter *ex-poſt facto*, that was not ſo at firſt by election, &c.

EXPRESSED oils, in chemiſtry, ſuch oils as are obtained from bodies only by preſſing. See Oil.

EXPRESSION, in rhetoric, the elocution, diction, or choice of words in a diſcourſe. See Language, Oratory, and Poetry.

Expression, in muſic. See Composition.

Expression, in painting, a natural and lively repreſentation of the ſubject, or of the ſeveral objects intended to be ſhown. The expreſſion conſiſts chiefly in repreſenting the human body and all its parts, in the action ſuitable to it: in exhibiting in the face the ſeveral paſſions proper to the figures, and obſerving the motions they impreſs on the external parts. See Painting.

Expression, in algebra, is any algebraical quantity, ſimple or compound; as the expreſſion, $3a$, or $2ab$, or $\sqrt{a^2 + c^2}$.

Expression, in medicine, chemiſtry, &c. the act of expreſſing or extracting the juices or oils of plants, fruits, or other matters, by ſqueezing, wringing, or preſſing them in a preſs. After having let the herbs infuſe a due time, their juice muſt be drawn by expreſſion in a linen cloth or by a preſs.

EXSICCATION, formed of *ex*, and *ſiccus* "dry," in chemiſtry, &c. the act of drying up or evaporating the moiſture of a thing.

EXSPIRATION, in phyſic, that part of reſpiration by which the air is expelled or driven out of the lungs. See Respiration.

EXSUDATION, or Exudation, the act of ſweating out. It is in this manner that gums, balſams, &c. are uſually produced from trees.

EXTACY, a tranſport which ſuſpends the function of the ſenſes, by the intenſe contemplation of ſome extraordinary or ſupernatural object. In medicine, it denotes a ſpecies of catalepſy, when a perſon perfectly remembers, after the paroxyſm is over, the ideas he conceived during the time it laſted.

EXTANT, ſomething that ſtill ſubſiſts, or is in being. It is but part of the hiſtory of Livy, of the writings of Cicero, Cæſar, &c. that are extant: the reſt are loſt. We have nothing extant of Socrates, though he wrote a great deal.

EXTENSION, in philoſophy, one of the common and eſſential properties of body; or that by which it poſſeſſes or takes up ſome part of univerſal ſpace, which is called the place of that body. See Metaphysics.

EXTENSOR, an appellation given to ſeveral muſcles, from their extending or ſtretching the parts to which they belong. See Anatomy, *Table of the Muſcles*.

EXTENT, in law, is uſed in a double ſenſe. Sometimes it ſignifies a writ or command to the ſheriff for the valuing of lands or tenements; and ſometimes the act of the ſheriff, or other commiſſioner, upon this writ.

EXTENUATION, the act of diminiſhing or leſſening the bulk or ſubſtance of a thing, eſpecially of the human body. Fevers, agues, long abſtinence, &c. occaſion great extenuations or emaciations.

Extenuation, is alſo a figure in rhetoric, oppoſite to the hyperbole. The Greeks call it λιτότης.

EXTERIOR, or External. See External.

EXTERMINATION, in general, the extirpating or deſtroying ſomething.

Extermination, or *Exterminating*, in algebra, is the taking away, or expelling of ſomething from an expreſſion, or from an equation: as to exterminate ſurds, fractions, or any particular letter or quantity out of equations.

Thus, to take away the fractional form from this equation $\frac{a^2 + x^2}{2c} = \frac{ab}{d}$; multiply each numerator by the other's denominator, and the equation becomes $a^2d + dx^2 = 2abc$, out of fractions.

Alſo, to take away the radicality from the equation $3\sqrt{a^2 - x^2} = 2c$, raiſe each to the 2d power, and it becomes $9a^2 - 9x^2 = 4c^2$.

For exterminating any quantity out of equations, there are various rules and methods, according to the form of the equations; of which many excellent ſpecimens may be ſeen in Newton's Algebra, p. 60, ed. 1738; or in Maclaurin's Algebra, part 1, chap. 12. For example, to exterminate out of theſe two equations, $a + x = b + y$,
and $3b = 2x + y$;
ſubtract the upper equation from the under, ſo ſhall there ariſe $3b - a - x = 2x - b$; then, by the known methods of tranſpoſition, &c. there is obtained $4b - a = 3x$, and hence $x = \frac{4b - a}{3}$.

EXTERNAL, a term of relation applied to the ſurface or outſide of a body, or that part which appears or preſents itſelf to the eye, touch, &c. in contradiſtinction to internal. It is alſo uſed to ſignify any thing that is without-ſide a man, or that is not within himſelf, particularly in his mind; in which ſenſe we ſay, external objects, &c.

EXTINGUISHMENT, in law, is a conſolidation or union, as where one has due to him a yearly rent out of lands, and afterwards purchaſes the lands out of which the rent ariſes; in this caſe, both the property and the rent being united in one poſſeſſor, the rent is ſaid to be extinguiſhed.

EXTIRPATION, formed of *ex*, and *ſtirps* "root," the act of pulling up or deſtroying a thing to the very roots. Among the prayers of the Romiſh jubilee, there is one for the extirpation of hereſy.

Extirpation is alſo uſed, in ſurgery, for cutting off any part entirely; as a wen, &c. or the eating it away, as a wart, &c. by corroſive applications.

EXTISPEX, in antiquity, the perſon who drew preſages from viewing the entrails of animals offered in ſacrifice.

EXTORTION, in law, is an illegal manner of wreſting any thing from a man, either by force, menace, or authority. It is alſo the exaction of unlawful uſury, winning by unlawful games, and taking more than is due under pretence of right, as exceſſive tolls in millers, &c. At the common law, extortion is puniſhable by fine and impriſonment; and the ſtatute of 3 Eliz. 1. c. 30. has enacted, that officers of juſtice guilty of extortion for the expedition of buſineſs, &c. ſhall render to the party treble value. There are likewiſe divers other ſtatutes for puniſhing extortions of ſheriffs' bailiffs, gaolers, clerks of the aſſize and of the peace, attorneys, ſolicitors, &c.

EXTRACT, in pharmacy, is a ſolution of the purer parts of a vegetable inſpiſſated, by diſtillation or evaporation, nearly to the conſiſtence of honey.

Extract, in matters of literature, is ſomething copied or collected from a book or paper.

EXTRACTION, in chemiſtry and pharmacy, the operation by which eſſences, tinctures, &c. are drawn from natural bodies. See Extract.

Extraction, in ſurgery, is the drawing any foreign matter out of the body by the hand, or by the help of inſtruments. See Surgery.

Extraction, in genealogy, implies the ſtock or family from which a perſon is deſcended. See Descent.

Extraction *of Roots*, in algebra and arithmetic, the methods of finding the roots of given numbers or quantities. See Algebra, p. 105, and Arithmetic, p. 322.

EXTRACTOR, in midwifery, an inſtrument or forceps for extracting a child by the head in difficult caſes.

EXTRAJUDICIAL, ſomething done out of the proper court, or the ordinary courſe of law. As when judgment is given in a cauſe, or caſe, not depending in that court where ſuch judgment is given, or wherein the judge has no juriſdiction.

EXTRAORDINARII, amongſt the Romans, was a body

of men confifting of a third part of the foreign horfe and a fifth of the foot, which was feparated from the reft of the forces borrowed from the confederate ftates, with great policy and caution, to prevent any defign that they might poffibly entertain againft the natural forces. A more choice body of men were drawn from among the extraordinarii under the name of *ablecti*. See ABLECTI.

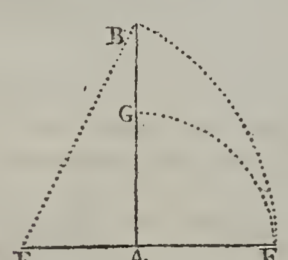
EXTRAORDINARY, fomething out of the common courfe. Thus, extraordinary couriers are thofe fent exprefs on fome urgent occafion. An extraordinary ambaffador, or envoy, is fuch a one as is fent to treat or negotiate fome fpecial and important affair, as a marriage, a treaty, confederacy, &c. or even on occafion of fome ceremony, as condolence, congratulation, &c. A *gazette*, journal, or other news-paper *extraordinary*, is that publifhed after fome great and notable event, containing the detail or particulars thereof, which are not found in the ordinary papers.

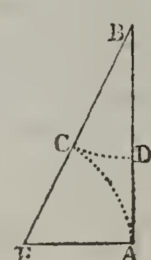
EXTRAVAGANTES, thofe decretal epiftles which were publifhed after the CLEMENTINES. They were fo called, becaufe at firft they were not digefted or ranged with the other papal conftitutions, but feemed to be, as it were, detached from the canon-law. They continued to be called by the fame name when they were afterwards inferted in the body of the canon law. The firft extravagantes are thofe of John XXII. fucceffor of Clement V. The laft collection was brought down to the year 1483, and was called the *common extravagantes*, notwithftanding that they were likewife incorporated with the reft of the canon law.

EXTRAVASATION, in contufions, fractures, and other accidents of the cranium, is when one or more of the blood-veffels are broken or divided, whereby there is a difcharge of blood into the cavity or cellular membrane of the parts where fuch veffel is fituated. See SURGERY.

EXTREME-*and-Mean Proportion*, is when a line or any quantity is fo divided, as that the whole line is to the greater part, as that greater part is to the lefs part. Hence, in any line fo divided, the rectangle of the whole line and the lefs fegment, is equal to the fquare of the greater fegment.

Euclid fhews how to divide a line in extreme and-mean ratio, in his Elements, book 2, prop. 11, to this effect: Let AB be the given line; to which draw AE perpendicular and equal to half AB; in EA produced take EF = EB, fo fhall AF be equal to the greater part; confequently if AG be taken equal to AF, the line AB will be divided in G as required.





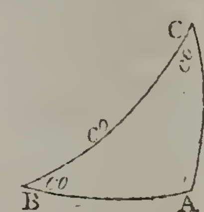
The fame may be done otherwife thus:

As before, make AE (fig. 2.) perpendicular and $= \frac{1}{2}$AB; join EB, on which take EC = EA, and then take BD = BC, fo fhall the line be divided in D as required.

No number can be divided into extreme and mean proportion, fo that its two parts fhall be rational; as is well demonftrated by Clavius, in his Commentary upon the 9th book of Euclid's Elements; and the fame thing will alfo appear from the following algebraical folution of the fame problem: Let a denote the whole line, and x the greater part; then fhall $a - x$ be the lefs part, and the rectangle of the whole and lefs part being put equal to the fquare of the greater part, gives this equation, $x^2 = a \times \overline{a - x} = a^2 - ax$; hence $x^2 + ax = a^2$ and by completing the fquare, and extracting the root, &c. there is at laft $x = \frac{\sqrt{5} - 1}{2}a$ the greater part; confequently $a - x = \frac{3 - \sqrt{5}}{2}a$ is the lefs part. And as the fquare root of 5, which cannot be exactly extracted, makes a portion of both thefe parts, it is manifeft that neither of them can be obtained in rational numbers.

Euclid makes great ufe of this problem, viz, in feveral parts of the 13th book of the Elements; and by means of it he conftructs that notable propofition, viz. the 10th of the 4th book, which is to conftruct an ifofceles triangle having each angle at the bafe double the angle at the vertex.

EXTREMES *Conjunct*, and EXTREMES Disjunct, in fpherical trigonometry, are the former the two circular parts that lie next the affumed middle part, and the latter are the two that lie remote from the middle part. Thefe were terms applied by lord Napier, in his univerfal theorem for refolving all right-angled and quadrantal fpherical triangles, and publifhed in his Logarithmorum Canonis Defcriptio, an. 1614. In this theorem, Napier condenfes into one rule, in two parts, the rules for all the cafes of right-angled fpherical triangles, which had been feparately demonftrated by Pitifcus, Lanfbergius, Copernicus, Regiomontanus, and others. In this theorem, neglecting the right angle, Napier calls the other five parts, circular parts, which are, the two legs about the right angle, and the complements of the other three, viz. of the hypothenufe, and the two oblique angles. Then, taking any three of thefe five parts, one of them will be in the middle between the other two, and thefe two are the extremes conjunct when they are immediately adjacent to that middle part, or they are the extremes disjunct when they are each feparated from the middle one by another part. Thus the five parts being AB, AC, and the complements of BC and of the two angles B and C: then if the three parts be AB, and the complements of the angle B and the hypothenufe BC be taken, thefe three are contiguous to each other, the angle B lying in the middle between the other two: therefore the comp. of B is middle part, and AB with the comp. of BC the extremes conjunct. But if the three fides be taken; BC is equally feparated from the two legs AB and AC, by two angles B and C; and therefore thefe two legs AB and AC are extremes disjunct, and the comp. of BC the middle part.



Napier's rule for refolving each rule is in two parts, as follows: The rectangle contained by radius and the fine of the middle part, is equal to the rectangle of the tangents of the extremes conjunct, or equal to the rectangle of the fines of the extremes disjunct; which rule comprehends all the cafes that can happen in right-angled fpherical triangles. In the application of this rule, the equal rectangles are divided into a proportion or analogy, in fuch manner that the term fought may be the laft of the four terms that are concerned, and confequently its correfponding term in the fame rectangle muft be the firft of thofe terms.

EXTREMES, in logic, the two extreme terms of the conclufion of a fyllogifm; viz. the predicate and fubject. They are called *extremes*, from their relation to another term, which is a medium or mean between them. The predicate, as being likewife had in the firft propofition, is called the *majus extremum*, greater extreme; and the fubject, as being put in the fecond or minor propofition, is called the *minus extremum*, leffer extreme. Thus, in the fyllogifm, man is an animal; Peter is a man, therefore Peter is an animal; the word animal is the

6

greater extreme. Peter the lefs extreme, and the man the medium. See SYLLOGISM.

EXTREME *Unction*. See UNCTION.

EXTREMITIES of figures, in painting, is ufed for the head, hands, and feet. Thefe fhould be drawn with more nicety and exactnefs, or more terminated than other parts; which will help to render the action more expreffive.

EXTRINSIC, among metaphyficians, is taken in various fenfes. Sometimes it fignifies a thing's not belonging to the effence of another; in which fenfe, the efficient caufe and end of a thing are faid to be extrinfic. Sometimes it fignifies a thing's not being contained within the capacity of another; in which fenfe, thofe caufes are called extrinfic which introduce fomething into a fubject from without, as when a fire introduces heat. Sometimes it fignifies a thing added or applied to another; in which fenfe accidents and adherents are faid to be extrinfic to the fubjects to which they adhere. Sometimes the vifion is faid to be extrinfic from fome form which does not exift in that thing, but is adjacent to it, or by fome means or other without it.

EXTUBERANCES, in furgery, are fwellings or rifings up in the flefh or other parts of the body.

EXUBERANCE, compounded of *ex*, and *uber* "plentiful," in rhetoric, a redundancy. See REDUNDANCE and PLEONASM.

EXUDATION. See EXSUDATION.

EXVERRÆ, in antiquity, a kind of brufh ufed in cleanfing houfes out of which a dead perfon had been carried.

EXULCERATION, in furgery, the act or procefs of ulceration, whether happening fpontaneoufly, or caufed by fome irritating or cauftic application.

EXUVIÆ, among naturalifts, the caft-off parts or coverings of animals, as the fkins of ferpents, caterpillars, and other infects.

EXUVIÆ is alfo ufed for fome fhells and other marine bodies, frequently found in the bowels of the earth; fuppofed to have been depofited there at the deluge, as being the remains of once living creatures. See SHELL, FOSSILE, &c.

EY, in our old writers, the fame with *infula* "an ifland;" from which comes *eyet*, a fmall ifland or iflet, vulgarly called *eyght*.

EYCK. See BRUGES (John of.)

EYE, in anatomy. See ANATOMY, p. 210. A new-born child fhall be obferved, perhaps, never to keep its eyes fixed on any one object, but continually changing from one to another, and if you put your hand before them, the child will not wink. Hence fome have thought, that new-born infants have no fight: but this is a miftake; and the true reafon why their eyes are in perpetual motion is, that they have not yet acquired the habit of examining one thing at once with their eyes: their not winking at the approach of the hand, arifes from their want of experience how eafily their eyes may be hurt; but in a few days they get the habit of winking, fo that afterwards their eyes do it fpontaneoufly at the approach of danger. *Artificial eyes* are made of concave plates of gold, filver, glafs, or enamel, and are coloured fo as to refemble the natural eye. They muft, when fixed in the orbit, be taken out and cleaned every night, and replaced in the morning. If no more of a difeafed eye is removed than what is preternaturally projected, or if enough is left to preferve the mufcles unhurt, the artificial eye will have a little motion from the mufcles that remain. If the eye does not fit well, it irritates and inflames the other eye; in which cafe it fhould be laid afide, until one can be had that fits better.

Bull's EYE, in Aftronomy. See ALDEBARAN.

EYE *of a Block*, in naval affairs, that part of the rope-ftrop which is faftened to fome neceffary place in the fhip: the ftrop is a fort of wreath or rope formed into a ring, and fixed round the block for the double convenience of ftrengthening the block and faftening it in any place where it is wanted.

EYE, in agriculture and gardening, fignifies a little bud or fhoot, inferted into a tree by way of graft. See ENGRAFTING.

EYE *of a Tree*, a fmall pointed knot to which the leaves ftick, and from which the fhoots or fprigs proceed. See GAMMA.

EYE, a town of Suffolk, 22 miles from Ipfwich and 91 from London. It may be called an ifland, becaufe it is furrounded by a brook near the borders of Norfolk, in the road between Ipfwich and Norwich. It was incorporated by king John; has two bailiffs, 10 principal burgeffes, 24 common-council, a recorder, and town-clerk. It is a mean-built place, with narrow ftreets. The chief manufacture is bone-lace and fpinning. Here is, however, a large handfome church; and near it are the ruinous walls of an ancient caftle and monaftery. The market is on Saturday, the fair on Whit-Monday. It has only fent members to parliament fince the reign of Edward IV.

EYE-*Bright*. See EUPHRASIA.

EYMOUTH, a town of Scotland in the county of Berwick, formerly fortified to curb the garrifon of Berwick, from which place it is diftant fix miles. W. long. 1. 50. N. lat. 55. 50.

EYRAC, or IRAC, ARABIA, a province of Turkey in Afia, 345 miles in length, and 190 in breadth; of which BAGDAD is the capital.

EYRAC *Agemi*, the principal province of Perfia, anciently called PARTHIA.

EYRE, or EIRE, in law, the court of itinerant juftices. See ASSIZE.

EYRIE, in falconry, a brood or neft, a place where hawks build and hatch their young.

EZEKIEL, a canonical book of the Old Teftament, referring chiefly to the degenerate manners and corruptions of the Jews of thofe times. It abounds with fine fentences and rich comparifons, and difcovers a good deal of learning in profane matters. Ezekiel was carried captive to Babylon with Jechoniah, and began his prophefies in the fifth year of the captivity. He was cotemporary with Jeremiah, who prophefied at the fame time in Judea. He foretold many events, particularly the deftruction of the temple, the fatal cataftrophe of thofe who revolted from Babylon to Egypt, and the happy return of the Jews to their own land.

EZION-GABER, a town of Arabia Petræa.

EZRA, a canonical book of the Old Teftament; comprehending the hiftory of the Jews from the time of Cyrus's edict for their return, to the 20th year of Artaxerxes Longimanus. It fpecifies the number of Jews who returned, and Cyrus's proclamation for the rebuilding the temple, together with the laying its foundation, the obftruction it met with, and the finifhing thereof in the reign of Darius. The illuftrious author of this book was alfo the reftorer and publifher of the canon of the Old Teftament. See BIBLE. The books of Ezra, called in the Englifh verfion the *Firft and Second Books of Efdras*, though held by fome, particularly the Greeks, for canonical, are thrown by the Englifh church into the number of apocryphal books, being only extant in Greek.

F

F, THE fourth consonant, and sixth letter of the alphabet. The letter F is borrowed from the digamma or double gamma of the Ælians, as is evident from the inscription on the pedestal of the colossus at Delos; and was undoubtedly formed from the old Hebrew vau: and though this letter is not found in the modern Greek alphabet, yet it was in the ancient one, from whence the Latins received it and transmitted it to us.

It is formed by a strong expression of the breath, and joining at the same time the upper-teeth and under-lip. It has but one sort of sound, which has a great affinity with *v* and *ph*, the latter being written for it by us in all Greek words, as *philosophy*, &c. though the Italians write it *filosofia*.

The Romans for some time used an inverted F, Ⅎ, instead of V consonant, which had no peculiar figure in their alphabet. Thus, in inscriptions we meet with TERMINAℲIT, DIℲI, &c. Lipsius and others say, that it was the emperor Claudius who introduced the use of the inverted digamma, or Ⅎ: but it did not long subsist after his death; for Quintilian observes, that it was not used in his time.

F, or FA, in music, is the fourth note in rising in this order of the gamut, *ut, re, mi, fa*. It likewise denotes one of the Greek keys in music, destined for the bass.

F, in physical prescriptions stands for *Fiat*, or "Let it be done." Thus *f. s. a.* signifies *fiat secundum artem*.

F was also a numeral letter, signifying 40; according to the verse, "*Sexta quaterdenos gerit quæ distat ab alpha.*" And when a dash was added at top, thus $\bar{F}$, it signified forty thousand.

F, in the civil law. Two f's joined together thus, *ff*, signify the pandects. See PANDECTS.

F, in criminal law, a stigma or brand put upon felons with a hot iron, on their being admitted to the benefit of clergy; by stat. 4 H. 7. c. 13.

FABA, in botany. See VICIA.

FABAGO, in botany; a species of bean-caper, or ZYGOPHYLLUM.

FABER, in ichthyology; a species of ZEUS.

FABIAN (Robert,) an alderman of the city of London, and sheriff in the year 1494; was a person of learning for the time he lived in, a good poet, and author of a Chronicle of England and France, intitled *The Concordaunce of Stories*, in two volumes folio, beginning with Brute, and ending with the 20th of Henry VII. 1504. It contains several curious particulars relative to the city of London, not elsewhere to be found. Stowe calls it "a painful labour, to the great honour of the city and of the whole realm." We are told that Cardinal Wolsey caused as many copies of this book as he could procure to be burned, because the author had made too clear a discovery of the large revenues of the clergy. Fabian died in 1512.

FABII, a noble and powerful family at Rome, who derived their name from *faba*, a bean, because some of their ancestors cultivated this pulse. They were once so numerous that they took upon themselves to wage war against the Veientes. They came to a general engagement near the Cremera, in which all the family, consisting of 306 men, were totally slain, year of Rome 277. There only remained one whose tender age had detained him at Rome, and from him arose the noble Fabii in the following ages.

FABIUS (Maximus Rullianus), was the first of the Fabii who obtained the surname of *Maximus*, for lessening the power of the populace at elections. He was master of horse, and his victory over the Samnites in that capacity nearly cost him his life, because he engaged the enemy without the command of the dictator. He was five times consul, twice dictator, and once censor. He triumphed over seven different nations in the neighbourhood of Rome, and rendered himself illustrious by his patriotism.

FABIUS (Rusticus), an historian in the age of Claudius and Nero. He was intimate with Seneca; and the encomiums which Tacitus passes upon his style, make us regret the loss of his compositions.

Q. FABIUS (Maximus), a celebrated Roman, who from a dull and inactive childhood was raised to the highest offices of the state. In his first consulship he obtained a victory over Liguria, and the fatal battle of Thrasymenus occasioned his election to the dictatorship. In this important office he began to oppose Hannibal, not by fighting him in the open field, like his predecessors, but he continually harassed his army by countermarches and ambuscades, from which he received the surname of *Cunctator*, or *Delayer*. Hannibal sent him word, that "If he was as great a captain as he would be thought, he ought to come into the plain and give him battle." But Fabius coldly replied, "That if he was as great a captain as he would be thought, he would do well to force him to fight." Such operations for the commander of the Roman armies gave offence to some; and Fabius was even accused of cowardice. He however continued firm in his first resolutions; and patiently bore to see his master of horse raised to share the dictatorial dignity with himself, by means of his enemies at home. When he had laid down his office of dictator, his successors, for a while, followed his plan; but the rashness of Varro, and his contempt for the operations of Fabius, occasioned the fatal battle of Cannæ. Tarentum was obliged to surrender to his arms after the battle of Cannæ; and on that occasion the Carthaginian enemy observed that Fabius was the Hannibal of Rome. When he had made an agreement with Hannibal for the ransom of the captives, which was totally disapproved by the Roman senate, he sold all his estates to pay the money, rather than forfeit his word to the enemy. The bold proposals of young Scipio to go and carry the war from Italy to Africa, was rejected by Fabius as chimerical and dangerous. He did not, however, live to see the success of the Roman arms under Scipio, and the conquest of Carthage by measures which he treated with contempt and heard with indignation. He died in the 100th year of his age, after he had been five times consul, and twice honoured with a triumph. The Romans were so sensible of his great merit and services, that the expences of his funeral were defrayed from the public treasury.—His son bore the same name, and showed himself worthy of his noble father's virtues. During his consulship he received a visit from his father on horseback in the camp. The son ordered the father to dismount; and the old man cheerfully obeyed, embracing his son, and saying, "I wished to know whether you knew what it is to be consul." He died before his father, and Cunctator with the moderation of a philosopher delivered a funeral oration over the dead body of his son.

FABIUS, styled *Pictor*, a Roman general and historian. He first introduced painting at Rome; and having caused the walls of the temple of Health to be painted, some authors have erroneously reckoned him a painter. He died about 216 B. C.

FABLE, a tale, or feigned narration, designed either to instruct or divert, disguised under the allegory of an action, &c. Fables were the first pieces of wit that made their appearance in the world; and have continued to be highly valued, not only in times of the greatest simplicity, but in the most polite ages of the world. Jotham's fable of the trees is the oldest that is extant, and as beautiful as any that have been made since. Nathan's fable of the poor man is next in antiquity. We find Æsop in the most distant ages of Greece; and in the early days of the Roman commonwealth, we read of a mutiny appeased by the fable of the belly and the members. As fables had their rise in the very infancy of learning, they never flourished more than when learning was at its greatest height; witness Horace, Boileau, and Fontaine.

Fable is a good way of giving counsel, and most universally pleasing, because least shocking to our pride; for, in the reading of a fable, a man thinks he is directing himself, whilst he is following the dictates of another, and consequently is not sensible of that which is the most unpleasing circumstance in advice. Besides, the mind is never so much pleased as when she exerts herself in any action that gives her an idea of her own abilities; this natural pride of the soul is very much gratified in the reading of fable.

Fables have been long thought an eligible species of reading for children; but M. Rousseau, in the first vol. of his Emilius, has assigned the most convincing reasons for being of a contrary opinion. See his curious dissection of one of Fontaine's fables, undertaken with a view of illustrating this subject, in our Treatise on Education, p. 181.

Fable, is also used for the plot of an epic or dramatic poem; and is, according to Aristotle, the principal part, and, as it were, the soul of the poem. See Poetry.

FABRI (Honorius), a laborious Jesuit born in the diocese of Bellay, distinguished himself by his skill in philosophy and the mathematics, and by writing a great number of books. The most curious of these treat of geometry, optics, the loadstone, the motion of the earth, the ebbing and flowing of the sea, &c. He died at Rome in 1688.

FABRIANO (Gentile da), painter of history, was born at Verona in 1332, and became a disciple of Giovanni da Fiesole. In that early age of painting he rendered himself very famous, and was employed to adorn a great number of churches and palaces at Florence, Urbino, Siena, Perusia, and Rome, but particularly in the Vatican; and one picture of his representing the Virgin and Child, attended by Joseph, which is preserved in the church of S. Maria Maggiore, was highly commended by Michael Angelo. By order of the Doge and Senate of Venice, he painted a picture in the great council-chamber, which was considered as so extraordinary a performance, that his employers granted him a pension for life, and conferred on him the highest honour of their state, which was, the privilege of wearing the habit of a noble Venetian. He died in 1412.

FABRIC, in general, denotes the structure or construction of any thing; but particularly of buildings, as a church, hall, house, &c. See Architecture.

Fabric-*Lands*, those formerly given towards rebuilding or repairing of cathedrals and other churches; for anciently almost every body gave more or less, by his will, to the fabric of the parish-church where he dwelt.

FABRICIUS (C.), a celebrated Roman, who in his first consulship, year of Rome 470, obtained several victories over the Samnites and Lucanians, and was honoured with a triumph. The riches which were acquired in those battles were immense, the soldiers were liberally rewarded by the consul, and the treasury was enriched with 400 talents. Two years after, Fabricius went as ambassador to Pyrrhus, and refused with contempt presents, and heard with indignation offers, which might have corrupted the fidelity of a less virtuous citizen. Pyrrhus had occasion to admire the magnanimity of Fabricius; but his astonishment was more powerfully awakened when he saw him make a discovery of the perfidious offers of his physician, who pledged himself to the Roman general for a sum of money to poison his royal master. To this greatness of soul was added the most consummate knowledge of military affairs, and the greatest simplicity of manners. Fabricius never used rich plate at his table. A small salt-cellar, the feet of which were of horn, was the only silver vessel which appeared in his house. This contempt of luxury and useless ornaments Fabricius wished to inspire among the people; and during his censorship he banished from the senate Cornelius Ruffinus, who had been twice consul and dictator, because he kept in his house more than ten pounds weight of silver plate. Such were the manners of the conqueror of Pyrrhus, who observed that he wished rather to command those that had money, than possess it himself. He lived and died in the greatest poverty. His body was buried at the public charge, and the Roman people were obliged to give a dowry to his two daughters when they had arrived to the years of maturity.

Fabricius (George), a learned German, born at Chemnitz in Misnia, in 1516. After a liberal education, he visited Italy in quality of a tutor to a young nobleman; and, examining all the remains of antiquity with great accuracy, compared them with their descriptions in Latin writers. The result of these observations was his work intitled *Roma*, containing a description of that city. He afterwards settled at Misenum, where he conducted a great school to the time of his death in 1571. He was also the author of a great number of sacred Latin poems, wrote seven books of the *Annals of Misnia*, three of the *Annals of Meissen*, and a volume of *Travels*.

Fabricius (Jerom), a celebrated physician in the latter end of the 16th century (surnamed *Aquapendente*, from the place of his birth), was the disciple and successor of Fallopius. He chiefly applied himself to surgery and anatomy, which he professed at Padua for 40 years with extraordinary reputation. The republic of Venice settled a large pension upon him, and honoured him with a gold chain and a statue. He died in 1603; leaving behind him several works which were much esteemed.

Fabricius (John Albert), one of the most learned and laborious men of his age, was born at Leipsic in 1668. He was chosen professor of eloquence at Hamburgh in 1699, and was made doctor of divinity at Kiel. His works are numerous; and he died at Hamburgh in 1736, after a life spent in the severest literary application to collect and publish valuable remains of ancient learning.

Fabricius (Vincent), born at Hamburgh in 1613, was a good poet, a great orator, an able physician, and a learned civilian. He was for some time counsellor to the bishop of Lubec, and afterward burgo-master and syndic of the city of Dantzic; from whence he was 13 times sent deputy into Poland, where he died at Warsaw in 1657, during the diet of that kingdom. The most complete edition of Fabricius's poems and other works was published at Leipsic in 1685, under the direction of his son Frederic Fabricius.

Fabricius (Baron), one of the finest gentlemen of his time, and known to the public by his letters relating to the transactions of Charles XII. of Sweden during his residence in the Ottoman empire; was descended from a good family in Germany. He was taken early into the service of the court of Holstein; and was sent in a public character to the king of Sweden whilst he was at Bender; where he soon acquired the good graces of that prince. He accompanied him in his exercises; gave him a turn for reading; and it was out of his hand Charles snatched Boileau's satires, when he tore out those that represented Alexander the Great as a madman. Fabricius

was alſo in favour with Staniſlaus, and with our king George I. whom he accompanied in his laſt journey to Hanover, and was with him when he died. A tranſlation of his letters was publiſhed in London 1761.

FABROT (Charles Hannibal), one of the moſt celebrated civilians of his time, was born at Aix in 1681; and acquired an extraordinary ſkill in the civil and canon law, and in the belles lettres. He publiſhed the *Baſilicæ*, or Conſtitutions of the Emperors of the Eaſt, in Greek and Latin, with learned notes, in ſeven vols. folio; and editions of *Cedrenus*, *Nicetas*, *Anaſtaſius*, *Bibliothecarius*, *Conſtantine Manaſſes*, and *Cujas*, with learned and curious notes.

FACE, the ſurface, or firſt ſide which a body preſents to the eye. We ſay, the *face* of the earth, of the waters, &c. Polyhedrons have ſeveral *faces*. A die, or cube, has ſix *faces*.

Face, is particularly uſed for the viſage of an animal, and eſpecially of man; and comprehends in the latter, all that part of the head which is not covered with the common long hair. The Latins call it *facies, vultus, os*, &c. The human face is called the *image of the ſoul*, as being the ſeat of the principal organs of ſenſe; and the place where the ideas, emotions, &c. of the ſoul are chiefly ſet to view. Pride and diſdain are ſhown in the eye-brows, modeſty on the cheeks, majeſty in the forehead, &c. It is the face ſhows the ſex, age, temperament, health, or diſeaſe, &c. The face, conſidered as the index of the paſſions, habits, &c. of the perſon, makes the ſubject of phyſiognomy. See Physiognomy.

Face, among painters and artiſts, is uſed to denote a certain dimenſion of the human body, adopted for determining the proportion which the ſeveral parts ſhould bear to one another: thus the different parts of the body are ſaid to conſiſt, in length, of ſo many faces. See Drawing.

Face, in the military art, a word of command, intimating to turn about: thus, *face to the right*, is to turn upon the left heel a quarter-round to the right; and, *face to the left*, is to turn upon the right heel a quarter-round to the left.

FACIES Hippocratica, in medicine, is when the noſtrils are ſharp, the eyes hollow, the temples low, the tips of the ears contracted and cold, the forehead dry and wrinkled, and the complexion pale or livid. The Hippocratic face occurs in perſons who are actually dying; and is held a ſure indication of a ſpeedy diſſolution.

FACTION, a cabal or party formed in a ſtate, city, or company. Hiſtory furniſhes innumerable inſtances of the dreadful effects of factions, ſtirred up by ambitious men to anſwer ſome private end at the expence of the community.

Faction, in antiquity, a name given to the different companies of combatants in the circus. They were four, viz. the white, the red, the green and the blue; to which Domitian added another of purple colour. They were ſo denominated from the colour of the liveries they wore; and were dedicated, according to M. Aur. Caſſiodorus, to the four ſeaſons of the year; the green being conſecrated to ſpring, the blue to winter, the red to ſummer, and the white to autumn. It appears from ancient inſcriptions, that each faction had its procurators and phyſician; and from hiſtory, that party-rage ran ſo high among them, that in a diſſenſion between two factions, in the time of Juſtinian, almoſt 40,000 men loſt their lives in the quarrel.

FACTOR, in commerce, is an agent employed by merchants reſiding at other places, to buy or ſell goods, or negotiate bills, or tranſact any kind of buſineſs on their account; and intitled to a certain allowance for his trouble. A ſupercargo differs from a factor in this: the buſineſs of the former is limited to the care of a particular cargo; he goes along with it, and generally returns when the buſineſs is completed: the latter has a fixed reſidence abroad, and executes buſineſs for different merchants. But their duties, and the circumſtances for which they are accountable, are the ſame.

The duty of a factor is to procure the beſt intelligence of the ſtate of trade at his place of reſidence; of the courſe of exchange; of the quantity and quality of goods at market, their preſent price, and the probability that it may riſe or fall; to pay exact obedience to the orders of his employers; to conſult their advantage in matters referred to his direction; to execute their buſineſs with all the diſpatch that circumſtances admit; to be early in his intelligence, diſtinct in his accounts, and punctual in his correſpondence.

A factor's power is either abſolute or limited. Though intruſted with ample diſcretionary powers, he is not warranted to take unreaſonable or unuſual meaſures, or do any thing contrary to his employer's intereſt; but it is incumbent on the employer, if he challenge his proceedings, to prove that he could have done better, and was guilty of wilful miſmanagement. When a factor's power is limited, he muſt adhere ſtrictly to his orders. If he exceeds his power, though with a view to his employer's intereſt, he is liable for the conſequence. For example, if he gives credit when not empowered, or longer credit if not empowered, for the ſake of a better price, and the buyer proves inſolvent, he is liable for the debt. A factor has no power to give credit unleſs authoriſed: but if the goods conſigned be generally ſold on credit at the place of conſignation, the factor will be vindicated for ſelling at the uſual credit, unleſs expreſsly reſtricted. Although opinion will never juſtify the factor for departing from orders, neceſſity ſometimes will. If he be limited not to ſell goods under a certain price, and the goods be periſhable, and not in a ſituation for being kept, he may ſell them, to prevent their deſtruction, even under the price limited.

A factor is never warranted to deal on truſt, except with perſons in good credit at the time. If the employer challenge the debtors, it is incumbent on him to prove that their bad circumſtances were known at the time of ſale; and the factor will be vindicated, if he truſted them at the ſame time for goods of his own. If the factor ſells his employer's goods on truſt, and, after the day of payment is elapſed, receive payment from the purchaſer for a debt of his own, he becomes liable in equity for the debt.

In caſe of bankruptcy, the factor ought immediately to lay attachments, and adviſe his employers; and he cannot withdraw his attachments, nor compound debts without orders. If a factor ſells goods belonging to different merchants to the ſame perſon, and the buyer proves inſolvent, they ſhall bear the loſs in equal proportions; and, if the buyer has paid part before his inſolvency, without ſpecifying for which, the payment ought to be diſtributed in equal proportions; but, if the days of payment be fixed, and part of the debts only due, the payment ought to be applied, in the firſt place, to ſuch debts as were due.

If he makes a wrong entry at the cuſtom-houſe, and the goods be ſeized in conſequence thereof, he muſt bear the loſs, unleſs the error be occaſioned by a miſtake in the invoice, or letter of advice. The owner bears the loſs of goods ſeized when attempted to be ſmuggled by his orders; but the factor complying with an unlawful order is liable in ſuch penalties as the laws exact. If a factor ſaves the duty of goods due to a foreign prince, he ſhall have the benefit; for, if detected, he bears the loſs.

If a factor ſells goods bought by his employer's orders for his own advantage, the employer may recover the benefit, and the factor ſhall be amerced for the ſame. If a factor receives bad money in payment, he bears the loſs; but if the value of the mony be leſſened by the government, the employer bears the loſs. A factor is not liable for goods ſpoiled, ſtolen, or

deſtroyed by fire. If a factor receives counterfeit jewels from his employer, and ſells them, the employer is liable to indemnify him for any penalties he may incur.

If a factor be ordered to make inſurance, and neglect it, and the ſubject be loſt, he is liable to make it good, provided he had effects in his hands. If a factor buys goods for his employer, his bargain ſhall be binding on the employer.

In caſe of a factor's inſolvency, the owner may reclaim his goods; and, if they be ſold on truſt, the owner, and not the factor's creditors, ſhall recover payment of the debts.

Factor, in multiplication, a name given to the multiplier and multiplicand, becauſe they conſtitute the product. See Arithmetic, Chap. iv.

FACTORAGE, called alſo *commiſſion*, is the allowance given to factors by the merchant who employs them. A factor's commiſſion in Britain, on moſt kinds of goods, is $2\frac{1}{2}$ *per cent.*: on lead, and ſome other articles, 2 *per cent.*; in Italy, $2\frac{1}{2}$ *per cent.*; in France, Holland, Spain, Portugal, Hamburgh, and Dantzick, 2 *per cent.*; in Turkey, 3 *per cent.*; in North America, 5 *per cent.* on ſales, and 5 *per cent.* in returns; in the Weſt Indies, 8 *per cent.* for commiſſion and ſtorage. In ſome places, it is cuſtomary for the factors to inſure the debts for an additional allowance, generally $1\frac{1}{2}$ *per cent.* In that caſe, they are accountable for the debt when the uſual term of credit is expired. Factorage on goods is ſometimes charged at a certain rate per caſk, or other package, meaſure, or weight, eſpecially when the factor is only employed to receive or deliver them.

FACTORY is a place where a conſiderable number of factors reſide, to negotiate for their maſters or employers. See Factor. The moſt conſiderable factories belonging to the Britiſh are thoſe eſtabliſhed in the Eaſt-Indies, Portugal, Turkey, &c. There are alſo Engliſh factories eſtabliſhed at Hamburgh, Peterſburg, Dantzic, and in Holland; all endowed with certain privileges.

FACTUM, in arithmetic, the product of two quantities multiplied by each other.

FACULÆ, in aſtronomy, certain bright and ſhining parts, which the modern aſtronomers have, by means of teleſcopes, obſerved upon or about the ſurface of the ſun: they are but very ſeldom ſeen. The word is pure Latin; being a diminutive of *fax* "torch;" and ſuppoſed to be here applied from their appearing and diſappearing by turns.

FACULTY, in law, a privilege granted to a perſon, by favour and indulgence, of doing what, by law, he ought not to do. For granting theſe privileges, there is a court under the archbiſhop of Canterbury, called the *court of the faculties*. The chief officer of this court is ſtyled *maſter of the faculties*, and has a power of granting diſpenſations in divers caſes; as, to marry without the bans being firſt publiſhed, to eat fleſh on days prohibited, to ordain a deacon under age, for a ſon to ſucceed his father in his benefice, a clerk to hold two or more livings, &c.

Faculty, in the ſchools, a term applied to the different members of an univerſity, divided according to the arts and ſciences taught there: thus in moſt univerſities there are four faculties, viz. 1. of arts, which include humanity and philoſophy. 2. of theology. 3. of phyſic. And, 4. of civil law.

Faculty *of Advocates*. See Advocates.

Faculty is alſo uſed to denote the powers of the human mind, viz. underſtanding, will, memory, and imagination. See Metaphysics.

FÆCES, in chemiſtry, the groſs matter, or ſediment, that ſettles at the bottom after diſtillation, fermentation, &c. The fæces of wine are commonly called Lees.

Fæces, in medicine, the excrements voided by ſtool. See Excrements.

FAENZA, a city of Romania in Italy, with a biſhop's ſee. It is an ancient place, and has undergone various revolutions. The river Amona waſhes its walls, and paſſes between the city and the ſuburbs, which are joined by a ſtone-bridge defended by two good towers. The city is remarkable for its earthen ware, which is the beſt in all Italy.

FAERNUS (Gabriel), a native of Cremona in Italy, was an excellent Latin poet and critic of the 16th century. He was ſo ſkilled in all parts of polite literature, that the cardinal de Medicis, afterward pope Pius IV. was particularly fond of him. He was the author of ſome Latin elegies; of 100 Latin fables, ſelected from the ancients, written in iambic verſe; and of ſeveral pieces of criticiſm, as *Cenſura emendationum Livianarum*, *De Metris Comicis*, &c. He was remarkably happy in decyphering manuſcripts, and reſtoring ancient authors to their purity: he took ſuch pains with Terence in particular, that Bentley has adopted all his notes in the edition he gave of that writer. He died at Rome in 1561; and Thuanus, who wrote his eloge, ſays, that the learned world was greatly obliged to him, yet had been ſtill more ſo, if, inſtead of ſuppreſſing the then unknown fables of Phædrus, for fear of leſſening the value of his own Latin fables, written in imitation of Æſop, he had been content with imitating them. M. Perault, however, who tranſlated Faernus's fables into French, has defended him from this imputation, by affirming that the firſt MS. of Phædrus's fables, found in the duſt of an old library, was not diſcovered till about 30 years after Faernus's death.

FAGARA, iron-wood; a genus of the monogynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking under the 43d order, *Dumoſæ*. The calyx is quadrifid, the corolla tetrapetalous, and the capſule bivalved and monoſpermous. There are five ſpecies, all natives of the warm parts of America, riſing with woody ſtems more than 20 feet high. They are propagated by ſeeds; but in this country muſt be kept continually in a ſtove.

FAGE (Raimond de la), an excellent deſigner and engraver, highly eſteemed by Carlo Maratti, was born at Toulouſe in 1648. He applied himſelf to deſigning, through inclination, in ſpite of his parents; and had no maſter nor any aſſiſtance: but his ſuperior talents ſupplied the want of them, and he became one of the beſt deſigners in Europe; but his performances on licentious ſubjects are the moſt eſteemed. It is reported of this artiſt, that he never made uſe of money, but contracted debts; and when the accounts were brought him, he drew upon the back of the bills, and bid the owners ſell the drawings to connoiſſeurs for the amount, by which they were generally great gainers. Several of thoſe drawings are in the cabinets of the curious. He led a looſe, depraved life; which his repeated debaucheries put an end to at the age of 42.

FAENSA, a city and biſhop's ſee of Italy, ſituated in the pope's territories, about 30 miles eaſt of Bologna. E. long. 12. 38. and N. lat. 44. 30.

FAGGOT, in times of popery here, was a badge worn on the ſleeve of the upper garment of ſuch perſons as had recanted or abjured what was then termed *hereſy*; being put on after the perſon had carried a faggot, by way of penance, to ſome appointed place of ſolemnity. The leaving off the wear of this badge was ſometimes interpreted a ſign of apoſtacy.

Faggots, among military men, perſons hired by officers, whoſe companies are not full, to muſter and hide the deficiencies of the company; by which means they cheat government of ſo much money.

FAGIUS (Paul), *alias* Buchlin, a learned Proteſtant miniſter, born at Rheinzabern in Germany in 1504. He was a ſchoolmaſter at Iſna; but afterwards became a zealous preacher, and wrote many books. The perſecution in Germany menacing danger to all who did not profeſs the Romiſh doctrines, he and Bucer came over to England in 1549, at the invitation of

archbishop Cranmer, to perfect a new translation of the scriptures. Fagius took the Old Testament, and Bucer the New, for their respective parts; but the design was at that time frustrated by the sudden death of both. Fagius died in 1550, and Bucer did not live above a year after. Their bodies were dug up and burned in the reign of queen Mary.

FAGONIA, in botany; a genus of the monogynia order, belonging to the decandria class of plants; and in the natural method ranking under the 14th order, *Gruinales*. The calyx is pentaphyllous; the petals are five, and heart-shaped; the capsule is quinquelocular, ten-valved, with the cells monospermous. There are three species, natives of Spain, Crete, and Arabia.

FAGOPYRUM, or BUCK-WHEAT. See POLYGONUM.

FAGUS, the BEECH-TREE; a genus of the polyandria order, belonging to the monœcia class of plants; and in the natural method ranking under the 50th order, *Amentaceæ*. The male calyx is quinquefid and campanulated: there is no corolla; the stamina are 12: the female calyx is quinquedentated; there is no corolla; there are three styles; the capsule (formerly the calyx) is muricated and quadrivalved: the seeds, two in number. There are three species: 1. The sylvaticus, or beech-tree, rises 60 or 70 feet high, and has a proportionable thickness, branching upward into a fine regular head, garnished with oval serrated leaves, with flowers in globular catkins, succeeded by angular fruit called *mast*. 2. The castanea, or chesnut-tree, hath a large upright trunk growing 40 or 50 feet high, branching regularly round into a fine spreading head, garnished with large spear-shaped acutely serrated leaves, naked on the under side, having flowers in long amentums, succeeded by round prickly fruit, containing two or more nuts. 3. The pumila, dwarf chesnut-tree, or chinkapin, rises eight or ten feet high, with a branching shrubby stem, and oval spear-shaped and acutely serrated leaves, hoary on the under side.

The first species is very easily raised from the mast or seed. "For woods (says Evelyn), the beech must be governed as the oak:—In nurseries, as the ash; sowing the masts in autumn, or later, even after January, or rather nearer the spring, to preserve them from vermin, which are very great devourers of them. But they are likewise to be planted of young seedlings to be drawn out of the places where the fruitful trees abound." Millar says, the season for sowing the masts "is any time from October to February, only observing to secure the seeds from vermin when early sowed; which if carefully done, the sooner they are sown the better after they are fully ripe." Hanbury orders a sufficient quantity of masts to be gathered about the middle of September, when they begin to fall: these are to be "spread upon a mat in an airy place six days to dry; and after that you may either proceed to sow them immediately, or you may put them up in bags in order to sow them nearer the spring: which method I would rather advise, as they will keep very well, and there will be less danger of having them destroyed by mice or other vermin, by which kinds of animals they are greatly relished." They must be sown in beds properly prepared about an inch deep. In the first spring many of the young plants will appear, whilst others will not come up till the spring following. Having stood two years in the seminary, they should be removed to the nursery, where they may remain till wanted.

The propagation of the second species is also chiefly from seeds. Evelyn says, "Let the nuts be first spread to sweat, then cover them in sand; a month being past, plunge them in water, and reject the swimmers; being dried for 30 days more, sand them again, and to the water-ordeal as before. Being thus treated until the beginning of spring or in November, set them as you would beans; and, as some practise it, drenched for a night, or more, in new milk; but with half this preparation they need only to be put into the holes with the point upwards, as you plant tulips. If you design to set them in winter or autumn, I counsel you to inter them in their husks, which being every way armed, are a good protection against the mouse, and a providential integument."—"Being come up, they thrive best unremoved, making a great stand for at least two years upon every transplanting; yet if needs you must alter their station, let it be done about November." Millar cautions us against purchasing foreign nuts that have been kiln-dried, which (he says) is generally done to prevent their sprouting in their passage; therefore he adds, "If they cannot be procured fresh from the tree, it will be much better to use those of the growth of England, which are full as good to sow for timber or beauty as any of the foreign nuts, though their fruit is much smaller." He also recommends preserving them in sand, and proving them in water. In setting these seeds or nuts (he says), "the best way is to make a drill with a hoe (as is commonly practised for kidney-beans) about four inches deep, in which you should place the nuts, at about four inches distance, with their eye uppermost; then draw the earth over them with a rake, and make a second drill at about a foot distance from the former, proceeding as before, allowing three or four rows in each bed. In April (he does not mention the time of sowing) these nuts will appear above-ground; you must therefore observe to keep them clear from weeds, especially while young: in these beds they may remain for two years, when you should remove them into a nursery at a wider distance. The best time for transplanting these trees is either in October or the latter end of February, but October is the best season: the distance these should have in the nursery is three feet row from row, and one foot in the rows. If these trees have a downright tap-root, it should be cut off, especially if they are intended to be removed again: this will occasion their putting out lateral shoots, and render them less subject to miscarry when they are removed for good. The time generally allowed them in the nursery is three or four years, according to their growth; but the younger they are transplanted, the better they will succeed. Young trees of this sort are very apt to have crooked stems; but when they are transplanted out and have room to grow, as they increase in bulk they will grow more upright, and their stems will become straight, as I have frequently observed where there have been great plantations."—Hanbury follows Millar almost literally; except that he mentions February as the time of sowing; and recommends that the young plants, a year after they have been planted in the nursery, be cut down to within an inch of the ground; which (he says) "will cause them to shoot vigorously with one strong and straight stem." There is one material objection against sowing chesnuts in drills, which are well known to serve as guides or conductors to the field-mouse, who will run from one end to the other of a drill without letting a single nut escape her: we rather recommend setting them with a dibble, either promiscuously or a quincunx, at about six inches distance. Evelyn says, that coppices of chesnuts may be thickened by layering the tender young shoots; but adds, that "such as spring from the nuts and marrons are best of all." There is a striped-leaved variegation which is continued by budding; and the French are said to graft chesnuts for their fruit; but Millar says, such grafted trees are unfit for timber. The chesnuts will thrive upon almost any soil which lies out of the water's way; but dislikes wet moory land.

The method of propagating the dwarf chesnut is from seeds, which we receive from America. These should be planted in drills, as soon as they arrive, in a moist bed of rich garden-mould. If the seeds are good, they will come up pretty soon in the spring. After they appear, they will require no trouble, except keeping them clean from weeds, and watering them in dry weather. They may stand in the seed-bed two

years, and be afterwards planted in the nursery-ground, at a foot asunder and two feet distance in the rows; and here when they are got strong plants, they will be fit for any purpose.

In statelinefs and grandeur of outline, the beech excels the oak. Its foliage is peculiarly soft and pleasing to the eye; its branches are numerous and spreading; and its stem grows to a great size. The bark of the beech is remarkably smooth, and of a silvery cast: this, added to the splendour and smoothness of its foliage, gives a striking neatness and delicacy to its general appearance. The beech, therefore, standing singly, and suffered to form its own natural head, is highly ornamental; and its leaves varying their hue as the autumn approaches, renders it in this point of view still more desirable. In respect of actual use the beech follows next to the oák and the ash: it is almost as necessary to the cabinet-maker and turner as the oak is to the ship-builder, or the ash to the plough and cart-wright. Evelyn nevertheless condemns it in pointed and general terms; because "where it lies dry, or wet and dry, it is exceedingly obnoxious to the worm." He adds, however, "but being put ten days in water, it will exceedingly resist the worm." The natural soil and situation of the beech are upon dry, chalky, or limestone heights: it grows to a great size upon the hills of Surry and Kent; as also upon the declivities of the Cotswold and Stroudwater hills of Gloucestershire, and flourishes exceedingly upon the bleak banks of the Wye, in Hereford and Monmouth shires; where it is much used in making charcoal. In situations like those, and where it is not already prevalent, the beech, whether as a timber-tree or as an underwood, is an object worthy the planter's attention.

The mast, or seeds, yield a good oil for lamps; and are a very agreeable food to squirrels, mice, and swine. The fat of swine fed with them, however, is soft, and boils away unless hardened by some other food. The leaves gathered in autumn, before they are much injured by the frosts, make much better matrasses than straw or chaff; and last for seven or eight years. The nuts, when eaten by the human species, occasion giddiness and headach; but when well dried and powdered, they make wholesome bread. They are sometimes roasted, and substituted for coffee. The poor people in Silesia use the expressed oil instead of butter.

The *chesnut tree* sometimes grows to an immense size. The largest in the known world are those which grow upon Mount Ætna in Sicily. See Ætna. At Tortworth in Gloucestershire, is a chesnut tree 52 feet round. It is proved to have stood there ever since the year 1150, and was then so remarkable that it was called the *great chesnut of Tortworth*. It fixes the boundary of the manor, and is probably near 1000 years old. As an ornamental, the chesnut, though unequal to the oak, the beech, and the esculus, has a degree of grandeur belonging to it which recommends it strongly to the planter's attention. Its uses have been highly extolled; and it may deserve a considerable share of the praise which has been given it. As a substitute for the oak, it is preferable to the elm, for door-jambs, window-frames, and some other purposes of the house-carpenter, it is nearly equal to oak itself; but it is very apt to be shakey, and there is a deceitful brittleness in it which renders it unsafe to be used as beams, or in any other situation where an uncertain load is required to be borne. It is universally allowed to be excellent for liquor casks; as not being liable to shrink, nor to change the colour of the liquor it contains: it is also strongly recommended as an underwood for hop-poles, stakes, &c. Its fruit too is valuable, not only for swine and deer, but as human food: bread is said to have been made of it. Upon the whole, the chesnut, whether in the light of ornament or use, is undoubtedly an object of the planter's notice.

FAINT-action, in law, a feigned action, or such as, although the words of the writ are true, yet, for certain causes, the plaintiff has no title to recover by.

Faint-*Pleader*, in law, a covinous, false, or collusory manner of pleading, to the deceit of a third person.

FAINTING. See Lipothymia.

FAINTS, in the distillery, the weak spirituous liquor that runs from the still in rectifying the low wines after the proof-spirit is taken off. This term denotes also the last runnings of all spirits distilled by the alembic. The clearing the worm is a very essential point in order to the obtaining a pure spirit by the subsequent distillation; indeed all other measures are fruitless without it. See Distillation.

FAIR, a greater kind of market, granted to a town, by privilege, for the more speedy and commodious providing of such things as the place stands in need of. The word *fair* is formed from the French *foire*, which signifies the same thing; and *foire* is by some derived from the Latin *forum*, "market;" by others from the Latin *feriæ*, because anciently fairs were always held in those places where the wakes, or feasts of the dedications of churches, called *feriæ*, were held. See Feriæ. It is incident to a fair, that persons shall be free from being arrested in it for any other debt or contract than what was contracted in the same; or, at least, promised to be paid there. These fairs are generally kept once or twice a year; and, by statute, they shall not be held longer than they ought, by the lords thereof, on pain of their being seized into the king's hands, &c. Also proclamation is to be made, how long they are to continue; and no person shall sell any goods after the time of the fair is ended, on forfeiture of double the value, one fourth to the prosecutor and the rest to the king. There is a toll usually paid in fairs on the sale of goods, and for stallage, picage, &c.

Fairs abroad are either free, or charged with toll and impost. The privileges of free fairs consist chiefly, first, in that all traders, &c. whether natives or foreigners, are allowed to enter the kingdom, and are under the royal protection, exempt from duties, impositions, tolls, &c. Secondly, that merchants, in going or returning, cannot be molested or arrested, or their goods stopped. They are established by letters-patent from the prince. Fairs, particularly free fairs, make a very considerable article in the commerce of Europe, especially that of the Mediterranean, and inland parts of Germany, &c.

The most celebrated fairs in Europe are those, 1. Of Francfort, held twice a-year, in spring and autumn; the first commencing the Sunday before Palm-Sunday, and the other on the Sunday before the 8th of September. Each lasts 14 days, or two weeks; the first of which is called the *week of acceptance*, and the second the *week of payment*. They are famous for the sale of all kinds of commodities; but particularly for the immense quantity of curious books no where else to be found, and whence the booksellers throughout all Europe used to furnish themselves. Before each fair, there is a catalogue of all the books to be sold there, printed and dispersed, to call together purchasers: though the learned complain of many unfair practices therein: as fictitious titles, names of books purely imaginary, &c. beside great faults in the names of the authors, and the titles of the real books. 2. The fairs of Leipsick, which are held thrice a-year: one beginning on the first of January; another three weeks after Easter; and a third after Michaelmas. They hold 12 days a piece; and are at least as considerable as those of Francfort. 3. The fairs of Novi, a little city in the Milanese, under the dominion of the republic of Genoa. There are four in the year, commencing on the second of February, the second of May, the first of August, and second of September. Though the commodities bought and sold here be very considerable; yet, what chiefly contributes to render them so famous, is the vast concourse of the most considerable merchants and

negocians of the neighbouring kingdoms, for the tranſacting of affairs and ſettling accounts. 4. The fairs of Riga, whereof there are two in the year; one in May, and the other in September. They are much frequented by the Engliſh, Dutch, and French ſhips, as alſo from all parts of the Baltic. The beſt time for the ſale of goods at Riga is during the fairs. Since the building of the famous city of Peterſburg, theſe fairs have ſuffered ſome diminution. 5. The fair of Archangel, during which all the trade foreigners have with that city, is managed. It laſts a month, or ſix weeks at moſt, commencing from the middle of Auguſt. The Muſcovite merchants attend here from all parts of that vaſt empire; and the Engliſh, Dutch, French, Swediſh, Daniſh, and other ſhips in the port of that city, on this occaſion, ordinarily amount to 300. But this is no free fair as the reſt are: the duties of exportation and importation are very ſtrictly paid, and on a very high footing. 6. The fair of St. Germain, one of the ſuburbs of Paris, commencing on the third of February, and holding till Eaſter; though it, is only free for the firſt fifteen days. 7. The fairs of Lyons, which Monſ. du Cheſne, in his Antiquity of cities, would inſinuate, from a paſſage in Strabo, were eſtabliſhed by the Romans; though it is certain, the fairs, as they now ſtand, are of a much later date. There are three in the year, each laſting 20 days, and free for ever. They begin on Eaſter Monday, the 26th of July, and the firſt of December. 8. Fair of Guibray, a ſuburb of the city of Falaiſe, in the Lower Normandy. It is ſaid to have been eſtabliſhed by our William the Conqueror, in conſideration of his being born at Falaiſe. It commences on the 16th of Auguſt; and holds 15 days free by charter, and longer by cuſtom. 9. Fair of Beaucaire, held partly in a city of that name, in Languedoc, and partly in the open country, under tents, &c. It commences on the 22d of July, and only holds for three days; yet it is the greateſt and moſt celebrated of all the fairs in that part of Europe, both for the concourſe of ſtrangers from all parts of the world, and for the traffic of all kind of goods: the money returned in theſe three days amounting ſometimes to above ſix millions of livres.

The fairs of Porto-bello, Vera Cruz, and the Havanna, are the moſt conſiderable of all thoſe in America. The two firſt laſt as long as the flota and galleons continue in thoſe parts; and the laſt is opened as ſoon as the flota or galleons arrive there upon their return for Spain; this being the place where the two fleets join. See Flota, and Galleons.

The principal Britiſh fairs are, 1. Sturbridge-fair, near Cambridge, by far the greateſt in Britain, and perhaps in the world. 2. Briſtol has two fairs, very near as great as that of Sturbridge. 3. Exeter. 4. Weſt Cheſter. 5. Edinburgh. 6. Wheyhill; and, 7. Burford-fair; both for ſheep. 8. Pancras fair, in Staffordſhire, for ſaddle-horſes. 9. Bartholomew-fair, at London, for lean and Welch black cattle. 10. St. Faith's, in Norfolk, for Scotch runts. 11. Yarmouth fiſhing-fair, for herrings, the only fiſhing-fair in Great Britain. 12. Ipſwich butter-fair. 13. Woodborough-hill, in Dorſetſhire, for weſt country manufactures, as kerſeys, druggets, &c. 14. Two cheeſe fairs at Chipping Norton: with innumerable other fairs, beſides weekly markets, for all ſorts of goods, as well our own as of foreign growth.

Fair, in ſea language, is uſed for the diſpoſition of the wind; when it is favourable to a ſhip's courſe, in oppoſition to that which is contrary or foul. The term *fair* is more comprehenſive than *large*, and includes about 16 or 18 points of the compaſs; whereas large is confined to the beam or quarter, that is, to a wind which croſſes the keel at right angles, or obliquely from the ſtern, but never to one right a-ſtern.

Fair *Iſle*, an iſland of the Northern ocean, nearly midway between Shetland and Orkney, from both which its high towering rocks are plainly diſcovered. On the E. ſide, the duke of Medina Sidonia, admiral of the Spaniſh armada, was wrecked in 1588.

Fair-*Curve*, is a winding line, uſed in delineating ſhips, whoſe ſhape is varied, according to the part of the ſhip which it is intended to deſcribe.

Fair-*Way*, in ſea language, the path or channel of a narrow bay, river, or haven, in which ſhips uſually advance in their paſſage up and down; ſo that, if any veſſels are anchored therein, they are ſaid to lie in the fair-way.

FAIRFAX (Edward), natural ſon of Sir Thomas Fairfax, was an Engliſh poet who lived in the reigns of Elizabeth and James I. He wrote ſeveral poetical pieces, and was an accompliſhed genius. Dryden introduces Fairfax with Spenſer, as the leading writers of the times; and even ſeems to give the preference to the former in the way of harmony, when he obſerves that Waller owned himſelf indebted for the harmony of his numbers to Fairfax's *Godfrey of Boulogne*. He died about the year 1632, at his own houſe called *Newhall*, in the pariſh of Fuyſton, between Denton and Knareſborough, and lies under a marble ſtone.

Fairfax (Sir Thomas), general of the parliamentary forces againſt Charles I. in 1644. He reſigned in 1650; after which he lived privately, till he was invited by general Monk to aſſiſt him againſt Lambert's army. He cheerfully embraced the occaſion; and, on the 3d of December 1659, appeared at the head of a body of gentlemen of Yorkſhire; when, upon the reputation of his name, a body of 12,000 men forſook Lambert and joined him. He was at the head of the committee appointed by the houſe of commons to attend king Charles II. at the Hague, to deſire him ſpeedily to return to England; and having readily aſſiſted in his reſtoration, returned again to his ſeat in the country; where he lived in a private manner till his death, which happened in 1671, in the 60th year of his age. He wrote, ſays Mr. Walpole, memorials of Thomas lord Fairfax, printed in 1699; and was not only an hiſtorian, but a poet. In Mr. Thoreſby's muſeum were preſerved in manuſcript the following pieces: the Pſalms of David, the Canticles, the Songs of Moſes, and other parts of Scripture, verſified; a poem on Solitude; Notes of Sermons, by his lordſhip, by his lady daughter of Horace lord Vere, and by their daughter Mary the wife of George ſecond duke of Buckingham; and a Treatiſe on the Shortneſs of Life. But of all lord Fairfax's works, ſays Mr. Walpole, the moſt remarkable were the verſes he wrote on the horſe on which Charles II. rode to his coronation, and which had been bred and preſented to the king by his lordſhip. How muſt that merry monarch, unapt to keep his countenance on more ſerious occaſions, have ſmiled at this awkward homage from the old victorious hero of republicaniſm and the covenant! He gave a collection of manuſcripts to the Bodleian library.

FAIRFORD, a town of Glouceſterſhire, with a market on Thurſday. The church was built for the ſake of the glaſs, taken in a ſhip going to Rome. It has 28 large windows, curiouſly painted with ſcripture hiſtories, in extreme beautiful colours, and deſigned by the famous Albert Durer. It is 25 miles S. E. of Glouceſter; and 80 W. by N. of London. W. lon. 1. 44. N. lat. 51. 40.

FAIRY, in ancient traditions and romances, ſignifies a ſort of deity, or imaginary genius, converſant on the earth, and diſtinguiſhed by a variety of fantaſtical actions either good or bad. They were moſt uſually imagined to be women of an order ſuperior to human nature, yet ſubject to wants, paſſions, accidents, and even death; ſprightly and benevolent while young and handſome; moroſe, peeviſh, and malignant, if ugly, or in the decline of their beauty; fond of appearing in white, whence, by credulous people, they were often called the *white ladies*.

Concerning theſe imaginary beings, no leſs a perſon than

Gervaise of Tilleberry, marſhal of the kingdom of Arles, who lived in the beginning of the 13th century, writes thus in a work inſcribed to the emperor Otho IV. "It has been aſſerted by perſons of unexceptionable credit, that fairies uſed to chooſe themſelves gallants from among men, and rewarded their attachment with an affluence of worldly goods; but if they married, or boaſted of a fairy's favours, they as ſeverely ſmarted for ſuch indiſcretion." The like tales ſtill go current in Languedoc; and, throughout the whole province, there is not a village without ſome ancient ſeat or cavern which had the honour of being a fairy's reſidence, or at leaſt ſome ſpring where a fairy uſed to bathe. This idea of fairies has a near affinity with that of the Greeks and Romans, concerning the nymphs of the woods, mountains, and ſprings; and an ancient ſcholiaſt on Theocritus ſays, "The nymphs are demons which appear on the mountains in the figure of women:" and what is more ſurpriſing, the Arabs and other orientals have their *ginn* and *peri*, of whom they entertain the like notions. But fairies have been likewiſe deſcribed as of either ſex, and generally as of minute ſtature, though capable of aſſuming various forms and dimenſions. The moſt charming repreſentation imaginable of theſe children of romantic fancy, is in the *Midſummer-night's dream* of Shakeſpear; in referring to which, we ſhall doubtleſs have been anticipated by the recollection of almoſt every reader.

Spenſer's *Fairy queen* is an epic poem, under the perſons and characters of fairies. This ſort of poetry raiſes a pleaſing kind of horror in the mind, and amuſes the imagination with the ſtrangeneſs and novelty of the perſons who are repreſented in it; but, as a vehicle of inſtruction, judicious critics object to it, as not having probability enough to make any moral impreſſion.

The belief of fairies ſtill ſubſiſts in many parts of our own country. The "Swart FAIRY *of the mine*," has ſcarce yet quitted our ſubterraneous works (*vide* next article); and *Puck* or *Robin Good-Fellow* ſtill haunts many of our villages. And in the highlands of Scotland, new born children are watched till the chriſtening is over, leſt they ſhould be ſtolen or changed by ſome of theſe fantaſtical perſonages.

FAIRY *of the Mine*; an imaginary being, an inhabitant of mines. The Germans believed in two ſpecies; one fierce and malevolent; the other a gentle race, appearing like little old men dreſſed like the miners, and not much above two feet high. Theſe wander about the drifts and chambers of the works; ſeem perpetually employed, yet do nothing; ſome ſeem to cut the ore, or fling what is cut into veſſels, or turn the windlaſs; but never do any harm to the miners, unleſs provoked; as the ſenſible Agricola, in this point credulous, relates in his book *de Animantibus ſubterraneis*.

FAIRY *Circle* or *Ring*, a phenomenon pretty frequent in the fields, &c. ſuppoſed by the vulgar to be traced by the fairies in their dances. There are two kinds of it; one of about ſeven yards in diameter, containing a round bare path, a foot broad, with green graſs in the middle of it. The other is of different extent, encompaſſed with a circumference of graſs. Meſſ. Jeſſop and Walker, in the Philoſophical Tranſactions, aſcribe them to lightning; which is thought to be confirmed by their being moſt frequently produced after ſtorms of that kind, as well as by the colour and brittleneſs of the graſs-roots when firſt obſerved. Lightning, like all other fires, moves round, and burns more in the extremity than in the middle: the ſecond circle ariſes from the firſt, the graſs burnt up growing very plentifully afterwards. Others maintain that theſe circles are made by ants, which are frequently found in great numbers therein. Mr. Cavallo does not think that lightning is at all concerned in the formation of them: "They are not (ſays he) always of a circular figure; and, as I am informed, they ſeem to be rather beds of muſhrooms than the effects of lightning."

FAITH, in philoſophy and theology, that aſſent which we give to a propoſition advanced by another, the truth of which we do not immediately perceive from our own reaſon or experience: or it is a judgment or aſſent of the mind, the motive whereof is not any intrinſic evidence, but the authority or teſtimony of ſome author who reveals or relates it. Hence, as there are two kinds of authorities and teſtimonies, the one of God, and the other of man, faith becomes diſtinguiſhed into divine and human. *Divine* FAITH, is that founded on the authority of God; or it is that aſſent we give to what is revealed by God. The objects of this faith, therefore, are matters of revelation. See REVELATION and RELIGION. *Human* FAITH, is that whereby we believe what is told us by men. The object hereof is matter of human teſtimony and evidence. See METAPHYSICS.

FAITH, or *Fidelity*, (*Fides*), was deified by the ancient Romans, and had a temple in the Capitol conſecrated to her by Attilius Catilinus. Here prieſts wore white veils: unbloody ſacrifices were offered to her, and the greateſt oaths were taken in her name. Horace clothes her in white, places her in the retinue of Fortune, and makes her the ſiſter of Juſtice, *Od.* 24, 35, l. i. Public faith is repreſented on a great number of medals; ſometimes with a baſket of fruit in one hand, and ſome ears of corn in the other; and ſometimes holding a turtle-dove. But the moſt uſual ſymbol is two hands joined together. The inſcriptions are generally, *Fides Auguſti, Fides exercitus*, or *Fides militum*, &c.

FAITHORN (William), an ingenious Engliſh artiſt, a native of London, was the diſciple of Peak the painter, and worked with him three or four years. At the breaking out of the civil war, Peak eſpouſed the cauſe of his ſovereign; and Faithorn, who accompanied his maſter, was taken priſoner by the rebels at Baringhouſe, from whence he was ſent to London, and confined in Alderſgate. In this uncomfortable ſituation he exerciſed his graver; and a ſmall head of the firſt Villers duke of Buckingham, in the ſtyle of Melan, is reckoned among his performances at that time. The ſolicitations of his friends in his favour at laſt prevailed; and he was releaſed from priſon, with permiſſion to retire to the continent. In France he found protection and encouragement from the Abbé de Marolles; and at this time it was, that he formed an acquaintance with Nanteuil, from whoſe inſtructions he derived very conſiderable advantages. About the year 1650 he returned to England, and ſoon after married the ſiſter of a Captain Grcund. By her he had two ſons; Henry, who was a bookſeller, and William an engraver in mezzotinto. Faithorn opened a ſhop near Temple-bar, where he ſold not only his own engravings, but thoſe of other Engliſh artiſts, and imported a conſiderable number of prints from Holland, France, and Italy. About the year 1680 he retired from his ſhop, and reſided in Printing-houſe-yard; but he ſtill continued to work for the bookſellers, eſpecially Royſton, Martin, and Peak the younger, his former maſter's brother. He painted portraits from the life in crayons; which art he learned of Nanteuil during his abode in France. He alſo painted in miniature; and his performances in both theſe ſtyles were much eſteemed. His ſpirits were broken by the indiſcretion and diſſipation of his ſon William; and a lingering conſumption put an end to his life in 1691. He wrote a book *upon drawing, graving, and etching*, for which he was celebrated by his friend Thomas Flatman, the poet.

FAKIRS, Indian monks or friars. They out-do the ſeverity and mortification of the ancient anchorets or ſolitaries. Some of them make a vow of continuing all their lifetime in one poſture, and keep it effectually. Others never lie down; but continue in a ſtanding poſture all their lives, ſupported only by

a ſtick, or rope under their arm-pits. Some mangle their bodies with ſcourges and knives. They look upon themſelves to have conquered every paſſion, and triumphed over the world; and accordingly ſcruple not, as if in a ſtate of innocence, to appear entirely naked in public. The common people of Eaſt India are thoroughly perſuaded of the virtue and innocence of the fakirs; notwithſtanding which, they are accuſed of committing the moſt enormous crimes in private.

They have alſo another kind of fakirs, who do not practiſe ſuch ſeverities: theſe flock together in companies, and go from village to village, propheſying, and telling fortunes. They are wicked villains, and it is dangerous for a man to meet them in a lone place: nevertheleſs the Indian idolaters have them in the utmoſt veneration. They make uſe of drums, trumpets, and other muſical inſtruments, to rouſe their ſouls, and work themſelves up to an artificial ecſtacy, the better to publiſh their pretended prophecies. Some of the votaries of theſe ſages moſt devoutly kiſs their privy parts; and they receive this monſtrous declaration of reſpect with a kind of ecſtatic pleaſure. The moſt ſober and diſcreet Indians conſult them in this prepoſterous attitude; and their female votaries converſe with them a conſiderable time with the moſt indecent freedom.

The fire they burn is made of cow's dung dried in the ſun. When they are diſpoſed to ſleep, they repoſe themſelves on cow's dung, and ſometimes on ordure itſelf. They are ſo indulgent towards every living creature, that they ſuffer themſelves to be over-run with vermin, or ſtung by inſects, without the leaſt reluctance or complaint.

It is more than probable, theſe Indian friars have ſome ſecret art to lull their ſenſes aſleep, in order to render themſelves in a great meaſure inſenſible of the exceſſive torments they voluntarily undergo. Ovington aſſures us, that "as he was one day in an aſſembly of fakirs, he obſerved, that they drank opiates infuſed in water; the intoxicating virtue whereof was enough to turn their brain."

The garment of the chief fakirs conſiſts of three or four yards of orange-coloured linen, which they tie round them, and a tiger's ſkin, which hangs over their ſhoulders. Their hair is woven in treſſes, and forms a kind of turban. The ſuperior of the fakirs is diſtinguiſhed from the reſt by having a greater number of pieces in his garment, and by a chain of iron, two yards long, tied to his leg. When he deſigns to reſt in any place, a garment is ſpread upon the ground; on which he ſits and gives audience, whilſt his diſciples publiſh his virtues. Some perſons of quality in India have become fakirs: among others, five great lords belonging to the court of Cha-gehan, mogul of the Indies. It is ſaid, there are about two millions of fakirs in the Eaſt Indies.

FALASHA, a people of Abyſſinia, of Jewiſh origin, deſcribed by Mr. Bruce, who was at great pains to acquaint himſelf with their hiſtory by cultivating the friendſhip of the moſt learned perſons among them he could meet with.

According to the accounts received from them, the Falaſha are the deſcendants of thoſe Jews who came from Paleſtine into Ethiopia, as attendants of Menilek the ſon of the queen of Sheba or Saba by Solomon. They agree in the relations given by the Abyſſinians of that princeſs, which are mentioned under the article Ethiopia; but deny that the poſterity of thoſe who came with Menilek ever embraced the Chriſtian religion, as the Abyſſinians ſay they did. They ſay, that at the decline of the Jewiſh commerce, when the ports of the Red Sea fell into the hands of other nations, and no intercourſe took place betwixt them and Jeruſalem, the Jewiſh inhabitants quitted the ſea-coaſts and retired into the province of Dembea. While they remained in the cities on the Red Sea, they exerciſed the trades of brick and tile making, pottery, thatching houſes, &c. and after leaving the ſea-coaſts, they choſe the country of Dembea on account of the plenty of materials it afforded for exerciſing the trades they profeſſed. Here they carried the art of pottery to a great degree of perfection, multiplied exceedingly, and became very numerous and powerful about the time that the Abyſſinians were converted to Chriſtianity. As this event was accounted by them an apoſtacy from the true religion, they now ſeparated themſelves from the Abyſſinians, and declared one Phineas, of the line of Solomon, their king. Thus they ſay, they have ſtill a prince of the houſe of Judah for their ſovereign, though their aſſertion is treated with contempt, and a nick-name beſtowed on the Falaſhan family by the other Abyſſinians. About the year 960, the queen of this people, after extirpating the Abyſſinian princes on the rock Damo, aſſumed the ſovereignty of the whole empire, which they retained for ſome time, as is related in the ancient hiſtory; but their power being by degrees reduced, they were obliged to take up their reſidence among the rugged mountains of Samen; one of which they choſe for their capital, and which has ever ſince been called the *Jews rock*. About the year 1600, they were almoſt entirely ruined by an overthrow from the Abyſſinians, in which both their king and queen were ſlain; ſince which time they have been in ſubjection to the emperors of that country, but are ſtill governed by their own princes. When Mr. Bruce was in Abyſſinia they were ſuppoſed to amount to about 100,000 effective men. Gideon and Judith were the names of the king and queen at that time: and theſe, according to our author, ſeem to be preferred to others for the royal family.

The language of this people is very different from the Hebrew, Samaritan, or any other which the Jews ever ſpoke in their own country. On being interrogated concerning it by Mr. Bruce, they ſaid, that it was probably one of thoſe ſpoken by the nations on the Red Sea, among whom they had ſettled at their firſt coming. They arrived in Abyſſinia ſpeaking Hebrew, and with the advantage of having books in that language; but had now forgot it, which indeed is not to be wondered at, as they had loſt their Hebrew books, and were intirely ignorant of the art of writing. At the time of their leaving Jeruſalem, they were in poſſeſſion both of the Hebrew and Samaritan copies of the law; but when their fleet was deſtroyed in the time of Rehoboam, and no farther communication with Jeruſalem took place, they were obliged to uſe tranſlations of the ſcriptures, or thoſe copies which were in poſſeſſion of the ſhepherds, who, they ſay, were all Jews before the time of Solomon. On being aſked, however, where the ſhepherds got their copy, and being told, that, notwithſtanding the invaſion of Egypt by Nebuchadnezzar, there was ſtill a communication with Jeruſalem by means of the Iſhmaelite Arabs through Arabia, they frankly acknowledged that they could not tell; neither had they any memorials of the hiſtory either of their own or any other country; all that they believed in this caſe being derived from mere tradition, their hiſtories, if any exiſted, having been deſtroyed by the famous Mooriſh Captain Gragné. They ſay, that the firſt book of ſcripture they ever received was that of Enoch; and they place that of Job immediately after it, ſuppoſing that patriarch to have lived ſoon after the flood. They have no copy of the Old Teſtament in the Falaſha language, what they make uſe of being in that of Geez. This is ſold to them by the Abyſſinian Chriſtians, who are the only ſcribes in that country. No difference takes place about corruptions of the text; nor do the Falaſha know any thing of the Jewiſh Talmud, Targum, or Cabala.

FALCADE, in the manege, the motion of a horſe when he throws himſelf upon his haunches two or three times, as in very quick curvets; which is done in forming a ſtop and half ſtop. See Stop.

FALCATED, fomething in the form of a fickle: thus, the moon is faid to be *falcated* when fhe appears horned.

FALCO, in ornithology, a genus belonging to the order of accipitres, the characters of which are thefe: the beak is crooked, and furnifhed with wax at the bafe: the head is thickfet with feathers, and the tongue is cloven. The eagle and hawk form this genus. See plate 18.

1. The *leucocephalus*, bald, or white-headed eagle of Catefby, is afh-coloured, with the head and tail white; the iris of the eye is white, over which is a prominence covered with a yellow fkin; the bill and the cere or wax are yellow, as are likewife the legs and feet; and the talons are black. Though it is an eagle of fmall fize, it weighs nine pounds, is ftrong and full of fpirit, preying on lambs, pigs, and fawns. They always make their nefts near the fea or great rivers, and ufually upon old dead pine or cyprefs trees, continuing to build annually on the fame tree till it falls. Though he is fo formidable to all birds, yet he fuffers them to build near his royal neft without moleftation; particularly the fifhing hawk, herons, &c. which all build on high trees, and in fome places are fo near one another, that they appear like a rookery. The nefts are very large and very fetid, owing to the relics of their prey. Lawfon fays they breed very often, laying again under their callow young; whofe warmth hatches the eggs. In Bering's ifle they make their nefts on the cliffs near fix feet wide and one thick; and lay two eggs in the beginning of July. This fpecies inhabits both Europe and America; but is more common in the latter. Befides flefh, it feeds alfo on fifh. This, however, it does not procure for itfelf; but fitting in a convenient fpot, watches the diving of the ofprey into the water after a fifh; which the moment it has feized the bald eagle follows clofe after, when the ofprey is glad to efcape by dropping the fifh from his bill; and fuch is the dexterity of the former, that it often feizes the prey before it can fall to the ground. Catefby fays the male and female are much alike.

2. The *offifragus*, or fea-eagle, with yellow wax, and half-feathered legs: it is about the fize of a peacock; the feathers are white at the bafe, iron-coloured in the middle, and black at the points; and the legs are yellow. It is found in feveral parts of Great Britain and Ireland. Mr. Willughby tells us, that there was an eyrie of them in Whinfield Park, Weftmoreland; and the bird foaring in the air with a cat in its talons (which Barlow drew from the very fact which he faw in Scotland) is of this kind. The cat's refiftance brought both animals to the ground, when Barlow took them up; and afterwards caufed the event to be engraved in the 36th plate of his collection of prints. Turner fays, that in his days this bird was too well known in England; for it made horrible deftruction among the fifh. All authors indeed agree, that it feeds principally on fifh, which it takes as they are fwimming near the furface, by darting itfelf down upon them; not by diving or fwimming, as fome authors have pretended, who furnifh it for that purpofe with one webbed foot to fwim with, and another divided foot to take its prey with. Martin, fpeaking of what he calls the great eagles of the Weftern Ifles, fays, that they faften their talons in the back of the fifh, commonly of falmon, which are often above the water, or very near the furface. Thofe of Greenland will even take a young feal out of the water. Turner, above mentioned, fays, that the fifhermen were fond of anointing their baits with the fat of this bird, imagining that it had a peculiar alluring quality: they were even fuperftitious enough to believe, that whenever the fea-eagle hovered over a piece of water, the fifh (as if charmed) would rife to the furface with their bellies upwards; and in that manner prefent themfelves to him. It alfo preys on water fowl. This fpecies is alfo frequent in North America, and was alfo met with in Botany ifland by Captain Cook.

3. The *chryfaëtos*, or golden eagle, weighs about 12 pounds, and is in length about three feet, the wings when extended meafuring about feven feet four inches. The fight and fenfe of fmelling are very acute: the head and neck are clothed with narrow, fharp-pointed feathers, of a deep brown colour bordered with tawny; the hind part of the head in particular is of a bright ruft colour. Thefe birds are very deftructive to fawns, lambs, kids, and all kinds of game; particularly in the breeding feafon, when they bring a vaft quantity of prey to their young. Smith, in his hiftory of Kerry, relates, that a poor man in that county got a comfortable fubfiftence for his family, during a fummer of famine, out of an eagle's neft, by robbing the eaglets of the food the old one brought; whofe attendance he protracted beyond the natural time, by clipping the wings and retarding the flight of the former. It is very unfafe to leave infants in places where eagles frequent; there being inftances in Scotland of two being carried off by them; but, fortunately, the theft was difcovered in time, and the children were reftored unhurt out of the eagles nefts. In order to extirpate thefe pernicious birds, there is a law in the Orkney ifles, which intitles every perfon that kills an eagle to a hen out of every houfe in the parifh where it was killed. Eagles feem to give the preference to the carcafes of dogs and cats. People who make it their bufinefs to kill thofe birds, lay one or other of thefe carcafes by way of bait; and then conceal themfelves within gunfhot. They fire the inftant the eagle alights; for fhe, that moment, looks about before fhe begins to prey. Yet, quick as her fight may be, her fenfe of hearing feems ftill more exquifite. If hooded crows or ravens happen to be nearer the carrion, and refort to it firft, and give a fingle croak, the eagle is certain of inftantly repairing to the fpot.

Eagles are remarkable for their longevity, and for their power of fuftaining a long abftinence from food. Mr. Keyfler relates, that an eagle died at Vienna after a confinement of 104 years. This pre-eminent length of days probably gave occafion to the faying of the Pfalmift, "Thy youth is renewed like the eagle's." One of this fpecies, which was nine years in the poffeffion of Owen Holland, Efq. of Conway, lived 32 years with the gentleman who made him a prefent of it; but what its age was when the latter received it from Ireland is unknown. The fame bird alfo furnifhes us with a proof of the truth of the other remark; having once, through the neglect of fervants, endured hunger for 21 days without any fuftenance whatever.

4. The *fulvus*, or white tailed eagle of Edwards, has the whole plumage of a dufky brown: the breaft marked with triangular fpots of white, but which are wanting in the Britifh kind: the tail is white, tipt with black; but in young birds dufky, blotched with white: the legs are covered to the toes with foft ruft-coloured feathers. Thefe birds inhabit Hudfon's bay and northern Europe as far as Drontheim. They are found on the higheft rocks of the Uralian chain, where it is not covered with wood; but are moft frequent on the Siberian, where they make their neft on the loftieft rocks. They are rather inferior in fize to the fea-eagle; but are generous, fpirited, and docile. The independent Tartars train them for the chafe of hares, foxes, antelopes, and even wolves. This practice is of confiderable antiquity; for Marco Polo, the great traveller of 1269, obferved and admired the diverfion of the great cham of Tartary; who had feveral eagles, which were applied to the fame purpofes as we have here defcribed. The Tartars alfo efteem the feathers of the tail as the beft they have for pluming their arrows. This fpecies is frequent in Scotland; where it is called the *black eagle*, from the dark colour of its plumage. It is very deftructive to deer, which it will feize between the horns; and by inceffantly beating it about the eyes with its wings, foon makes a prey of the haraffed animal. The eagles

in the isle of Rum have nearly extirpated the stags that used to abound there. They generally build in cliffs of rocks near the deer-forests; and make great havock not only among them, but also among the white hares and ptarmigans. Mr. Willughby gives the following curious account of the nest of this species. "In the year of our Lord 1668, in the woodlands near the river Darwent, in the peak of Derbyshire, was found an eagle's nest made of great sticks, resting one end on the edge of a rock, the other on two birch trees; upon which was a layer of rushes, and over them a layer of heath, and upon the heath rushes again; upon which lay one young one and an addle egg; and by them a lamb, a hare, and three heath poults. The nest was about two yards square, and had no hollow in it. The young eagle was black as a hobby, of the shape of a goshawk, almost of the weight of a goose, rough-footed, or feathered down to the foot: having a white ring about the tail."

5. The *cyaneus*, or hen-harrier, with white wax, yellow legs, a whitish blue body, and a white ring round the eyes and throat. It is the blue hawk of Edwards, and is a native of Europe and Africa. These birds are extremely destructive to young poultry and to the feathered game: they fly near the ground, skimming the surface in search of prey. They breed on the ground, and never are observed to settle on trees.

6. The *albiulla*, or cinereous eagle, is inferior in size to the golden eagle; the head and neck are of a pale ash-colour; the body and wings cinereous, clouded with brown; the quill feathers very dark; the tail white: the legs feathered but little below the knees, and of a very bright yellow. The male is of a darker colour than the female. The bill of this species is rather straighter than is usual in the eagle; which seems to have induced Linnæus to place it among the *vultures*. But Mr. Pennant observes, that it can have no title to be ranked with that genus, the characteristical mark of which is, that the head and neck are either quite bare, or only covered with down; whereas this bird is wholly feathered. This species is in size equal to the black eagle, and inhabits Europe as high as Iceland and Lapmark. It is common in Greenland, but does not extend to America; or, according to Mr. Pennant, if it does, it varies into the white-headed eagle, to which it has great affinity, particularly in its feeding much on fish; the Danes therefore call it *Fiské-orn*. It is common in the south of Russia, and about the Volga, as far as trees will grow; but is very scarce in Siberia. It inhabits Greenland the whole year, sitting on the rocks with flagging wing, and flies slowly. It makes its nest on the lofty cliffs, with twigs, lining the middle with mosses and feathers; lays two eggs; and sits in the latter end of May or beginning of June. These birds prey on young seals, which they seize as they are floating on the water; but frequently, by fixing their talons in an old one, they are overmatched, and drawn down to the bottom, screaming horribly. They feed also on fish, especially the lumpfish, and a sort of trout; on ptarmigans, auks, and eider ducks. They sit on the tops of rocks, attentive to the motion of the diving birds; and with quick eyes observe their course by the bubbles which rise to the surface of the water, and catch the fowls as they rise for breath. The Greenlanders use their skins for clothing next to their bodies; eat the flesh; and keep the bill and feet for amulets. They kill them with the bow; or take them in nets placed in the snow properly baited; or tempt them by the fat of seals, which the eagles eat to an excess which occasions such a torpidity as to make them an easy prey. They are common in Scotland and the Orkneys; where they feed on fish, as well as on land animals.

7. The *crying eagle* (Arct. Zool. p. 215.), with a dusky bill and yellow cere; the colour of the plumage is a ferruginous brown; the coverts of the wings and scapulars are elegantly varied with oval white spots; the primaries dusky, the ends of the greater, white; the breast and belly are of a deeper colour than the rest of the plumage, streaked downwards with dull yellow; the tail is dark brown, tipt with dirty white; the legs are feathered to the feet, which are yellow. The length of the bird is two feet.—This species is found in many parts of Europe, but not in Scandinavia; is frequent in Russia and Siberia; and extends even to Kamtschatka. It is less generous and spirited than other eagles, and is perpetually making a plaintive noise; from which it was styled by the ancients *planga & clanga*; and *anataria*, from its preying on ducks, which Pliny describes with great elegance. The Arabs used to train it for the chase; but its quarry was cranes and other birds; the more generous eagle being flown at antelopes and various quadrupeds. This species was itself an object of diversion, and made the game of even so small a falcon as the sparrow hawk; which would pursue it with great eagerness, soar above, then fall on it, and fastening with its talons, keep beating it about the head with its wings, till they both fell together to the ground. This Sir John Chardin has seen practised about Tauris.

8. The *milvus*, or kite, is a native of Europe, Asia, and Africa. This species generally breeds in large forests or woody mountainous countries. Its nest is composed of sticks, lined with several odd materials, such as rags, bits of flannel, rope, and paper. It lays two, or at most three, eggs; which, like those of other birds of prey, are much rounded and blunt at the smaller end. They are white, spotted with dirty yellow. Its motion in the air distinguishes it from all other birds, being so smooth and even that it is scarce perceptible. Sometimes it will remain quite motionless for a considerable space; at others glide through the sky without the least apparent action of its wings; from thence deriving the old name of *glead* or *glede*, from the Saxon *glida*. They inhabit the north of Europe, as high as Jarlsberg, in the very south of Norway; but do not extend farther. They quit Sweden in flocks at the approach of winter, and return in spring. Some of them winter about Astrakan, in lat. 46. 30: but the far greater part are supposed to retire into Egypt, being seen in September passing by Constantinople in their way from the north; and again in April returning to Europe, to shun the great heats of the east. They are observed in vast numbers about Cairo, where they are extremely tame, and feed even on dates, probably for want of other food. They also breed there; so that, contrary to the nature of other rapacious birds, they increase and multiply twice in the year; once in the mild winters of Egypt, and a second time in the summers of the north. It makes its appearance in Greece in the spring; and in the early ages, says Aristophanes, "it governed that country; and men fell on their knees when they were first blessed with the sight of it, because it pronounced the flight of winter, and told them to begin to shear their vernal fleeces." In Britain they are found the whole year. Lord Bacon observes, that when kites fly high, it portends fair and dry weather.

9. The *gentilis*, or gentil falcon, inhabits the north of Scotland, and was in high esteem as a bold and spirited bird in the days of falconry. It makes its nest in rocks: it is larger than the goshawk; the head of a light rust colour, with oblong black spots; the whole under side from chin to tail white, tinged with yellow; the back of a brown colour; the tail barred with four or five bars of black, and as many of ash-colour; the very tips of all the tail feathers white.

10. The *subbuteo*, or hobby, was used like the kestrel in the humbler kind of falconry; particularly in what was called *daring of larks*: the hawk was cast off; the larks, aware of their most inveterate enemy, were fixed to the ground for fear; by which means they became a ready prey to the fowler, who drew a net over them. The back of the bird is brown; the nape of

the neck white; and the belly pale, with oblong brown ſpots. It is a bird of paſſage; but breeds in Britain, and migrates in October.

11. The *buteo*, or buzzard, is the moſt common of the hawk kind in England. It breeds in large woods; and uſually builds on an old crow's neſt, which it enlarges, and lines with wool and other ſoft materials. It lays two or three eggs, which are ſometimes perfectly white, ſometimes ſpotted with yellow. The cock buzzard will hatch and bring up the young if the hen is killed. The young keep company with the old ones for ſome little time after they quit the neſt; which is not uſual with other birds of prey, who always drive away their brood as ſoon as they can fly. The buzzard is very ſluggiſh and inactive, and is much leſs in motion than other hawks; remaining perched on the ſame bough for the greateſt part of the day, and dwelling at moſt times near the ſame place. It feeds on birds, rabbits, moles, and mice; it will alſo eat frogs, earthworms, and inſects. This bird is ſubject to ſome variety in its colour. Some have the breaſt and belly of a brown colour, and are only marked acroſs the craw with a large white creſcent; but uſually the breaſt is of a yellowiſh white, ſpotted with oblong ruſt-coloured ſpots, pointing downwards: the back of the head, neck, and coverts of the wings, are of a deep brown, edged with a pale ruſt-colour: the middle of the back covered only with a thick white down. The tail is barred with black, and aſh-colour, and ſometimes with ferruginous.

12. The *tinnunculus*, or keſtrel, breeds in the hollows of trees, in the holes of high rocks, towers, and ruined buildings. It feeds on field-mice, ſmall birds, and inſects; which it will diſcover at a great diſtance. This is the hawk that we ſo frequently ſee in the air fixed in one place; and, as it were, fanning it with its wings; at which time it is watching for its prey. When falconry was in uſe in Great Britain, this bird was trained for catching ſmall birds and young partridges. It is eaſily diſtinguiſhed from all other hawks by its colours. The crown of the head and the greater part of the tail are of a fine light grey; the back and coverts of the wing of a brick-red, elegantly ſpotted with black: the whole under ſide of the bird of a pale ruſt-colour ſpotted with black.

13. The *ſufflator*, with yellowiſh wax and legs; the body is of a browniſh white colour; and the covers of the eyes are bony. He has a fleſhy lobe between the noſtrils; which, when angry or terrified, he inflates till his head becomes as big as his whole body. He is a native of Surinam.

14. The *cachinnans*, or laughing hawk, has yellowiſh legs and wax, and white eye-brows; the body is variegated with brown and white; and it has a black ring round the top of the head. It makes a laughing kind of noiſe when it obſerves any perſon, and is a native of America.

15. The *columbarius*, or pigeon-hawk of Cateſby, weighs about ſix ounces. The bill is black at the point, and whitiſh at the baſe; the iris of the eye is yellow; the baſe of the upper mandible is covered with a yellow cere or wax; all the upper part of the body, wings, and tail, are brown. The anterior vanes of the quill-feathers have large red ſpots. The tail is marked with large regular tranſverſe white lines; the throat, breaſt, and belly, are white, mixed with brown; the ſmall feathers that cover the thighs reach within half an inch of the feet, and are white, with a tincture of red, beſet with long ſpots of brown; the legs and feet are yellow. It inhabits America, from Hudſon's bay as low as South Carolina. In the laſt it attains to a larger ſize. In Hudſon's bay it appears in May on banks of the river Severn, breeds, and retires ſouth in autumn. It feeds on ſmall birds; and, on the approach of any perſon, flies in circles, and makes a great ſhrieking. It forms its neſt in a rock, or ſome hollow tree, with ſticks and graſs; and lines it with feathers: and lays from two to four eggs, white ſpotted with red. In Carolina it preys on pigeons, and young of the wild turkies.

16. The *furcatus*, or ſwallow-tailed hawk, has a black bill, leſs hooked than uſual with rapacious birds: the eyes are large and black, with a red iris: the head, neck, breaſt, and belly, are white; the upper part of the back and wings a dark purple: but more duſky towards the lower parts, with a tincture of green. The wings are long in proportion to the body, and, when extended, meaſure four feet. The tail is dark purple mixed with green, and remarkably forked. This moſt elegant ſpecies inhabits only the ſouthern parts of North America; and that only during ſummer. Like ſwallows, they feed chiefly flying; for they are much on wing, and prey on various ſorts of inſects. They alſo feed on lizards and ſerpents; and will kill the largeſt of the regions it frequents with the utmoſt eaſe. They quit North America before winter, and are ſuppoſed to retreat to Peru.

17. *Haliætus*, the fiſhing-hawk of Cateſby, or the oſprey, weighs three pounds and a quarter; it meaſures, from one end of the wing to the other, five feet and a half. The bill is black, with a blue cere or wax; the iris of the eye is yellow, and the crown of the head brown, with a mixture of white feathers; from each eye, backwards, runs a brown ſtripe: the back, wings, and tail, are of a dark brown; the throat, neck, and belly, white; the legs and feet are rough and ſcaly, and of a pale blue colour; the talons are black, and nearly of an equal ſize; the feathers of the thighs are ſhort, and adhere cloſe to them, contrary to others of the hawk kind, which nature ſeems to have deſigned for the more eaſily penetrating the water. Notwithſtanding the oſprey is ſo perſecuted by the bald eagle, yet it always keeps near its haunts. It is a ſpecies of vaſt quickneſs of ſight; and will ſee a fiſh near the ſurface from a great diſtance; deſcend with prodigious rapidity, and carry the prey with an exulting ſcream high into the air. The eagle hears the note, and inſtantly attacks the oſprey: who drops the fiſh, which the former catches before it can reach the ground or water. The lower parts of the rivers and creeks near the ſea, in America, abound with theſe eagles and hawks, where ſuch diverting conteſts are often ſeen. It ſometimes happens that the oſprey periſhes in taking its prey; for if it chances to fix its talons in an over-grown fiſh, it is drawn under water before it can diſengage itſelf, and is drowned.

18. The *Iceland falcon* or gyrfalco *(Lin.)* has a ſtrong bill, much hooked, the upper mandible ſharply angulated on the lower edges, with a blueiſh wax: the head is of a very pale ruſt-colour, ſtreaked downwards with duſky lines: the neck, breaſt, and belly, are white, marked with cordated ſpots; the thighs white, croſſed with ſhort bars of deep brown: the back and coverts of the wings are duſky, ſpotted, and edged with white; the exterior webs of the primaries duſky mottled with reddiſh white, the inner barred with white: the feathers of the tail are croſſed with 14 or more narrow bars of duſky and white; the duſky bars regularly oppoſing thoſe of white: the wings, when cloſed, reach almoſt to the end of the train: the legs are ſtrong and yellow. The length of the wing, from the pinion to the tip, is ſixteen inches. This ſpecies is an inhabitant of Iceland, and is the moſt eſteemed of any for the ſport of falconry.

19. The *fuſcus*, or Greenland falcon, has duſky irides; lead-coloured wax and feet; brown crown, marked with irregular oblong white ſpots; whitiſh forehead, blackiſh cheeks; the hind part of the head and throat white; breaſt and belly of a yellowiſh white, ſtriped downwards with duſky ſtreaks; the back duſky, tinged with blue, the ends of the feathers lighteſt, and ſprinkled over with a few white ſpots, eſpecially towards the rump; the wings of the ſame colours, variegated beneath with white and black; the upper part of the tail duſky croſſed very faintly with paler bars, the under ſide whitiſh. It inhabits all parts of

Greenland, from the remoteſt hills to thoſe which impend over the ſea. They are even ſeen on the iſlands of ice remote from ſhore. They retire in the breeding-ſeaſon to the fartheſt part of the country, and return in autumn with their young. They breed in the ſame manner as the cinereous eagle, but in more diſtant places; and lay from three to five eggs. The tail of the young is black, with great brown ſpots on the exterior webs. They prey on ptarmigans, auks, and all the ſmall birds of the country. They have frequent diſputes with the raven, but ſeldom come off victors; for the raven will, on being attacked, fling itſelf on its back; and either by defending itſelf with its claws, or by calling, with its croaking, numbers of others to its help, oblige the falcon to retire. The Greenlanders uſe the ſkin, among others, for their inner garments; the wings for bruſhes; the feet for amulets: but ſeldom eat the fleſh, unleſs compelled by hunger.

20. The *gyrfalcon* (Br. Zool. n° 47.) has a yellow wax; the bill blueiſh, and greatly hooked; the eye dark blue; the throat of a pure white: the whole body, wings, and tail, of the ſame colour, moſt elegantly marked with duſky bars, lines, or ſpots, leaving the white the far prevailing colour. There are inſtances, but rare, of its being found entirely white. In ſome, the whole tail is croſſed by remote bars of black or brown; in others, they appear only very faintly on the middle feathers: the feathers of the thighs are very long and unſpotted: the legs ſtrong, and of a light blue. Its weight is 45 ounces Troy: length near two feet; extent, four feet two. This ſpecies has the ſame manners and haunts with the former. It is very frequent in Iceland; is found in Lapmark and Norway; and rarely in the Orknies and North Britain. In Aſia, it dwells in the higheſt points of the Urallian and other Siberian mountains, and dares the coldeſt climates throughout the year. It is kept in the latitude of Peterſburgh, uninjured in the open air during the ſevereſt winters. This ſpecies is pre-eminent in courage as well as beauty, and is the terror of other hawks. It was flown at all kinds of fowl, how great ſoever they were; but its chief game uſed to be herons and cranes.

The three laſt ſpecies are in high eſteem for ſport. They are reſerved for the kings of Denmark; who ſend their falconer with two attendants annually into Iceland to purchaſe them. They are caught by the natives; a certain number of whom in every diſtrict are licenſed for that purpoſe. The Iceland falcons will laſt 10 or 12 years; whereas thoſe of Norway, and other countries, ſeldom are fit for ſport after two or three years uſe. Yet the Norwegian hawks were in old times in great repute in this kingdom, and even thought bribes worthy of a king.

21. The *aviporus*, with black wax, yellow legs, half naked, the head of an aſh colour, and having an aſh-coloured ſtripe on the tail, which is white at the end. It is the honey-buzzard of Ray, and had its name from the combs of waſps being found in its neſt. It is a native of Europe, and feeds on mice, lizards, frogs, bees, &c. It runs very ſwiftly, like a hen.

22. The *æruginoſus*, or moor-buzzard, with greeniſh wax, a greyiſh body, the top of the head, nape of the neck, and legs, yellowiſh; is a native of Europe, and frequents moors, marſhy places, and heaths: it never ſoars like other hawks; but commonly ſits on the ground or on ſmall buſhes. It makes its neſt in the midſt of a tuft of graſs or ruſhes. It is a very fierce and voracious bird; and is a great deſtroyer of rabbits, young wild-ducks, and other water-fowl. It preys, like the oſprey, on fiſh.

23. The *palumbarius*, with black wax edged with yellow; yellow legs, a brown body, the prime feathers of the tail marked with pale ſtreaks, and the eye-brows white. It is the goſhawk of Ray; and was formerly in high eſteem among falconers, being flown at cranes, geeſe, pheaſants, and partridges. It breeds in Scotland, and builds its neſt in trees. It is very deſtructive to game, and daſhes through the woods after its quarry with vaſt impetuoſity; but if it cannot catch the object of its purſuit almoſt immediately, deſiſts, and perches on a bough till ſome new game preſents itſelf. This ſpecies is common in Muſcovy and Siberia. They extend to the river Amur; and are uſed by the emperor of China in his ſporting progreſſes, attended by his grand falconer, and 1000 of the ſubordinate. Every bird has a ſilver plate faſtened to its foot, with the name of the falconer who had the charge of it; that in caſe it ſhould be loſt, it might be brought to the proper perſon; but if he could not be found, the bird is delivered to another officer, called the *guardian of loſt birds*; who keeps it till it is demanded by the falconer to whom it belonged. That this great officer may the more readily be found among the army of hunters who attend the emperor, he erects a ſtandard in the moſt conſpicuous place.

24. The *niſus*, or ſparrow hawk, with green wax, yellow legs, a white belly undulated with grey, and the tail marked with blackiſh belts. This is the moſt pernicious hawk we have; and makes great havock among pigeons as well as partridges. It builds in hollow trees, in old neſts of crows, large ruins, and high rocks: it lays four white eggs, encircled near the blunter end with red ſpecks.

25. The *minutus*, with white wax, yellow legs, and the body white underneath. It is the leaſt hawk of Briſſon, being about the ſize of a thruſh; and is found on the iſland of Melita.

There are near 100 other ſpecies diſtinguiſhed by ornithologiſts. Among theſe are two deſcribed by Mr. Bruce; one of which deſerves particular notice, as being not only the largeſt of the eagle kind, but, in our author's opinion, the largeſt bird that flies. He calls it the *golden eagle*; by the natives it is vulgarly called *abon duchn*, or *father long-beard*. This bird, from wing to wing, was 8 feet 4 inches; from the tip of his tail to the point of his beak when dead, 4 feet 7 inches. He was remarkably ſhort in the legs, being only four inches from the joining of the foot to where the leg joins the thigh, and from the joint of the thigh to the joining of his body ſix inches. The thickneſs of his thigh was little leſs than four inches; it was extremely muſcular, and covered with fleſh. His middle claw was about two inches and a half long, not very ſharp at the point, but extremely ſtrong. From the root of the bill to the point was three inches and a quarter, and one inch and three quarters in breadth at the root. A forked bruſh of ſtrong hair, divided at the point into two, proceeded from the cavity of his lower jaw at the beginning of his throat. His eye was remarkably ſmall in proportion to his bulk, the aperture being ſcarcely half an inch. The crown of his head was bare or bald, as was alſo the front where the bill and ſkull joined. This is the deſcription given by Mr. Bruce, of one of theſe birds, which he had ſhot.

FALCON, or FAUCON, a bird of prey of the hawk kind, ſuperior to all others for courage, docility, gentleneſs, and nobleneſs of nature. See FALCO. Several authors take the name *falcon* to have been occaſioned by its crooked talons or pounces, which reſemble a falx or ſickle. Giraldus derives it *a falcando*, becauſe it flies in a curve. The falcon, or falcon gentle, is both for the fiſt and for the lure. In the choice, take one that has wide noſtrils, high and large eye-lids, a large black eye; a round head, ſomewhat full on the top; barb feathers on the clap of the beaks, which ſhould be ſhort, thick, and of an azure colour; the breaſt large, round, and fleſhy; and the thighs, legs, and feet, large and ſtrong; with the ſear of the foot ſoft and blueiſh: the pounces ſhould be black, with wings long and croſſing the train, which ſhould be ſhort and very pliable. The name *falcon* is confined to the female: for the male is much ſmaller, weaker, and leſs courageous, than the

female; and therefore is denominated *taſſel*, or *tircelet*. The falcon is excellent at the river, brook, and even field; and flies chiefly at the larger game, as wild-gooſe, kite, crow, heron, crane, pye, ſhoveler, &c. For further particulars, ſee FALCONRY, and HAWKING. The cuſtom of carrying a falcon about extended to many countries, and was eſteemed a diſtinction of a man of rank. The Welch had a ſaying, that you may know a gentleman by his hawk, horſe, and greyhound. In fact, a perſon of rank ſeldom went without one on his hand. Harold, afterwards king of England, is painted going on a moſt important embaſſy, with a hawk on his hand and a dog under his arm. Henry VI. is repreſented at his nuptials, attended by a nobleman and his falcon. Even the ladies were not without them in earlier times; for in an ancient ſculpture in the church of Milton Abbas, in Dorſetſhire, appears the conſort of king Athelſtan with a falcon on her royal fiſt tearing a bird.

FALCONER, a perſon who brings up, tames, and manages birds of prey; as falcons, hawks, &c. See HAWKING. The grand ſeignor uſually keeps 6000 falconers inhis ſervice. The French king has a grand falconer, which is an office diſmembered from that of great hunt, *grand venur*. Hiſtorians take notice of this poſt as early as the year 1250.

A falconer ſhould be well acquainted with the quality and mettle of his hawks, that he may know which of them to fly early and which late. Every night after flying he ſhould give them caſting; one while plumage, ſometimes pellets of cotton, and at another time phyſic, as he finds neceſſary. He ought alſo every evening to make the place clean under the porch, that by her caſting he may know whether ſhe wants ſcouring upwards or downwards. Nor muſt he forget to water his hawk every evening, except on ſuch days as ſhe has bathed; after which, at night, ſhe ſhould be put into a warm room, having a candle burning by her, where ſhe is to ſit unhooded, if ſhe be not ramage, that ſhe may pick and prune herſelf.—A falconer ſhould always carry proper medicines into the field, as hawks frequently meet with accidents there. Neither muſt he forget to take with him any of his hawking implements; and it is neceſſary he ſhould be ſkilful in making lures, hoods of all ſorts, jeſſes, bewets, and other furniture. Neither ought he to be without his coping irons, to cope his hawk's beak when overgrown, and to cut her pounces and talons as there ſhall be occaſion: nor ſhould his cauterizing irons be wanting.

FALCONER (William), an ingenious Scots ſailor, who, about the year 1762, came up to London with a pretty pathetic poem, called the *Shipwreck*, founded on a diſaſter of his own experience. The publication of this piece recommended him to the late duke of York; and he would in all probability have been ſuitably preferred, if a ſecond ſhipwreck, as may be ſuppoſed, had not proved fatal to him, and to many gentlemen of rank and fortune with whom he ſailed. In 1766, he went out a volunteer in the Aurora frigate ſent to carry Meſſrs. Vanſittart, Scrafton, and Ford, the ſupervifors appointed to regulate our Eaſt India ſettlements; which veſſel, after it had touched at the Cape of Good Hope, was never more heard of. Before his departure he publiſhed a very uſeful *marine dictionary*, in one vol. 4to.

FALCONRY, the art of training all manner of hawks, but more eſpecially the larger ones called *falcons*, to the exerciſe of hawking. See HAWKING.

FALKIA, in botany; a genus of the trigynia order, belonging to the hexandria claſs of plants. The calyx is monophyllous; the corolla monopetalous; the ſeeds four in number.

FALKIRK, a handſome town of Stirlingſhire, in Scotland, chiefly ſupported by the great markets for Highland cattle, called tryſts, which are held in its neighbourhood thrice a year: 15000 head of cattle are ſometimes fold at one tryſt: theſe, for the moſt part, are ſent to England, and fattened for the butcher. At Falkirk, in 1746, the rebels defeated the king's forces. It is nine miles S. of Stirling. W. lon. 4. 58. N. lat. 55. 57.

FALKLAND, a borough of Fifeſhire, in Scotland, at the foot of one of the beautiful green hills called the Lomonds. Here are the magnificent ruins of a royal palace, ſome apartments of which are ſtill inhabited. Falkland has ſome linen manufacture, but, like moſt ſmall inland towns, its inhabitants are chiefly employed in agriculture. It is 20 miles N. of Edinburgh. W. lon. 3. 7. N. lat. 56. 18.

FALKLAND *Iſlands*, near the ſtraits of Magellan, in South America, were diſcovered by Sir Richard Hawkins in 1594; and, in 1764, lord Egmont, then firſt lord of the admiralty, ſent commodore Byron to take poſſeſſion of them in the name of his Britannic majeſty. The commodore, accordingly, made a ſettlement on a part which he called Port Egmont; but, in 1770, the Spaniards forcibly diſpoſſeſſed the Engliſh garriſon. This produced an armament on the part of the Britiſh court; but the affair was ſettled by a convention, in conſequence of which the Engliſh regained poſſeſſion of the place; which, however, in 1774, it was thought proper to abandon. W. lon. 60°. S. lat. 52°.

FALL, the deſcent of a heavy body towards the centre of the earth. It is alſo the name of a meaſure of length uſed in Scotland, containing ſix ells.

FALL *of Man*, in ſacred hiſtory, that terrible event by which ſin and death were introduced into the world. Many have been the ſuppoſitions and conjectures upon this ſubject in general; and ſome have ſo far indulged their fancy in the circumſtances of the fall, that they have perverted the whole narration of Moſes into a fable full of the moſt ſhameful extravagancies.

FALLACY, a deception, fraud, or falſe appearance. The *Epicureans* deny that there is any ſuch thing as a fallacy of the ſenſes: for, according to them, all our ſenſations and perceptions, both of ſenſe and phantaſy, are true; whence they make ſenſe the primary criterion of truth. The *Carteſians*, on the other hand, maintain, that we ſhould ſuſpect as falſe, or at moſt as dubious, every thing that preſents itſelf to us by means only of the external ſenſes, becauſe they frequently deceive us. They add, that our ſenſes, as being fallacious, were never given us by nature for the diſcovery of truth, or the contemplation of the principles of things; but only for pointing out to us what things are convenient or hurtful to our bodies. The *Peripatetics* keep a middle courſe. They ſay, that if a ſenſible object be taken in its common or general view, the ſenſe cannot be deceived about it; but that if the object be taken under its ſpecific view, the ſenſe may be miſtaken about it, from the want of the diſpoſitions neceſſary to a juſt ſenſation, as a diſorder in the organ, or any thing uncommon in the medium: thus, in ſome diſorders of the eye, all objects appear yellow; a ſtick in water appears broken or crooked, &c.

FALLING SICKNESS, or EPILEPSY. See MEDICINE.

FALLING-*Stars*. See STAR.

FALLOPIAN TUBES, in anatomy, two ducts ariſing from the womb, one on each ſide of the fundus, and thence extended to the ovaries, having a conſiderable ſhare in conception. They are called *tubæ*, from their form, which bears ſome reſemblance to a trumpet; and their denomination, *Fallopianæ*, they take from Gabriel Fallopius, mentioned in the next article. See ANATOMY, p. 209.

FALLOPIUS (Gabriel), a moſt celebrated phyſician and anatomiſt, was born at Modena in Italy, in the year 1523, and deſcended of a noble family. He made ſeveral diſcoveries in anatomy, one of which was that of the tubes, called from him the *Fallopian tubes*. He travelled through the greateſt part of Europe, and obtained the character of being one of the ableſt

physicians of his age. He was made professor of anatomy at Pisa in the year 1548, and at Padua in the year 1551: here he died in 1562, aged 39. His writings, which are numerous, were first printed separately, and afterwards collected under the title of "Opera genuina omnia, tam practica quam theoretica, in tres tomos distributa." They were printed at Venice in 1585, and in 1606; at Francfort in 1600, *cum operum appendice*; and in 1606, in folio.

FALLOW, a pale red-colour, like that of brick half-burnt; such is that of a fallow-deer.

FALLOW-*Field*, or *Fallow-ground*; land laid up, or that has been untilled for a considerable time.

FALLOWING *of* LAND, a particular method of improving land. See HUSBANDRY.

FALMOUTH, a seaport of Cornwall, with a market on Thursday. About two centuries ago, there were not more than two or three houses, but it is now governed by a mayor, four aldermen, and a town clerk. It has a very noble and extensive harbour, communicating with a number of navigable creeks; and it is a flourishing town of great traffic, which has been much improved by its being the station of the packets to Spain, Portugal, and America. The entrance of the harbour is defended by the castle of St. Mawes and Pendennis. It is 10 miles S. of Truro, and 268 W. by N. of London. W. lon. 4. 57. N. lat. 50. 8.

FALSE, in general, denotes something contrary to truth, or not what it ought to be: thus we say a false action, false weights, false claim, &c.

FALSE *Action*, if brought against one whereby he is cast into prison, and dies pending the suit, the law gives no remedy in this case, because the truth or falsehood of the matter cannot appear before it is tried: and if the plaintiff is barred, or nonsuited at common law, regularly all the punishment is amercement.

FALSE *Imprisonment* is a trespass committed against a person, by arresting and imprisoning him without just cause, contrary to law; or where a man is unlawfully detained without legal process: and it is also used for a writ which is brought for this trespass. If a person be any way unlawfully detained, it is false imprisonment; and considerable damages are recoverable in those actions.

FALSE *News, spreading of*, in order to make discord between the king and nobility, or concerning any great officer of the realm, is punishable by common law with fine and imprisonment; which is confirmed by statutes Westm. 1. 3 Edw. I. cap. 34. 2 Ric. II. stat. 1. cap. 5. and 12 Ric. II. cap. 11.

FALSE *Oath*. See PERJURY.

FALSE *Prophecy*. See PROPHECY.

FALSE *Quarter*, in farriery. See QUARTERS.

FALSE *Bay*, a bay lying to the eastward of the Cape of Good Hope; frequented by vessels during the prevalence of the north-westerly winds, which begin to exert their influence in May, and render it dangerous to remain in Table bay. It is terminated to the eastward by False Cape, and to the westward by the Cape of Good Hope. It is 18 miles wide at its entrance, and the two capes bear due east and west from each other.

FALSI CRIMEN, in the civil law, is fraudulent subornation or concealment, with design to darken or hide the truth, and make things appear otherwise than they are. The *crimen falsi* is committed: 1. By words, as when a witness swears falsely. 2. By writing, as when a man antedates a contract, or the like. 3. By deed, as when he sells by false weights and measures.

FALSIFY, in law, is used for proving any thing to be false. Hence we find the term *falsifying* a record, for showing it to be erroneous. Thus lawyers teach, that a person purchasing land of another, who is afterwards outlawed of felony, &c. may falsify the record, not only as to the time wherein the felony is supposed to have been committed, but also as to the point of the offence. But where a man is found guilty by verdict, a purchaser cannot falsify as to the offence; though he may for the time where the party is found guilty generally in the indictment, because the time is not material upon evidence.

FALSTAFF. See FASTOLFF.

FALX, in anatomy, a part of the dura mater, descending between the two hemispheres of the brain, and separating the fore-part from the hinder. It is called *falx*, i. e. "sickle," because of its curvature, occasioned by the convexity of the brain. It divides the brain as low as the corpus callosum. See ANATOMY, p. 202.

FAME, a heathen goddess, celebrated chiefly by the poets. She is feigned to have been the last of the race of Titans produced by the earth, to have her palace in the air, and to have a vast number of eyes, ears, and tongues. She is mentioned by Hesiod, and particularly described by Ovid and Virgil.

FAMES CANINA, the same with BULIMY.

FAMIA, or AFAMIA, the modern name of one of the ancient Apameas. See APAMEA.

FAMILIARS of the INQUISITION, persons who assist in apprehending such as are accused, and carrying them to prison. They are assistants to the inquisitor, and called *familiars*, because they belong to his family. In some provinces of Italy they are called *cross-bearers*, and in others the *scholars of St. Peter the martyr*; and they wore a cross before them on the outside garment. They are properly bailiffs of the inquisition; and this vile office is esteemed so honourable, that noblemen in the kingdom of Portugal have been ambitious of possessing it. Nor is this surprising, when it is considered that Innocent III. granted very large indulgences and privileges to these familiars; and that the same plenary indulgence is granted by the pope to every single exercise of this office, as was granted by the Lateran council to those who succoured the Holy Land. When several persons are to be seized at the same time, these familiars are commanded to order matters, that they may know nothing of one another's being apprehended; and it is related, that a father and his three sons, and three daughters, who lived together in the same house, were carried prisoners to the inquisition, without knowing any thing of one another's being there till seven years afterwards, when they that were alive were released by an act of faith.

FAMILY, denotes the persons that live together in one house, under the direction of one head or chief manager. It also signifies the kindred or lineage of a person; and is used by old writers for a hide or portion of land sufficient to maintain one family. See HIDE.

FAMILY, in natural history, a term used by authors to express any order of animals, or other natural productions of the same class. See CLASS and ORDER.

FAMINE, dearth, or scarcity of food. For preservatives against hunger in times of famine, see HUNGER and FOOD.

FAN, a machine used to raise wind, and cool the air by agitating it. That the use of the fan was known to the ancients is very evident from what Terence says, "*Cape hoc* flabellum, *et ventulum huic sic facito*;" and from Ovid, Art. Amand. i. 161. "*Profuit et tenues ventos movisse* flabello." The fans of the ancients were made of different materials; but the most elegant were composed of peacocks' feathers, or perhaps painted so as to represent a peacock's tail.

The custom which now prevails among the ladies of wearing fans, was borrowed from the east, where the hot climate renders the use of fans and umbrellas indispensably necessary. In the east they chiefly use large fans made of feathers, to keep off the sun and flies. In Italy and Spain they have a large sort of square fans, suspended in the middle of their apartments, and particularly over the tables: these, by a motion at first given

them, and which they retain a long time on account of their perpendicular sufpenfion, help to cool the air and drive off flies. In the Greek church, a fan is put into the hands of the deacons in the ceremony of their ordination, in allufion to a part of the deacon's office in that church, which is to keep the flies off the priefts during the celebration of the facrament.

What is called a *fan* amongft us and throughout the chief parts of Europe, is a thin piece of paper, taffety, or other light ftuff, cut femicircularly, and mounted on feveral little fticks of wood, or ivory. If the paper be fingle, the fticks of the mounting adhere on the leaft ornamental fide: if double, the fticks are placed betwixt them. Before they proceed to place the fticks, which they call *mounting* the fan, the paper is firft plaited in fuch a manner, as that the plaits may be alternately inward and outward. The two outer fticks are bigger and ftronger than the others; and the number of the whole is ufually 22.

Fan is alfo an inftrument to winnow corn. The machine ufed for this purpofe by the ancients feems to have been of a form fimilar to ours. The fan, which Virgil calls *myftica vannus Iacchi*, was ufed at initiations into the myfteries of the ancients: for, as the perfons who were initiated into any of the myfteries, were to be particularly good, this inftrument, which feparates the wheat from the chaff, was the fitteft emblem that could be of fetting apart the good and virtuous from the vicious and ufelefs part of mankind. It is figuratively applied in a fimilar manner in Luke iii. 17.

FANATICS, wild, enthufiaftic, vifionary perfons, who pretend to revelation and infpiration. The ancients called thofe *fanatici* who paffed their time in temples *(fana)*, and, being often feized with a kind of enthufiafm, as if infpired by the divinity, fhowed wild and antic geftures. Prudentius reprefents them as cutting and flafhing their arms with knives. Shaking the head was alfo common among the fanatici; for Lampridius informs us, that the emperor Heliogabalus was arrived to that pitch of madnefs, as to fhake his head with the *gafhed* fanatics. Hence the word was applied among us to the anabaptifts, quakers, &c. at their firft rife, and is now an epithet given to the modern prophets, muggletonians, &c.

FANCY, or imagination. See Imagination.

FANIONS, in the military art, fmall flags carried along with the baggage.

FANSHAW (Sir Richard), famous for his embaffies and writings, was the tenth and youngeft fon of Sir Henry Fanfhaw of Ware-park in Hertfordfhire, where it is fuppofed he was born about the year 1607. He diftinguifhed himfelf fo early by his abilities, that in 1635 he was taken into government employments by king Charles I. and fent refident to the court of Spain; whence being recalled in the beginning of the troubles in 1641, he adhered to the royal intereft, and was employed in feveral important matters of ftate. During his vacant hours he wrote many poems, and made feveral tranflations. At the reftoration it was expected he would have been made one of the fecretaries of ftate: however, he was made mafter of the requefts; a ftation in thofe times of confiderable profit. Afterwards, on account of his fkill in the Latin language, he was made fecretary for that tongue. In 1661 he was fent envoy to the king of Portugal. In 1662 he was again fent to that court with the title of *ambaffador*, and negotiated the marriage of his mafter king Charles II. with the infanta Donna Catherina. Upon his return he was made one of the privy council. In 1664 he was fent ambaffador to both the courts of Spain and Portugal; at which time the foundation of peace betwixt thofe crowns and England was laid by him. His conduct during his former employments in thofe courts gained him fuch high efteem there, that his reception was magnificent, exceeding all that were before, which thofe kings declared was not to be a precedent to fucceeding ambaffadors. He died at Madrid in 1666, on the very day he had fixed for fetting out on his return to England. Befides fome original poems, and others, tranflations, he publifhed a tranflation of Bathifta Guarini's *Paftor fido*, and another of the *Lufiad* of Camoens. Among his pofthumous publications are, "Letters during his embaffies in Spain and Portugal; with his life prefixed."

FANTASTA, in the Italian mufic, fignifies *fancy*; and is ufed for a compofition wherein the compofer ties himfelf to no particular time, but ranges according as his fancy leads, amidft various movements, different airs, &c. This is otherwife called the *capricious ftyle*: before fonatas were ufed, there were many of this kind, fome of which remain even now.

FANUM, among the Romans, a temple or place confecrated to fome deity. The deified men and women among the heathens had likewife their *fana*; even the great philofopher Cicero erected one to his daughter Tullia.

FARANDMAN, a traveller, or merchant ftranger, to whom, by the laws of Scotland, juftice ought to be done with all expedition, that his bufinefs or journey be not hindered.

FARCE, was originally a droll, petty fhow, or entertainment, exhibited by charlatans, and their buffoons, in the open ftreet to gather the crowd together. The word is French, and fignifies literally, "force-meat or ftuffing." It was applied on this occafion, no doubt, on account of the variety of jefts, gibes, tricks, &c. wherewith the entertainment was interlarded. Some authors derive farce from the Latin *facetia*; others from the Celtic *farce*, "mockery;" others from the Latin *farcire*, "to ftuff." At prefent it is removed from the ftreet to the theatre; and inftead of being performed by merry-andrews to amufe the rabble, is acted by comedians and becomes the entertainment of a polite audience. Poets have reformed the wildnefs of the primitive farces, and brought them to the tafte and manner of comedy. The difference between the two on our ftage is, that comedy keeps to nature and probability, and therefore is confined to certain laws prefcribed by ancient critics; whereas farce difallows of all laws, or rather fets them afide on occafion. Its end is purely to make a laugh; and it fticks at nothing which may contribute thereto, however wild and extravagant. Hence the dialogue is ufually low, the perfons of inferior rank, the fable or action trivial or ridiculous, and nature and truth every where heightened and exaggerated to afford the more palpable ridicule.

FARCY, or Farcin, a difeafe appearing like fmall buds on the fkin in horfes, and fometimes in oxen, &c. See Farriery.

FARDING-deal, the fourth part of an acre of land. See Acre.

FAREWELL-cape, the moft foutherly promontory of Greenland, in W. long. 50°, and N. lat. 60°.

FARIN, or Farm. See Farm.

FARINA, a Latin term fignifying meal, or the flour of corn. See Corn.

Farina *Fœcundans*, among botanifts, the fuppofed impregnating meal or duft on the apices or antheræ of flowers. See Pollen. The manner of gathering the farina of plants for microfcopical obfervations is this: Gather the flowers in the midft of a dry funfhiny day when the dew is perfectly off, then gently fhake off the farina, or lightly brufh it off with a foft hair-pencil, upon a piece of white paper; then take a fingle talc or ifinglafs between the nippers, and, breathing on it, apply it inftantly to the farina, and the moifture of the breath will make that light powder ftick to it. If too great a quantity be found adhering to the talc, blow a little of it off; and, if there is too little, breathe upon it again, and take up more. When this is done, put the talc into the hole of a flider, and, applying it to the microfcope, fee whether the little grains are laid as you defire; and if they are, cover them up with another talc, and

fix the ring; but be careful that the talcs do not press upon the farina in ſuch a manner as to alter its form.

FARLEU, money paid by the tenants in the weſt of England, in lieu of a heriot. In ſome manors of Devonſhire, farleu is often diſtinguiſhed to be the beſt goods, as heriot is the beſt beaſt, payable at the death of a tenant.

FARM, FARIN, or *Ferm, (Firma)*, in law, ſignifies a little country meſſuage or diſtrict; containing houſe and land, with other conveniencies; hired, or taken by leaſe, either in writing, or parole under a certain yearly rent. See LEASE. This in divers parts is differently termed: in the north, it is a *tack*; in Lancaſhire, a *fermeholt*; in Eſſex, a *wike*, &c. In the corrupted Latin, *firma* ſignified a place incloſed or ſhut in: whence, in ſome provinces, Menage obſerves, they call *cloſerie*, or *cloſure*, what in others they call a *farm*. Add, that we find *locare ad firmam*, to ſignify to let to *farm*; probably on account of the ſure hold the tenant here has in compariſon of tenants at will.

Spelman and Skinner, however, chooſe to derive the word *farm* from the Saxon *fearme*, or *feorme*, that is, *victus*, "proviſion;" by reaſon the country people and tenants anciently paid their rents in victuals and other neceſſaries, which were afterwards converted into the payment of a ſum of money. Whence a *farm* was originally a place that furniſhed its landlord with proviſions. And among the Normans they ſtill diſtinguiſh between farms that pay in kind, *i. e.* proviſions, and thoſe which pay in money: calling the former ſimply *fermes*, and the latter *blanche ferme*, "white ferm." See BLANCHE *ferme*.

Spelman ſhows, that the word *firma* anciently ſignified not only what we now call a *farm*, but alſo a feaſt or entertainment, which the farmer gave the proprietor or landlord, for a certain number of days, and at a certain rate, for the lands he held of him. Thus *fearme* in the laws of king Canute is rendered by Mr. Lambard, *victus*: and thus we read of *reddere firmam unius noctis*, and *reddebat unum diem de firma*; which denote proviſion for a night and a day, the rents about the time of the Conqueſt being all paid in proviſions: which cuſtom is ſaid to have been firſt altered under King Henry I. We alſo ſay *to farm* duties, impoſts, &c.

Culture of a FARM. See HUSBANDRY.

FARM, as connected with gardening, and ſuſceptible of embelliſhment. See GARDENING. In ſpeculation, it might have been expected that the firſt eſſays of improvement ſhould have been on a farm, to make it both advantageous and delightful; but the fact was otherwiſe: a ſmall plot was appropriated to pleaſure; the reſt was reſerved for profit only. And this may, perhaps, have been a principal cauſe of the vicious taſte which long prevailed in gardens. It was imagined that a ſpot ſet apart from the reſt ſhould not be like them: this conceit introduced deviations from nature, which were afterwards carried to ſuch an exceſs, that hardly any objects truly rural were left within the encloſure, and the view of thoſe without was generally excluded. The firſt ſtep, therefore, towards a reformation, was by opening the garden to the country, and that immediately led to aſſimilating them; but ſtill the idea of a ſpot appropriated to pleaſure only prevailed, and one of the lateſt improvements has been to blend the uſeful with the agreeable; even the ornamental farm was prior in time to the more rural; and we have at laſt returned to ſimplicity by force of refinement.

Some of the greateſt beauties of nature are to be found in the fields, and attend an ordinary ſtate of cultivation: wood and water may there be exhibited in ſeveral forms and diſpoſitions; we may enlarge or divide the incloſures; and give them ſuch ſhapes and boundaries as we pleaſe; every one may be an agreeable ſpot; together, they may compoſe beautiful views; the arable, the paſture, and the mead, may ſucceed one another; and now and then a little wild may be intermixed without impropriety; every beauty, in ſhort, which is not unuſual in an incloſed country, whether it ariſe from neglect or improvement, is here in its place.

The buildings, alſo, which are frequent in ſuch a country, are often beautiful objects; the church and the manſion are conſiderable; the farm-yard itſelf, if an advantageous ſituation be choſen for it; if the ricks, and the barns, and the outhouſes, are ranged with any deſign to form them into groups, and if they are properly blended with trees; may be made a pictureſque compoſition. Many of them may be detached from the group, and diſperſed about the grounds: the dove-cote, or the dairy, may be ſeparated from the reſt; they may be elegant in their forms, and placed wherever they will have the beſt effect. A common barn, accompanied by a clump, is ſometimes pleaſing at a diſtance; a Dutch barn is ſo when near; and an hay-ſtack is generally an agreeable circumſtance in any poſition. Each of theſe may be ſingle: and beſides theſe, all kinds of cottages are proper. Among ſo many buildings, ſome may be converted to other purpoſes than their conſtruction denotes; and, whatever be their exterior, may within be made agreeable retreats for refreſhment, indulgence, or ſhelter.

With ſuch opportunities of improvement, even to decoration within itſelf, and with advantages of proſpect into the country about it, a ſimple farm may undoubtedly be delightful. It will be particularly acceptable to the owner, if it be cloſe to his park or his garden: the objects which conſtantly remind him of his rank, impoſe a kind of conſtraint; and he feels himſelf relieved, by retiring ſometimes from the ſplendour of a ſeat into the ſimplicity of a farm: it is more than a variety of ſcene; it is a temporary change of ſituation in life, which has all the charms of novelty, eaſe, and tranquillity, to recommend it. A place, therefore, can hardly be deemed perfect, which is not provided with ſuch a retreat.

A ſenſe of the propriety of ſuch improvements about a ſeat, joined to a taſte for the more ſimple delights of the country, probably ſuggeſted the idea of an *ornamental farm*, as the means of bringing every rural beauty within the verge of a garden. This idea has been partially executed very often; but no where, perhaps, ſo completely, and to ſuch an extent, as at Woburn farm, near Weybridge in Surry.

FARMER, he that tenants a farm, or is leſſee thereof. Alſo generally every leſſee for life, years, or at will, is called *farmer*. As this word implies no myſtery, except it be that of huſbandry, huſbandman is the proper addition for a farmer.

FARMER, in mining, is the lord of the field, or one that farms the lot and cope of the king.

FARN ISLANDS, two groups of little iſlands and rocks, 17 in number, lying oppoſite to Bamborough caſtle in Northumberland. At low water the points of ſeveral others are viſible beſides thoſe above mentioned. The neareſt iſland to the ſhore is called the *Houſe-iſland*, and lies exactly one mile and 68 chains from the coaſt. The moſt diſtant is about ſeven or eight miles. Their produce is kelp, feathers, and a few ſeals, which the tenant watches and ſhoots for the ſake of the oil and ſkins. Some of them yield a little graſs that may ſerve to feed a cow or two; which the people tranſport over in their little boats. The largeſt or Houſe iſland is about one mile in compaſs, and has a fort and a light-houſe. It contains about ſix or ſeven acres of rich paſture; and the ſhore abounds with good coals which are dug at the ebb of tide. St. Cuthbert is ſaid to have paſſed the two laſt years of his life on this iſland. A priory of Benedictines was afterwards eſtabliſhed here, for ſix or eight monks, ſubordinate to Durham. A ſquare tower, the remains of a church, and ſome other buildings, are ſtill to be ſeen on this iſland; and a ſtone coffin, which is pretended to be that of St. Cuthbert. At the north end of the iſle is a deep chaſm, from

the top to the bottom of the rock, communicating with the sea; through which, in tempestuous weather, the water is forced with great violence and noise, and forms a fine jet d'eau of 60 feet high. It is called by the inhabitants of the opposite coast, the *Churn*. One of the islands in the most distant group is called the *Pinnacles*, from some vast columnar rocks at the south end, even at their sides, flat at the tops, and entirely covered with guillemots and shags. The fowlers pass from one to the other of these columns by means of a board, which they place from top to top, forming a narrow bridge over such a dreadful gap that the very sight of it strikes one with horror.

FARNHAM, a town in Surry, with a market on Thursday. It is seated on the river Wey, and has a castle, situated on an eminence, where the bishop of Winchester usually resides; but it is now much decayed. The houses are handsome; and it is remarkable for one of the greatest wheat markets in England, and for the sale of the finest hops, grown in plantations round it, and which bear a much greater price than those of Kent. It is 12 miles W. of Guildford, and 39 W. S. W. of London. W. lon. 0. 46. N. lat. 51. 16.

FARNOVIANS, in ecclesiastical history, a sect of Socinians, so called from Stanislaus Farnovius, who separated from the other Unitarians in the year 1568, and was followed by several persons eminent for their learning. This sect did not last long; for, having lost their chief, who died in 1615, it was scattered abroad and reduced to nothing. Farnovius was engaged by Gonesius to prefer the Arian system to that of the Socinians, and consequently asserted, that Christ had been produced out of nothing by the Supreme Being before the creation of this terrestrial globe. His sentiments concerning the Holy Ghost are not certainly known: however, it appears that he warned his disciples against paying the tribute of religious worship to the Divine Spirit.

FARQUHAR (George), an ingenious poet and dramatic writer, the son of a clergyman in Ireland, was born at Londonderry in 1678. He was sent to Trinity college, Dublin; but his volatile disposition not relishing a college life, he betook himself to the stage; where, having dangerously wounded a brother-actor in a tragic scene, by forgetting to change his sword for a foil, it shocked him so much that he left the Dublin theatre and went to London. Here he procured a lieutenant's commission by the interest of the earl of Orrery; which he held several years, and gave many proofs both of courage and conduct. In 1698, he wrote his first comedy called *Love and a Bottle*; which, for its sprightly dialogue and busy scenes, was well received. In the beginning of the year 1700, which was the jubilee year at Rome, he brought out his *Constant Couple*, or *A Trip to the Jubilee*; and suited Mr. Wilks's talents so well in the character of Sir Harry Wildair, that the player gained almost as much reputation as the poet. This tempted him to continue it in another comedy called *Sir Harry Wildair*, or *The Sequel of the Trip to the Jubilee*; in which Mrs. Oldfield acquired great applause. In 1702 he published his miscellanies, which contain a variety of humorous sallies of fancy. In 1703 appeared *The Inconstant*, or *The Way to win him*; in 1704, a farce called *The Stage-coach*; in 1705, *The Twin Rivals*; and in 1706, *The Recruiting Officer*, founded on his own observations while on a recruiting party at Shrewsbury. His last comedy was *The Beaux Stratagem*, of which he did not live to enjoy the full success. Mr. Farquhar married in 1703. Before that time his manner of life had been rather dissipated. The lady, therefore, who afterwards became his wife, having fallen violently in love with him, but judging that a gentleman of his humour would not easily be drawn into the trammels of matrimony, contrived to have it given out that she was possessed of a large fortune; and finding means afterwards to let Mr. Farquhar know her attachment to him, interest and vanity got the better of his passion for liberty, and the lady and he were united in the hymeneal bands. But how great was his disappointment, when he found all his prospects overclouded so early in life (for he was then no more than 24), by a marriage from which he had nothing to expect but an annual increase of family, and an enlargement of expence in consequence of it far beyond what his income would support! Yet, to his honour be it told, though he found himself thus deceived in a most essential particular, he never was known once to upbraid his wife with it; but generously forgave an imposition which love for him alone had urged her to, and even behaved to her with all the tenderness and delicacy of the most indulgent husband. Mrs. Farquhar, however, did not very long enjoy the happiness she had purchased by this stratagem; for the circumstances that attended this union were in some respect perhaps the means of shortening the period of her husband's life. For, finding himself considerably involved in debt in consequence of their increasing family, he was induced to make application to a certain noble courtier, who had frequently professed the greatest friendship for him, and given him the strongest assurances of his intended services. This pretended patron repeated his former declarations; but, expressing much concern that he had nothing at present immediately in his power, advised him to convert his commission into money to answer his present occasions, and assured him that in a short time he would procure another for him. Farquhar, who could not bear the thoughts of his wife and family being in distress, followed this advice, and sold his commission; but, to his great mortification and disappointment, found, on a renewal of his application to this inhuman nobleman, that he had either entirely forgotten, or had never intended to perform, the promise he had made him. This distracting frustration of all his hopes fixed itself so strongly on our author's mind, that it soon brought on him a sure, though not a very sudden, declension of nature, which at length carried him off the stage of life in 1707, before he arrived at 30 years of age. His comedies are so diverting, and the characters so natural, that his plays still continue to be represented to full houses.

FARRIER, one whose employment is to shoe horses, and cure them when diseased or lame. It is very extraordinary, that, for many ages, two employments requiring the exercise of such very opposite talents should have been continued in the same person. Yet this has been the case, till within a very few years, that a *college* has been established near London, called the VETERINARY COLLEGE, for the instruction of young men, of good education, in the art of curing the diseases to which horses, horned cattle, and other useful animals are subject. Common farriers do infinite mischief not only by treating the complaints of horses ignorantly, but by destroying their feet by cutting away the hoof in shoeing.

F A R R I E R Y,

THE art of curing, palliating, or preventing the diseases of horses, called of late years, and since the subject has employed the attention of scientific persons, the *Veterinary Art*.

The practice of this useful art has been almost entirely confined to a set of men who are totally ignorant of anatomy and the general principles of medicine. It is not there-

fore ſurpriſing, that their preſcriptions ſhould be equally as abſurd as the reaſons they pretend to give for adminiſtering them. It cannot indeed be expected, that farriers, who are almoſt univerſally illiterate men, ſhould make any real progreſs in this important branch of knowledge. They preſcribe draughts and balls, they rowel, cauteriſe, &c. without being able to give any other reaſon for their practice, but that their fathers did ſo before them. How then can ſuch men be expected to deduce the cauſe of a diſeaſe from its ſymptoms, or form a rational method of cure, when they are equally ignorant of the œconomy of the animal and the operation of drugs?

The miſerable ſtate of this uſeful art, however, has given riſe to an inſtitution, likely, as we have obſerved in the foregoing article, to lead to a ſyſtem of practice formed on rational principles; and conducted by men of talents and integrity throughout the kingdom.

Notwithſtanding the idle prejudices which have for ſo many ages diſcouraged men of education from undertaking to remedy the diſeaſes of brute animals, we are not without inſtances of ſome few laudable efforts of the kind. The treatiſes publiſhed by Gibſon, Bracken, Bartlet, and others, tended, at the time they were written, to throw conſiderable light on a ſubject till then clouded in the darkeſt obſcurity. Theſe writers certainly gave to farriery ſomething of the air of a *ſcience*; but the prevailing notion, that its practice was unworthy of men of education, and more eſpecially derogatory to *medical* practitioners, who alone were likely to make any conſiderable improvements in it, rendered their judicious ſyſtems productive of very limited benefits to the community.

The principal merit of thoſe writers who, at an early period, thus publiſhed ſucceſſively their remarks on the practice of farriery, was that which indeed conſtitutes the principal merit of later works on the ſubject, namely, the adaptation of medicine and ſurgery, as practiſed in their days, to the diſeaſes of brute animals. It muſt be obſerved however, that even medicine and ſurgery have undergone many and great revolutions and improvements; and of courſe, however meritorious at the time they were publiſhed, the ſyſtems of Gibſon, Bracken, &c. cannot claim our firſt attention in this place; and the leſs ſo, as, in imitation of the French and other veterinary inſtitutions in different parts of Europe, we have not only a regular ſeminary in which farriery is ſcientifically taught, but the ſubject alſo has of late years employed the pens of ſeveral gentlemen in the practice of medicine and ſurgery. From the writings of the latter therefore, we propoſe, though not entirely, yet chiefly, to draw the materials of our treatiſe; and as Anatomy muſt be acknowledged the true baſis on which the veterinary art is founded, we ſhall not enter on thoſe ſubjects which uſually take the lead in modern ſyſtems of farriery, till we have firſt deſcribed the *Anatomy of the* Horse, for which, and the delineations annexed, we are chiefly indebted to the liberality of Mr. D. Blaine, author of an elegant work on this ſubject now publiſhing in numbers.

PART I. OF THE ANATOMY OF THE HORSE.

IN a great many reſpects the anatomy of the horſe bears ſo cloſe an analogy to that of the human ſubject, that the general deſcriptions of the one will apply pretty accurately to the other. Thus, the horſe is an animal made up, like the human ſubject, of *ſolids* and *fluids*; he is compoſed of *bone*, *cartilage*, *ligament*, *fibres*, *membranes*, *arteries*, *veins*, *nerves*, *abſorbents*, *muſcles*, *glands*, &c. It is therefore ſuperfluous to enter minutely into ſuch inquiries here as may with little variation be found in another place; and for this reaſon we ſhall refer the reader to the article Anatomy in every inſtance where the ſimilarity happens to occur. Thus the *Explanation of the general terms of Anatomy* in p. 161, may be now conſulted, as well as the 1ſt Section of Part I. which treats *Of the Bones in general*, their ſtructure, uſes, &c. all which apply with equal truth to the anatomy of the horſe.

Sect. I. *Of the* Skeleton.

The ſkeleton of the horſe may be divided into the head, trunk, and extremities; and ſuch diviſion, when treating of the bones, appears more convenient than into fore-hand, hind-hand, &c. which ſome have adopted. In plate 19, the letters and figures on the engraving of the ſkeleton refer to the following deſcription; where the more ſtriking parts of the bones only are noticed, as each bone will undergo a ſeparate and individual examination. *a a a a*, ſhow the os frontis, or forehead bone. *b b*, the parietal, or vertical bone. *c c c*, the occipital, by ſome called the knoll bone. *d d*, the temporal bone, made up of two parts, a ſquamous and petrous. *e e*, maxilla ſuperior, or anterior. *f*, jugal, or cheek bone. *g g*, naſal, or bones of the noſe. *h*, os unguis. *i i i*, poſterior jaw, or maxilla poſterior. Theſe are all the bones forming the head that appear on a ſide view.

The following figures refer to *particular parts of the bones*, viz. 1. the petrous portion of the temporal bone, a hollow proceſs, which forms: 2. the meatus auditorius, or opening to the ear. 3. the maxillary proceſs of the temporal bone. 4. the cuneiform proceſs of the occipital. 5. the zygomatic proceſs of the temporal, joined to the jugal proceſs, and forming the zygoma, or arch of this part. 6. the occipital protuberance. 7. the orbit, or cavity of the eye. 8. the coronoid proceſs of the poſterior or lower jaw. 9. the condoloid proceſs that articulates the poſterior jaw with the head. 10. a hole, called ſuperciliary foramen, from which the frontal nerve and artery paſs. 11. a proceſs of the frontal bone joining with the zygomatic proceſs of the temporal. 12. a hole tranſmitting a nerve and artery to furniſh the face. 13. a third foramen, from which proceeds a branch of the fifth pair of nerves, and an artery. 14. the grinders. 15. The tuſhes. 16. The nippers.

The cervical or neck bones.

A A A, &c. The ſeven cervical or neck vertebræ, the firſt of which, *b*, is called the atlas; as the ſecond of them is termed dentata; *c*, marks the tranſverſe proceſs of the firſt; as *d d d d d d*, do the ſame proceſſes of the other ſix: *e e c*, &c. the ſuperior or anterior oblique proceſſes of the ſix laſt, in the firſt it is wanting; *f f f*, &c. their inferior or poſterior oblique proceſſes; *g g g*, &c. the ſpinous proceſſes of the ſame.

The remainder of the bones of the ſpine. *a a a a a a*, &c. the eighteen dorſal vertebræ; *b*, their ſpinous proceſſes; *c*, their tranſverſe proceſſes; *d*, their upper or anterior oblique proceſſes; *e*, their lower or poſterior oblique proceſſes; *f*, the cartilage interpoſed between each dorſal and lumbar vertebra; one only is marked, but will ſerve as a guide for the reſt.

B C D E F G. The lumbar vertebræ, or thoſe of the loins. The ſame deſcription anſwers to theſe as to the dorſal, the great length of their tranſverſe proceſſes only being noticed.

1, 2, 3, 4, 5. Theſe mark the five pieces, of which the ſacrum is compoſed in the young ſubject, but by age becomes one entire bone. 1, 2, 3, &c. to 18. the eighteen bones of the tail.

The bones of the thorax and shoulder blades.

A A. The sternum: 1, 2, 3, 4, 5, 6, 7, 8, the eight true ribs, so called as their cartilages are immediately attached to the sternum; 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, the false ribs, so called from their cartilages not being inserted into the sternum, but into each other; *a*, the head that articulates with the transverse process of the first vertebra of the back; *b*, the anterior part of the head that is connected to the body of the seventh vertebra of the neck; the same description answers for each other rib.

A. A. The scapula or shoulder blade; *a*, the superior, or more properly anterior spinatus fossa; *c*, the spine which divides these two fossa, and from which they take their name; *d*, the upper costa; *e*, lower costa; *f*, the neck: *g*, coracoid apophysis: at the upper part is seen a line, shewing the extent of the cartilage of the scapula.

Bones of the fore legs.

B. The humerus, or bone of the arm; *i*, its head that articulates with the shoulder blade; *k*, its external condyle; *l*, the fossa, or cavity receiving the radius; *m*, that which receives the cubitus. *C.* the cubitus or ulna; this in the young subject is a distinct bone, but in the grown horse is fastened to the radius; *b*, the process called olceranon, forming the elbow. *D.* the radius; *o*, its upper end; *p*, its lower extremity, forming a part of the knee. *E.* the carpus, which in the horse is formed of seven bones; the trapezium, which in the human forms the eighth, is wanting in the horse; this part, forming the wrist of man, is by long custom called the knee of the animal. *F.* the metacarpus, or shank bones, to each of which are joined two imperfect metacarpal bones marked *g*, called by the French epineux; *r, r*, the sessamoid bones. *G.* the pastern bones. *H.* the coronet, or little pastern bones. *I.* the coffin bone. There is another sessamoid or small bone within the curve of the coffin bone; this will be described in another place.

The pelvis and hinder extremities, or legs.

K. The pelvis, composed of three bones in the young subject, which are *a a a a a*, the illium; *b b b*, the ischium; *c c c*, the pubis; *d*, foramen magnum. *L.* the femur: *e*, its head, articulating with the acetabulum, or cavity in the pelvis; *f f f*, the great trochanter; *g*, the linea aspera; *k k*, the patella, or stifle, but more properly the knee bone. *M.* the tibia. *N.* the fibula; this, as in the cubitus or ulna, is firmly attached to the tibia, and is an inconsiderable bone, compared with that of the human. *O.* the tarsus, consisting of six bones, the great cuneiform bone being wanting, which in the human forms the seventh; *b b*, the calcaneum. *P P, p p*, the metatarsus, which follow the same description as the anterior extremities.

Sect. II. *Of the* Muscles.

The muscles of the horse and other quadrupeds are made up of bundles of red fibres, and resemble the muscles of the human subject so entirely, in regard to their structure and functions, that it is not necessary to enter into a description of them here. Every thing that the reader can require, by way of introduction to this part of the subject, may be found under the article Anatomy, sect. 1. of Part II. We shall therefore proceed to speak of the references which belong to the muscular figure of the horse, in plate 20.

In the head.

a b c d, The lateral dilator of the nostril and upper lip; *b c*, its insertion into the upper lip and nostril; *d*, its origin. *f*, the anterior dilator of the nostril. *g h i k*, the orbicular muscle of the mouth; *g*, the part belonging to the lower lip; *h*, the corner of the mouth; *i*, the part belonging to the upper lip; *k*, fibres which tend upwards to the insertion of the nasal muscles of the upper lip. *l m n o*, the long nasal muscle of the upper lip; *l m n*, the fleshy part; *m*, its origin; at *n*, the tendon begins; *o*, the tendon. *p p q*, the masseter. *r* 8 8, buccinator. *s t*, the broad ligaments of the eye-lids, which are membranous elongations formed by the union of the periosteum of the orbits, and pericranium along both edges of each orbit. *u u w*, the ciliaris muscle; *w*, its origin. *x y*, a muscle belonging, in part, to the alæ narium *z*, but chiefly to the concha narium inferior; *x*, its insertion into the alæ narium; *y*, its origin, by a small tendon from the bone along the nasal muscle of the upper lip; below *x*, it passes under the alæ narium to the inside of the nostril, and is there inserted into the concha narium inferior. *z*, alæ narium. &, septum narium. 2 2 3, the temporal muscle; 3, its insertion into the coronary process of the under jaw bone. 4 4, muscular fibres which extend and draw outwards the pituitary membrane 5. 5, membrana pituitaria. 6 7 7, a muscle called caninus, or elevator of the corner of the mouth, arising from the upper jaw bone under the muscle *x y*, and inserted at 7 7 into the buccinator. 9 10, the depressor of the lower lip; it arises along with the buccinator, and is almost divided into two muscles, one superior, the other inferior, for the passage of nerves and blood-vessels to the lower lip; the superior arises tendinous, and is inserted fleshy into the lower lip laterally; the inferior arises fleshy, and is inserted tendinous nearer the middle of the lower lip. 12, the elevator of the chin. 13, a nerve going to the alæ narium. 14, vena angularis, which is a branch of the vena jugularis externa anterior. 15, arteria angularis. 16, a branch of the vena temporalis. 17 17, two valves, in a branch of the jugular vein. 18, branches of the nervus maxillaris inferior. They are branches of the third branch of the fifth pair of nerves. 18, the salivary duct. 20, the anterior cartilage of the outer ear. 21, the outer ear. 22 23, a muscle arising from the anterior cartilage at 22, and inserted at 23 into the outer ear. 24, a muscle which arises by two fleshy heads from the internal surface of the anterior cartilage, and is inserted into the lower convex part of the external ear near the root, nearer the posterior edge than the anterior. It assists the posterior part of the retrahens in action. 25, a muscle which is a sort of antagonist to that marked 24; it arises from the ridge of the occiput under the retrahens, and is inserted into the ear at 25. It helps to turn the opening of the ear forwards. 26 26 26 *c*, the parotid gland.

In the neck.

a b c, Sterno mastoidæus, or sterno maxillaris: it arises from the top of the sternum at *b*, and is inserted by a flat tendon into the lower jaw bone, under the parotid gland at, or near, *c*, is likewise inserted into the root of the processus mastoidæus by a flat tendon. *d*, the spungy, fatty substance of the mane cut directly down the middle, and the left side remaining on to shew its thickness. *e*, ligamentum colli. *f f*, caracohyoidæus; it arises from the upper and internal side of the humerus, betwixt the insertions of the subscapularis and teres major by a flat membranous tendon; it begins to be fleshy as it comes from under the serratus minor anticus, and is inserted into the os hyoides. *g*, sternohyoidæus. *h i*, transversalis; *h*, the tendinous part; *i*, a fleshy part. *k l*, the tendon of the trachelomastoidæus; *l*, a fascia or membranous part. *m n*, rectus internus major capitis; *m*, its lowest origin from the transverse process of the fourth vertebra of the neck, and the part *p*, of the longus colli, which origin is sometimes continued down almost as low as the lower part of the transverse process of the fifth. *o o o o*, inter transversales minores colli; they run from the transverse process of one vertebra to the transverse process of the next to it. *p q*, longus colli. *r s t u w*, splenius; *r*

the part coming from the origin of this muſcle, which is from the expanſion common to it, and the ſerratus minor poſticus, &c. It ariſes tendinous from the ligamentum colli under the rhomboides, and fleſhy about the ſuperior part of the neck. At *s* it is inſerted into, or attached to the tranſverſalis; at *t*, to the tendon of the trachelomaſtoidæus; *u*, the part which goes to be inſerted into the occiput. It is alſo inſerted into the tranſverſe proceſſes of the fifth, fourth, and third vertebræ of the neck, by flat, ſtrong tendons which run on the internal ſide of the muſcle: it is externally fleſhy within a minute or two of theſe inſertions. *x*, ſternothyroidæus. *y*, hyothyroidæus. *z*, cricothyroidæus. &, the lower conſtrictor of the pharynx. 1 1, vena jugularis communis. 2, vena jugularis externa anterior. 3, vena jugularis externa, poſterior, or ſuperior. 4, part of the carotid artery, or carotis communis. 5, glandulæ claviculares, or axillares (in this animal, as there are no clavicles) or cervicales inferiores or thoracicæ ſuperiores lymphaticæ. They are lymphatic glands. 6 6 6 6, branches of the cervical nerves accompanied with arteries which are diſtributed to the muſculus levator humeri proprius, &c. and integuments. 7, branches of the cervical arteries and veins coming out of the ſplenius to go to the trapezius and integuments.

Muſcles in the neck and trunk, which are inſerted into the ſcapula.

a a b, Rhomboides; *a a*, the origin from the ligamentum colli: it has another origin from the ſuperior ſpines of the vertebræ of the back: *b*, its inſertion, or the part going to be inſerted into the ſcapula. *c d e f*, ſerratus minor anticus; *c d*, the fleſhy part ariſing near *c*, from the ſternum, and part of the firſt rib, and from the cartilaginous endings of the ſecond, third, and fourth ribs, near their joining to the ſternum; and is inſerted into the ſuperior coſta near the baſis ſcapulæ and tendinous ſurface of the ſupra ſpinatus; and is connected to the teres minor by the faſcia *e f*, which is ſent from this muſcle over the infra-ſpinatus ſcapulæ and ſupra-ſpinatus ſcapulæ to its outer edge. Its flat tendon may be ſeparated ſome part of the way to the baſis and ſpine of the ſcapula from the tendinous ſurface of the ſupra-ſpinatus ſcapulæ. *g h i k l o p*, ſerratus major anticus; *g*, part of its inſertion on the external part of the ſcapula; the reſt of its inſertion poſſeſſes about one half of the internal part of the ſcapula; *h*, the part which ariſes from the tranſverſe proceſs of the third vertebra of the neck; *i*, that from the fourth; *k*, that from the fifth; *l*, that from the ſixth; *o*, its origin from the ſeventh rib; *p*, from the eighth. This muſcle ariſes from the ſix ſuperior ribs, alſo within about five minutes of the cartilages. It does not adhere to the intercoſtals as it paſſes over them; but at the extremity of its origin ſends off a membranous tendon over the intercoſtals, towards the ſternum: it ariſes all the way, from its firſt beginning, from the external ſurface of the ribs up to the inſertion of the tendons of the ſacro lumbalis.

Muſcles, &c. inſerted into the humerus and cubit.

1 1 2 3 4 5 5 6, Pectoralis; 1 1, its origin from the linea alba abdominis; 1 2, its origin from the lower part of the ſternum; 3 its origin from the ſuperior part of the ſternum; the part 3 4, which is the ſuperior part of this muſcle, ſends a flat membranous tendon in betwixt the biceps and levator humeri proprius, to which it is joined before its inſertion into the humerus; 5 5 6, the flat tendon cut off at 5 5; the external part below this runs down the cubit. *a b c d e f*, ſupra-ſpinatus ſcapulæ; it continues its origin from the ſcapula from *a* to about *b*, and is inſerted at *c*, into the head of the os humeri, and capſular ligament on the outſide of the origin of the biceps cubiti; and by the other half into the head and capſular ligament of the os humeri, or the inſide of the origen of the biceps cubiti; the lower part is covered by a tendinous faſcia which runs from the ſupra-ſpinatus to the ſerratus minor anticus, and binds that muſcle in its place; it is pretty ſtrong at *d*, but ſtronger at *e*, below the protuberating part of the humerus; at *e f*, a faſcia runs over this muſcle from the ſerratus minor anticus to the teres minor. *h i k l m n*, infra-ſpinatus ſcapulæ; from *h*, to *i*, are marked traces of the ſuperior part of the trapezius's inſertion on the ſurface of this muſcle, it is attached to it at *i*, but ſtrongly inſerted into it near *h*; *h k*, marks the inſertion of the ſuperior part of the trapezius upon this muſcle; *l*, the beginning of its origin from the dorſum ſcapulæ, and the cartilage on the border of that bone; *i k m*, marks of the inferior outline of this muſcle, where it is bounded by the teres minor, but not eaſily diſtinguiſhed, by reaſon of the tendinous ſurface by which they are both covered and attached together; *n*, its ſtrongeſt tendon, by which it is ſtrongly inſerted into the protuberating part of the humerus under the tendinous expanſion which goes from the teres minor to the leſſer anterior ſaw muſcle. The lines upon this muſcle mark the direction of ſome of the principal fibres of the tendinous covering. *o p q q*, teres minor; *o*, its origin along with the triceps cubiti; *p*, its inſertion into the faſcia ariſing from the humerus; *q q*, its inſertion into the humerus; from *q* to *k*, it ſends off a faſcia that connects it to the ſerratus minor anticus. The outline is much obſcured by the faſcia or tendinous covering of part of this muſcle and the infra-ſpinatus with the ſupra-ſpinatus, which connects them. *k p* marks the cutting off of the membranous tendon of the ſuperior part of the trapezius, as *h k* marks it upon the infra-ſpinatus. *r r s t t u w*, latiſſimus dorſi; *r r s t t*, its flat tendon; *r r*, its origin from the ſpinal proceſſes of the back; at *r s*, this tendon is cut away from its attachment to the faſcia lata; and at *r* I, it is entirely cut away to uncover the glutæi; *t t u w*, the fleſhy part; *t t*, the origin of the carnous fibres. *r*, *r u*, mark the traces of the inferior part of the trapezius incloſed betwixt the tendon of this muſcle, and a tendinous faſcia which covers them both together; the ſaid faſcia being cut off at *r u*, and left on the latiſſimus dorſi, leaves the marks of the trapezius very plain; *t u u*, ſhews the direction of the fibres of the tendinous faſcia which connects this part of the muſcle to the triceps cubiti: theſe fibres run over the infra-ſpinatus towards the inſertion of the trapezius *h k*; *w*, the fleſhy part going to be inſerted into the humerus; *s* I, the aponeuroſis which runs towards the obliquus deſcendens, and ſeems to be loſt upon it, degenerating into a membrane.

In the Trunk.

IIIIIKKKLM, Obliquus externus, or deſcendens abdominis; IIIII, the place where the thickeſt carnous part ceaſes to ariſe from the ribs, and begins to run over them without adhering to them or the intercoſtals; KKK, the ending or inſertion of the carnous part into the tendinous part; L, the linea alba, or ſtrong broad aponeuroſis, formed by this and the internal oblique muſcle; it is like a broad, ſtrong ligament, much reſembling that of the neck, forming a ſort of rugæ which appear on its external ſurface, running from above downwards: it has a communication with the ſerratus major anticus by an aponeuroſis, which ariſes from that muſcle; its firſt or ſuperior origin is from the fifth rib, it ariſes tendinous from the back part of the inſertions of the indentations of the ſaw muſcle into the ribs, and at its origin receives the inſertion of the lower part of the indentations of the ſaw muſcle; it ariſes from the poſterior or inferior labeum or edge of the eighth rib, near all the way from I to the inſertion of one of the indentations of the ſuperior, or leſſer, poſterior ſerratus; from the poſterior labeum of the ninth, almoſt as high as where an indentation of the leſſer ſerratus poſtericus is inſerted in the ſuperior or anterior labeum of the ſame rib; it alſo ariſes from the tenth; and, in this ſub-

ject, oppofite to the infertion of the ferratus minor pofticus, it arifes from all the ribs below that from the part where the indentations of the ferratus major pofticus are inferted, or a little higher than that more externally, which is the cafe generally with the three or four laft digitations, but moft as they are the loweft, and runs over the indentations of the faw mufcle; thefe digitations continue their origin from the ribs all the way down to the part marked I I I I I, and unite with the intercoftal mufcles in their paffage; this mufcle has a communication with the latiffimus dorfi by an aponeurofis, which is fent over it by that mufcle; I *r* marks the cutting away of the tendon of the latiffimus dorfi to uncover the glutæi, &c. it is inferted into the os illium and os pubis and to its fellow by the linea alba.

The blood-veffels and nerves which are marked on the thorax are thofe which were diftributed to the parts taken off as the membrana-carnofa, &c. and integuments; the nerves come from the nervi dorfales or coftales and nervi lumbares; the arteries from the arteriæ inter-coftales inferiores and arteriæ lumbares; the veins from the venæ intercoftales and venæ lumbares.

In the right upper Limb.

N O P, Triceps brachii; N the head, which is called extenfor longus major; O the fhort head of the triceps, called the extenfor brevis; P the head called brachialis extenfor longus minor. The fhort head O arifes from the humerus, the other two from the fcapula; its infertion is into the ancon. Q R S biceps brachii, or coraco radialis; Q the belly of the fhort head; R the belly of the long head; S the fafcia of this mufcle, which is fent down upon the mufcles on the cubit. *aAbcdecgb*, a fafcia or ftrong membranous production lying over the extending mufcles on the cubit; *a* A its origin from the edge of the triceps from the levator humeri proprius, and from the two protuberating parts of the humerus, betwixt which it is extended like a ftrong ligament, and gives origin to fome of the flefhy fibres of the extenfor carpi radialis; it is inferted into the radius at *b c b*; at *b b* into the ligament; and being expanded over all the extending mufcles which lie on the cubit, is inferted into the internal fide of that bone, all along the bounds of the bending mufcles on that fide; there lies under it the extenfor carpi radialis, of which *d* is the flefhy part; *e e f* the tendon; *b c* extenfor digitorum communis; *g* what is analogous to the extenfors of the thumb.

This fafcia is attached to the upper edge of the extenfor digitorum communis, and may, perhaps, be properly called a flat tendon, arifing common to this mufcle, and the extenfor carpi radialis, and fending an expanfion not only over but alfo under them, and being attached to the bone on each fide down to the carpus, and alfo to the ligaments that bind down the tendons, running over the carpus, it makes a continued cafe for them from their originations down to the carpus, confining them fteady in their proper places. It communicates with the fafcia of the biceps mufcle, and with it is inferted into the tendon of the extenfor carpi radialis. *f*, the tendon of the extenfor carpi radialis inferted into the metacarpal bone. *i*, the tendon of the extenfor digitorum communis going to its infertion into the coffin bone. *m n o o* P *p q r s t*, an expanfion arifing at *o o* from the articulating ligament, and at *n* from the olecranon: it receives an addition from the longus minor, and internal protuberance of the humerus, and expanfion of the biceps mufcle, then defcends over the bending mufcle down to the ligaments on the carpus, to which it is attached, as well as to the bones of the cubit on each fide of the bounds of the bending mufcles; the different directions of its fibres being marked as at *q*, *r*, &c. and its infertion into the bone on the external fide as at P *m b*; it then runs into the ligaments. It gives rife to flefhy fibres of the mufcle *m*, which is analogous to the extenfor minimi digiti, all the way from the out-line *q m b* to the bone where the expanfion is inferted. It has a ftrong infertion at P into that protuberating bone of the carpus called the os pififorme or orbiculare, and another betwixt the tendons *s s* of the flexor carpi ulnaris, befides its conjunction with the ligaments on the carpus to which it is a confiderable addition; *t* a part of the expanfion which appears like a number of fmall tendons. At *z* a ligament arifes which joins the tendon *m* near *m w*, and goes along with it to be inferted into the great paftern. A flender ligament arifes about P which covers the tendon *m* and then runs betwixt it and the tendon *i* to be inferted into the upper and anterior part of the great paftern. *b b* P *p u w x y y z*, ligaments which bind down the tendons lying upon the carpus. 16 *b b y y u*, a ligament whofe fibres run in a tranfverfe direction over the anterior part of the carpus to which the carnous membrane adheres at *u*; at 16 the ligament *b b y y* 16 adheres to the burfal ligament; *x w* the infertions of the articular ligament; betwixt *c* and *b* is a ligament proper to the extenfor digitorum communis, inferted at two protuberating parts of the radius, one on each fide the channel in which the tendon lies; *p z w*, a ligament, the fibres of which run in the upper part tranfverfe, in the lower rather obliquely downwards, it lies on the lateral or external part of the carpus, it was covered in table the firft by the production of the membrana carnofa, and pectoralis, but rather the membrana carnofa, as it lies on the external part. 1 2, a ligament arifing at 1 and inferted at 2 *w*; it helps to bind down the projecting bone of the carpus, and ferves as a ftay to it when the flexor carpi ulnaris is in action: there is a large vein protuberating under it. 3, a ligament which helps to bind down the tendons of the fublimis and profundus. 4, the tendon of the profundus. 5, the tendon of the fublimis. 6, a vein arifing from under the hoof called vena plantaris externa. 7, nervus plantaris externus. 9, an articular ligament. 10, a ligament fent from the interoffeus and inferted into the tendon of the extenfor digitorum communis, which it binds down. 11, 12, the horny part of the hoof; 11, the fuperior part; 12, the fole, or inferior part going under the coffin bone. 13, a fubftance refembling the villous furface of a mufhroom arifing from the coffin bone, received by the like arifing from the hoof, which it mutually receives.

In the right lower Limb.

a b c c d d d D *e f g g b i k l* Shew the fafcia lata; *a* its origin from the ilium; *b* its anterior flefhy belly; D the pofterior flefhy belly, over which the fafcia lata fends a ftrong membrane, as well as under, fo that it is received or contained in a duplicature of the fafcia lata; the fibres *d d d* D *c* arifing from the fuperior or external fafcia, and defcending to be inferted into the inferior on its external fide; the part *a b c* arifes from the fpine of the os ilium internally tendinous; flefhy fibres arifing from that flat internal tendon, and defcending to be inferted chiefly into the infide of the fafcia in the angle *c d g g*; the flefhy part in the fuperior angle *d* being thickeft, it gradually diminifhes till it is loft in the line *g g*; the dark colour of the flefhy fibres make fome appearance in this angle though the fafcia is very ftrong, but not near fo much as the part *a b g*, becaufe the covering of that is little more than a common membrane; the line *a e*, makes the place where the fafcia lata is cut off before it paffes betwixt this mufcle and the glutæus externus to be inferted into the anterior cofta of the os ilium; *d e*, marks the place where the production of the fafcia lata, which is fent over this mufcle, is cut off; and *d d d*, the place where it joins to the broad tendon of this mufcle in which place it is cut off; *e f*, fhews the place where the fafcia lata is cut from its conjunction with what may be called the broad tendon of this mufcle, in order to pafs down over the leg and foot; at *b*, the tendinous furface of the rectus cruris makes its appearance

through the tendon of this muſcle; *i k*, ſhews the tendon or ligament which binds the patella to the tibia protuberating; *l*, the ligament which binds the patella to the external protuberance of the os femoris. This muſcle is inſerted, by a ſtrong tendon, into the tibia at *i*, adhering to the tendon of the anterior and middle part of the biceps muſcle in its way; its adheſion is all the way from *i* to the ſuperior 4, where it has a little inſertion into the patella. *m n o o p*, glutæus externus; *m*, a fleſhy origin from the ligament which runs betwixt the ſpinal and tranſverſe proceſſes of the os ſacrum; *m n*, the place where the faſcia lata is cut off from the production which it ſends under this muſcle, or from its attachment to the tendinous ſurface of the internal part of this muſcle, which ariſes from the ligament running betwixt the os ſacrum and iſchium; and which receives firſt the inſertion of thoſe fleſhy fibres which ariſe betwixt it and the ends of the ſpinal proceſſes of the os ſacrum from the ſame ligament, and then the fibres *m n o o*, which ariſe from the faſcia lata and deſcend obliquely inwards and downwards to be inſerted into it; *o o*, the place where this muſcle ceaſes to ariſe from the faſcia lata and goes to be inſerted at *p*, into the lateral protuberance of the thigh bone; it ſends off a faſcia over the poſterior part of the thigh bone, which runs in a tranſverſe direction, and into which the pyramidalis is inſerted, or joins in with it before its inſertion into the ſuperior or rather poſterior part of this protuberance. *q Q r s t*, glutæus medius; *q r s*, its origin from the tendinous ſurface of the ſacro lumbalis; *s*, its origin from the ilium; *q Q r s*, the part which is covered by its own proper membrane, and does not adhere to the tendon of the latiſſimus dorſi, &c. nor faſcia lata; *q Q t*, the part which receives fleſhy fibres from the faſcia lata, going under the glutæus externus to be inſerted into the great trochanter. *i k l u u w w x y z*, 3 4 4 5 7 7 8 8 9 11, biceps cruris; *u u w w*, mark the ſuperior or anterior head where it ariſes by fleſhy fibres from the faſcia lata; its principal origin is from the ligaments which run from the ſpinal to the tranſverſe proceſſes of the os ſacrum, and from thence to the tubercle of the iſchium; *w* 5 *y z*, mark the inferior or poſterior head, where it ariſes by carnous fibres from the faſcia lata; its principal origin is from the tubercle of the iſchium beginning at the extremity of that tubercle from the inferior angle, and continuing its origin by a flat ſtrong tendon about ſix minutes along the inferior edge of that bone; this tendon is continued down from the tubercle towards 5 betwixt *y* and *z*, from which, a little above *y*, the fleſhy fibres *y* 5 7 *l*, begin to ariſe; but the fleſhy part *x z* 7, begins its origin from the tubercle, and continues it down the ſaid tendon; *w w l* 4, the fleſhy part of the anterior head where it does not ariſe from the faſcia lata, it is inſerted into the patella and ſuperior and anterior part of the tibia; betwixt *p* and *w* are marked tendinous fibres which bind the anterior part of this muſcle to the external glutæus; and a little below that it is inſerted into the thigh bone by a flat tendon, and by this inſertion the anterior part of this muſcle is kept from ſtarting too much forwards, the fibres of this tendon or ligament running in almoſt a tranſverſe direction; the part *f* 4 4 *l w*, lies under a faſcia ſent from the anterior part of the poſterior head, to the tendon of the muſculus faſcia lata, which is cut off at *w f*, and on which the direction of its fibres is marked; *x z* 5 *y w l* 7 7, the fleſhy part of the poſterior head where it does not ariſe from the faſcia lata; *l i* 8 8 9 3 7 7, the tendon of the poſterior head which joins the tendon of the anterior head near the patella, and is likewiſe inſerted at *i* 8 8 into the anterior part of the tibia all the way down to the ligament common to the extenſor longus digitorum pedis, and tibialis anticus, and into part of the upper edge of that ligament and forms the tendon 11 with the faſcia lata (which is cut off at 3 9) and is inſerted into the os calcis; 7 7 3 is the ſtrongeſt part of the poſterior tendon which is inſerted into the os calcis. 15, the tendon of the plantaris. 16 17 17 18 19, ſemi-tendinoſus; 16, its origin from the ligament which runs betwixt the ſpines of the ſacrum and the iſchium, from the ligament betwixt the ſpinal and tranſverſe proceſſes of the os coccygis; 16 17 17, marks the part which receives fleſhy fibres from the faſcia lata; 18, the fleſhy part which does not adhere to the faſcia lata; 19, the tendinous production which wraps over the gemellus to join in with the faſcia lata and tendon of the biceps cruris; the lines 16 17, betwixt this muſcle and the biceps mark the faſcia lata where it runs in betwixt theſe muſcles; the poſterior of the two lines marks the cutting off of the part of the faſcia which runs over the ſemi-tendinoſus to the large adductor of the thigh: its principal inſertion is by a flat tendon into the ſuperior and anterior part of the tibia internally, it is alſo attached to the plantaris near the bottom of its fleſhy part by a flat tendon or expanſion. 22, ſhows the large adductor of the thigh. 24 25 25 26 27 30 31 32 33 34, ligaments which bind down the tendons, &c. on the tarſus, the inferior and anterior part of the leg or tibia, and the ſuperior part of the metatarſus laterally and anteriorly; 24 25 25, a ſtrong ligament common to the tendon of the extenſor longus digitorum pedis and tibialis anticus; at 24, it falls off to be very thin, but continues to receive ſome origin of tendinous fibres from the tibia for ſome way upwards, which run internally till they are loſt in the tendinous expanſion of the biceps muſcle, &c. which is inſerted into the upper internal edge of this ligament pretty ſtrongly, but falls away to little or nothing in its way towards the external lateral part of this ligament; from 24 downwards this ligament ſtrengthens as it deſcends towards 25 25, where it is thick and ſtrong: its origin on the external lateral part of the tibia is marked 25 33: there is another ſtrong ligament marked 26, proper to the tendon of the extenſor longus digitorum pedis, which ſhews itſelf under the common membranous ligament 27, which covers it, and the articular ligament as well as blood-veſſels, &c. upon the tarſus, and is attached to the ligament 24 25 25; at 25 25; at 30, are marked the directions of tendinous fibres, in this ligament, which ariſe from the bones of the tarſus and deſcend obliquely inwards and downwards; 31 marks fibres ariſing from the ſplint bone, or a bone of the metatarſus, and running tranſverſely over the anterior part of the metatarſus, joins in with the part 30; it is inſerted into the ſuperior and anterior part of the metatarſal bone; 34 marks ſome little appearance, by protuberation, of a ligament common to the tendon 37, and the blood-veſſels marked 14; 32 marks a ligament proper to the ſaid tendon 37, its origin and inſertion being both from the tibia. 35, a ligament which binds down the tendons of the flexors. 36 36, extenſor longus digitorum pedis. 37 37, peroneus anticus. 38, flexor digitorum pedis. 39, a branch of the arteria tibialis anterior. 40, plantaris. 41, flexor digitorum pedis. 42 46, vena plantaris externa. 43, nervus plantaris externus. 44, the interoſſeus, &c. 45, a ligament ſent from the interoſſeus, &c. by which the tendon of the extenſor longus digitorum pedis 36, is bound down, otherwiſe it would ſtart from the bone when the fetlock joint gives much way. 47 48, the horny part of the hoof; 47, the ſuperior part; 48, the ſole, or inferior part going under the coffin bone. 49, a ſubſtance reſembling the villous ſurface of a muſhroom ariſing from the coffin bone, received by the like ariſing from the hoof, which it mutually receives.

In the internal ſide of the left lower Limb.

a, The tendon of the rectus cruris. *b*, vaſtus internus. *c d*, ſartorius. *e e f*, gracilis. *g b k l*, ſemi-tendinoſus; *g* the fleſhy part; *k l* the tendon which is inſerted into the tibia at *k*; at *l* it ſends off a tendon to the gemellus, to which, at *o*, the faſciæ are attached. *m m m*, gemellus; *m* a fleſhy part; under *n* lies the tendon over which the tendon of the plantaris

is twisted. *n*, a tendon formed by that going off from the semi-tendinosus at *l*, and by another tendinous fascia. *o p q r s*, the fasciæ which are inserted into the os calcis gemellus and plantaris; *o* the place where the fascia lata is cut off; *p* the part going to be inserted into the os calcis on the external side; the part *q* joins with the part *r* to be inserted into the os calcis at *s*. *t u u w x*, the tendon of the plantaris coming from under the fascias and twisting over the gemellus at *t*; *w* a part which it sends off to the os calcis, which makes a sort of ligament to bind in the tendon of the flexor digitorum pedis; it is spread a little upon the ligament 8 9 9, and inserted into it near its origin from the os calcis about 8. *y*, the tendon of the flexor digitorum pedis lying under the thin ligament marked 3 5 on the right leg in this table; the bounds of it are here marked though it falls off gradually into nothing more than a common membrane, and is insensibly lost as it descends from about *y*; the lowest part of its insertion into the splint bone is about *y*, but is here hid by the blood vessel. *z* 1, the tibialis anticus appearing under the fascia. 2 3 3, the ligament marked 24 25 25 33 36, in this table of the right leg; 3 3, its insertion into the tibia. 4, the ligament marked 30 on the right lower limb in this table. 5, a ligament which covers the tendon of the tibialis posticus arising from the posterior and inferior part, or internal inferior angle, and inserting itself into the articular ligament 9 9. 6 6 7, a ligament arising at 7 from the astragalus, and inserted at 6 6, into a cartilage lying under the tendon of the flexor digitorum pedis, which, assisted by another ligament on the other side the limb, confines it in its place. These ligaments seem to be a part of the fascia which covers the muscles on the external side of the limb, which (passing under the tendon of the flexor digitorum pedis) forms a cartilaginous substance as it passes and is a smooth proper bed for that tendon to slide upon. 8 9 9, a strong ligament which binds the os calcis to the astragalus, os naviculare, ossa cuneiformia, and splint-bone, arising from a protuberance about 8, and inserted into the other bones of the tarsus and metatarsus about 9 9. 9 9, The articular ligament which binds the tibia to the bones of the tarsus. 10 11, a ligament running over the tendon of the plantaris, inserted into the ligament 8 9 9, and splint-bone. It is marked 35 on the right leg in this table. 12 12 12, a sort of ligamentous fascia betwixt which and the bursal ligament the mucilaginous glands are contained. 13 the ligament proper to the tendon of the extensor longus digitorum pedis, marked 26 in the right limb in this table. 14 15 16 17, the tendon of the extensor digitorum, at 14 going to be inserted into the last bone of the toe, or coffin bone: it receives the ligament 19 at the part 16, and the ligament 20 at the part 17; and, in its passage down the toe, it adheres to the bursal ligaments under 21 and 20. It is marked 5 in table the first. 18, interosseus, &c. 19, the ligament marked *d* in table the first. It arises from the interosseus, &c. and is inserted into the tendon of the extensor longus digitorum pedis, and binds it down. 20, a ligament which arises from the internal-lateral and inferior part of the first bone of the toe, and is inserted into the tendon of the flexor digitorum pedis, and binds it to this side, as 46 on the right lower limb, doth the same tendon to the other side. 21, vena sapphena. 22, nervus sciaticus internus. 23, nervus plantaris internus. 24, vena plantaris interna. 25 26, the horny part of the hoof; 25, the superior part; 26, the sole or inferior part going under the coffin bone. 27, a substance resembling the villous surface of a mushroom arising from the coffin bone, received by the like arising from the hoof, which it mutually receives.

In the left upper Limb.

c, Part of the biceps which sends an expansion over the bending muscles lying upon the cubit. *d e f*, the expansion marked *m n o o p* P *q r s s t*, on the left upper limb in this table. *g g*, the fascia marked *a* A *b c d e e g b* on the left upper limb in this table. *b*, the tendon of the muscle which is analogous to the extending muscles of the thumb, marked *g* on the right upper limb in this table. *i i k l m*, the ligament marked 16 *b b y y u*, on the left upper limb in this table: the articular ligament appears under this: from *k* to *l* this ligament communicates with the fascia *d e f*. *n o*, a ligament arising at *n*, and inserted, about *o*, like the ligament marked 1 2 on the right upper limb in this table. *p*, the ligament maked 3 on the right upper limb in this table. It is a continuation of the ligaments marked *n o* on the right, and 1 2 on the left upper limb in this table; it is here something thinner than the ligaments *n o* and 1 2, but as it descends down the limb is soon insensibly lost in a membrane. *q*, the tendon of the profundus. *r*, the tendon of the sublimis. *s*, a vein arising from under the hoof, called vena plantaris interna. *t*, nervus plantaris internus. *w x*, the tendon of the extensor digitorum communis; *w*, the part which is sent off from the principal tendon to be inserted into the superior and internal part of the great pastern; *x*, the principal tendon inserted into the coffin bone, but in its way is attached to the coronary bone on its anterior and superior part. *y*, a ligament which arises from the interosseus, &c. and is inserted into the tendon of the extensor digitorum communis, which it binds down. *z*, the interosseus, &c. 1 2, the horny part of the hoof; 1, the superior part; 2, the sole or inferior part going under the coffin bone. 3, a substance resembling the villous surface of a mushroom arising from the hoof, received by the like arising from the coffin bone, which it mutually receives.

SECT. III. *Of the Cavities of the* CHEST *and* BELLY.

THE bodies of most animals are furnished with three principal cavities, for the preservation of the organs immediately essential to their existence.—These are the HEAD, CHEST, and BELLY. Having in the annexed engravings given a view of the parts contained in the two last of these cavities; we shall proceed to speak generally of their contents.

The thorax, or chest, is formed superiorly, by the dorsal vertebræ; inferiorly, by the sternum or breast bone, and ensiform cartilage; laterally, by the ribs; and posteriorly, it is bounded by the diaphragm or midriff. In figure it is rather conical with its base or largest part towards the abdomen, and its apex opposed to the neck. It is proportionably much smaller than the human, and differing considerably in form, being very much contracted at its lower (*a*) part near the sternum.

This cavity is not at all times of equal magnitude; being alternately larger and smaller. This dilatation and contraction, is for the reception and expulsion of air; and is performed by means of muscles placed between the ribs, named intercostal; which draw the ribs forward, and dilate the chest from side to side. The diaphragm assists likewise by pressing the contents of the belly backwards, thereby enlarging the cavity. The cessation of these actions, produces the return of the cavity to its original size. The reception of air into the cavity during its

(*a*) It must be remembered, that whenever we speak of parts as anterior, posterior, &c. &c. we speak of them as relative to their real situation in the horse, in his natural posture. The difference in the position of the human and brute, as well as of the animal when prostrate for the purposes of dissection, must be always kept in mind; particularly by those who are in the habits of reading human anatomy.

enlargement, is termed *inſpiration*; and its expulſion on its contraction *exſpiration*; which actions form the function we underſtand by *reſpiration*, which will be found more fully conſidered under the article ANATOMY, p. 192.

SECT. IV. *Of the Contents of the* CHEST.

THE cheſt being opened by raiſing the ſternum; there appears a ſmooth poliſhed membrane, the pleura, attached to its upper ſurface. This membrane is there double, but unites about an inch above the ſternum: and the ſpace between the double reflection is filled by cellular ſubſtance *(b)* poſteriorly, and by the thymus gland anteriorly.

This ſpace is called the inferior mediaſtinum: the two lamina then ſeparating, paſs over the pericardium, and over the veſſels, to be reflected on the lungs. After having paſſed over the lungs; one portion goes over the ſpine on one ſide, the other portion over the ſpine of the other ſide; leaving in this diviſion a tubular opening, filled by the aorta, cava, vena azygos, thoracic duct, and œſophagus. This forms the ſuperior mediaſtinum. There are therefore two reflections of the pleura on each ſide; one cloſe under the ribs, the other in contact with the lungs. A bag is formed by this reflection; but the lung is not contained within it, as is uſually deſcribed, but a ſmall quantity of water, the liquor pleuræ.

If this bag be cut into, the lung on that ſide is rendered for a time uſeleſs, by the air being admitted and preventing its expanſion; but the diſtinct ſeparation, formed by the reflections of the pleura, preſerves the functions and powers of the other lung entire: without which wiſe proviſion, accidents and diſeaſes of theſe parts would be more injurious, and more frequently fatal. The pleura has few arteries and veins; nor has it but little ſenſibility if any, when uninflamed: but under inflammation, as is ſeen in pleuriſy, peripneumony, &c. it has a great degree of it.

The mediaſtinum, is ſimply the junction of the two lamina of the pleura, dividing by diſtinct partitions the cavity of the cheſt.

At the anterior and inferior diviſion of the pleura, is ſituated the thymus gland *(c)*; being under the aorta and vena cava, near to their firſt diviſions. It appears compoſed of two lobes of conſiderable magnitude, and faintly red in the colt; but much darker, and leſs in ſize in the grown horſe; and ſcarcely diſcernible in old age. It was thought to be largeſt in ſize ſome months after foaling; but it is now proved to exiſt larger in the fœtal colt previous to birth, than at any period afterwards *(d)*. From this, though its uſe *(e)* is not fully underſtood, it appears more eſſential to the exiſtence of the animal previous to birth, than afterwards. It is ſupplied with veſſels called arteriæ and venæ thymicæ, and with nerves from a neighbouring plexus *(f)*.

The lungs, when inflated, are ſaid to reſemble the figure of the cloven foot of the ox. They are ſpongy in their texture, being every where full of little cavities, which are the minute ramifications, or diſtribution of veſſels termed bronchial, ariſing from one common trunk called the trachea or windpipe. By means of theſe veſſels, air is received throughout the ſubſtance of the lungs; depoſiting its vital part, it is returned from thence, and freſh air admitted. The lungs move freely within the cheſt, or rather readily obey its motions. In this they are aſſiſted by their being divided into lobes, or ſeparate portions; and further, by the fluid contained. In both the living and dead ſtate, they leave no ſpace between their ſurfaces and that of the inner part of the cheſt; but are always diſtended by the air to the capacity of the cavity. Their functions, and particular ſtructure, are more fully explained under ANATOMY, p. 192.

Between the lungs is placed the heart, ſupported in its ſituation by various attachments. It is covered by a membrane called pericardium.

The pericardium firſt looſely inveſts the heart, then paſſes cloſe over its ſurface, giving it a ſecond covering. Between the one reflection and the other is contained a quantity of water, called liquor pericardii. The pericardium where it looſely inveſts the heart, is more denſe than the pleura. It has few arteries or veins, and apparently little ſenſibility. Its internal ſurface is that which pours out the liquor pericardii.

The heart is of an elliptical form: its anterior and ſuperior part is called its baſis; its poſterior and inferior part its apex. The baſis is confined by veſſels; the apex is looſe, and ſtrikes againſt the intercoſtal muſcles, giving the pulſe from the heart. It has four cavities within it: two placed in the right ſide, and two in the left. The firſt are for the circulation through the lungs; the ſecond for that through the other parts of the body. The cavities on the right are divided from thoſe on the left, by a ſeptum or partition. For a more particular deſcription of this organ, with its functions, ſee ANATOMY, p. 193.

Fig. 1. in plate 21. repreſents ſuch of the abdominal viſcera, or contents of the belly, as appear immediately on the integuments being removed; and ſuch of the thoracic viſcera, or contents of the cheſt, as become evident on raiſing the ſternum. *a a a a a*, the ſkin. *b b b b*, the integuments thrown back, conſiſting of muſcles, tendons, and peritoneum. *c c c c*, the moſt extenſive of the large inteſtines, called the colon. *d d d*, the ligamentous bands of the colon, drawing it into folds. *e*, one of the ſmall inteſtines. *f f*, the diaphragm, a large muſcle, dividing the cheſt from the abdomen. *g g g*, the lungs. *h*, the heart. *i i i*, the pericardium, a bag ſurrounding the heart, containing a quantity of fluid; it is here opened to ſhew the heart. *k k*, the ribs. *l l*, the ſternum. *m*, the enſiform cartilage.

(b) By cellular ſubſtance, is meant, an univerſal connecting membrane, ſpread over moſt parts of the body; compoſed of cells filled with an oily fluid called fat. This membrane differs in thickneſs, according to the number of its lamina and its ſituation. In ſome places it ſerves as a covering to parts; in others as a connecting medium. The cells of this membrane diſtended give that puffed appearance to veal and other meats, when blown up by the butchers.

(c) So called from Dionis an ancient anatomiſt, who thought it reſembled a leaf of thyme. By ſome of the French anatomiſts it is termed *fagoüe* or ſweetbread; by which laſt name it is known to our butchers, and many of our farriers.

(d) Vide Elemens d'Hippiatrique.

(e) Morgagni has remarked a milky fluid within its ſubſtance, which Monſ. Bourgelat has likewiſe obſerved to exiſt in colts; and moreover, that this has ſometimes been red. Bellingerus fancied he had diſcovered a duct running from it to the jaw. Vercelloni likewiſe thought he had diſcovered a ſimilar one; with this difference, that his united with the trachea. A celebrated anatomiſt, of the name of Pozzius, was of opinion that the uſe of the thymus, was to fill up the ſpace occupied after birth, by the increaſe of the lungs and their inflation; and this opinion was received by Senec and Lieutaud, as well as by ſome later anatomiſts.

(f) La Foſſe informs us that this gland in colts, ſometimes becomes diſeaſed and ſuppurates, occaſioning their death: ſhould they recover, an indolent ſteatomous tumour remains during life. Vide Dict. d'Hippiatrique.

Sect. V. *Of the Cavity of the Belly.*

The abdomen, or cavity of the belly, is much the largeſt of the three, forming, when its contents are removed, an extenſive oval vault; bounded anteriorly by the diaphragm, poſteriorly by the bones of the pelvis, ſuperiorly by the vertebræ, laterally by the ribs, and inferiorly by the abdominal muſcles; ſo that the ſuperior and anterior part is generally called the back, and poſteriorly the loins; the lateral parts the ſides, more poſteriorly the flanks; and the inferior portion, throughout its whole length, the belly. But theſe diviſions being more properly exterior, and withal too indeterminate; it was neceſſary to make others, that the ſituation of the viſcera, or the peculiar part of the abdomen affected under diſeaſe, might be eaſily deſcribed: and theſe diviſions are now generally received and made uſe of.

The abdomen is divided into four regions. The epigaſtric, umbilical, and hypogaſtric inferiorly; and the lumbar ſuperiorly. In the human, theſe again admit of ſubdiviſions; but thoſe we have already mentioned, are ſufficient to anſwer every uſeful purpoſe in the horſe *(a)*.

The epigaſtric region begins at the enſiform cartilage or end of the breaſt-bone, and extends to within about ſix inches of the umbilicus or navel: within its limits are ſituated the liver, the ſtomach, the pancreas, parts of the colon, of the ſpleen, of the duodenum, of the aorta, and vena cava.

The umbilical region begins where the epigaſtric ends, at about ſix inches before the navel, to the ſame diſtance behind it; ſo that its extent is about twelve inches. It contains great part of the ſmall inteſtines, the cœcum, parts of the colon, of the aorta, and vena cava, with a portion of the meſentery, and omentum.

From the extent of the umbilical region, that is ſix inches behind the navel, to the bottom of the pelvis, and whole poſterior part of the belly, is the hypogaſtric region; containing the rectum, bladder, part of the colon, the iliac veſſels, and parts of generation.

The lumbar region is that which is ſituated as it were upon theſe; and is formed from the hollows left on each ſide of the ſpine, from the beginning of the abdomen nearly to the end. It includes the kidneys and their appendages, the emulgent veſſels, part of the ureters, and greater part of the ſpleen.

Sect. VI. *Of the Contents of the Cavity of the Belly.*

The whole of the abdominal cavity is lined by a membrane, which is termed peritoneum; it not only lines the cavity, but inveſts the whole of its contents, by being reflected over them. It poſſeſſes but few veſſels or nerves; when wounded therefore it bleeds but little, nor does it afford much pain, except under inflammation, when it becomes very ſenſible. It ſecretes a fluid of a ſerous nature, for the lubrication of the viſcera, and for the prevention of adheſions: this may become ſo much increaſed in quantity as to cauſe dropſy. By its attachments it preſerves the parts it inveſts, in their proper and true ſituation; which ſeems to be its principal uſe.

The viſcera of the belly are divided uſually into three claſſes. 1. Thoſe deſtined to convert the food into nutriment by forming the chyle. 2. The parts concerned in the formation of urine. 3. The organs contributing to the formation and growth of the colt.

The firſt claſs is by far the moſt extenſive and numerous, comprehending the ſtomach, inteſtines, liver, pancreas, ſpleen, thoracic duct, omentum, and meſentery. The ſecond claſs takes in the kidneys, renal glands *(b)*, the ureters, urinary bladder, and urethra. The third claſs compriſes, in the male, the vaſa deferentia, the veſiculæ ſeminales, teſticles, and penis *(c)*. In the female, the ovaria, uterus, and vagina.

The principal organ concerned in digeſtion, or the converting the food into nutriment, is the ſtomach. This is a bag whoſe internal ſurface in the horſe is partly membranous, and partly cuticular; in form reſembling a bagpipe, but not ſo much in the horſe as in the human. It is ſituated behind the diaphragm, acroſs the left ſide of the abdomen, within the epigaſtric region; its right portion covered by the liver, its left by the ſpleen, and its whole inferior ſurface reſts on the ſmall inteſtines. The ſtomach has two curvatures; a greater and a leſſer: it has likewiſe two openings, a recipient, called *cardiac*, on its left, and an expellent, named *pyloric*, on its right portion near the ſpine.

To the recipient orifice is attached the œſophagus; a membranous and muſcular canal, conducting the food from the mouth, through the throat and thorax, into the ſtomach; where it undergoes the neceſſary changes for forming it into chyle; that milky fluid which is taken up by the lacteal veſſels for the nouriſhment of the body. See Anatomy, p. 200.

The inteſtines are a long membranous tract or canal, beginning at the expellent orifice of the ſtomach, and receiving its digeſted contents. They form many circumvolutions round the abdomen, and at length end at the anus. They are divided into ſmall and large. The ſmall inteſtines are the duodenum, jejunum, and ileum. The large inteſtines are the cœcum, colon, and rectum. The inteſtines are bound down to the ſpine by the meſentery, which is a production of the peritoneum, but the inteſtines have yet room ſufficient for performing the motion termed periſtaltic.

The periſtaltic motion is a gradual contraction of the inteſtines from before backwards, thereby expelling their contents. This force alone not being ſufficient for the expulſion of the fæculent matter; nature has ſtill farther aſſiſted the animal with a fluid that ſerves as a ſtimulus to the inteſtines. This is generated within the liver.

The liver is a large gland ſituated behind the diaphragm; the greateſt part in the right ſide of the epigaſtric region; divided into ſeveral lobes. It ſeparates from the blood a fluid called bile.

The bile of the horſe is not contained in a reſervoir or gall bladder, as in moſt other animals; but is conſtantly furniſhed to the inteſtines by means of a duct entering into the duodenum, called the gall duct.

The pancreas is a long glandular body attached to part of the duodenum and ſtomach, and lying acroſs the abdomen. It ſecretes a fluid called pancreatic juice. Its duct enters the duodenum with the gall duct. This fluid is ſuppoſed to aſſiſt in diluting the contents of the inteſtines.

The ſpleen is a ſoft ſpongy viſcus of a blueiſh colour, which is found to differ in ſize in different ſubjects. It is attached to the ſtomach by veſſels; it extends down the left ſide to the kidney of that ſide, to which it is attached. Its excretory duct has not yet been diſcovered, and this renders its uſe doubtful; it is however thought to aſſiſt in digeſtion.

(a) La Foſſe likewiſe has made other ſubdiviſions, which ſeem to have led him into error. Vide Dict. d'Hippiatrique.

(b) Though the uſe of the renal glands is not perfectly aſcertained, yet their ſituation and other circumſtances warrant us to claſs them with the urinary organs.

(c) Though the penis and teſticles are not within the cavity of the abdomen, yet they are uſually deſcribed with its contents.

There is continually ſeparating from the blood an aqueous ſaline fluid, named urine. This is effected by means of the kidneys, which are two glandular bodies, ſituated one on the right, the other on the left ſide of the lumbar region. They differ a little from each other in ſhape. The right approaches a triangular form; but the left reſembles, as in the human, the ſhape of a kidney bean, and is ſituated a little more poſteriorly than the right.

The ureters are the excretory ducts of the kidneys; extending to the lateral and ſuperior parts of the bladder, into which they are inſerted.

The bladder is a bag or reſervoir for the urine. It is ſituated in the cavity of the pelvis (*a*); with its largeſt extremity towards the abdomen, and its ſmalleſt or neck towards the buttocks. When the bladder is diſtended to a certain degree it contracts, and the urine is forced out through the urethra.

Fig. 2. in plate 21. repreſents the two cavities of the cheſt and belly; with ſuch of their contents as are immediately ſeen, when the parts repreſented in the former plate (the heart, lungs, and inteſtines) are removed. *A*, the ſtomach nearly in its natural ſituation; upon its ſurface are ſeen its veſſels. *B B B*, the lobes of the liver. *C*, the omentum or caul, attached to the ſtomach throughout its whole length, covering the pancreas entirely, and in part the ſpleen. At one part it is held back by a pin, forced into the ſubſtance of the ſpleen, to ſhew the renal gland. *D*, the ſpleen. *E E*, the kidneys. *F*, part of the rectum. *G G*, the ovaria. *H*, the uterus or womb. *I*, the bladder diſtended with urine. *K K*, the diaphragm; or midriff, a large muſcle dividing the cheſt and belly. *a a a*, the aorta deſcendens, ſeen in both cavities. *b*, vena cava deſcendens; it is not ſeen plainly in this view in the cheſt, therefore is not diſtinguiſhed. *c c*, the emulgent veins, emptying their blood into the vena cava. *d d*, the emulgent arteries, ariſing from the aorta. *e e*, the ſpermatic arteries and veins, united by a cellular ſubſtance ſoon after their origin, diſtributed to the ovaria. *f f*, the ureters, ariſing from the kidneys, and inſerted into the ſides of the bladder rather ſuperiorly. *g g*, the iliac veſſels, being the bifurcations of the aorta and vena cava. *h h*, the cavity of the pelvis. *i*, part of the duodenum or firſt inteſtine, with which the expellent orifice of the ſtomach is united. *k*, the gall duct, ſeen ariſing from the liver, and inſerting itſelf obliquely into the duodenum. *l*, ligamentum ſuſpenſorium, one of the ligaments attaching the liver to the diaphragm. *m m*, capſulæ renales or renal glands, deſcribed in old anatomical books as deputy kidneys; receiving veſſels from the emulgent artery and vein. *n n*, the œſophagus, or canal for the paſſage of the food into the ſtomach. *o*, the aſcending aorta. *p*, the aſcending vena cava. *q*, the diviſion of theſe veſſels into branches, the principal of which are, *r r*, the ſubcoſtal arteries cut off, furniſhing with blood the fore legs. *s s*, ſubcoſtal veins cut off, returning the blood from the fore legs. *t t t t*, jugular veins, returning the blood from the head. *u u u u*, carotid arteries, carrying blood to the head. *v*, a pipe, ſupporting theſe laſt veſſels to render them more diſtinct. *w w*, the trachea or windpipe, the portion entering into the cheſt is removed. *x*, the œſophagus or gullet, brought from its ſituation behind the trachea, and ſupported with a knife. *y y y y*, the integuments of the abdomen thrown back.

What has been already ſaid on the anatomy of the horſe being ſufficient for every practical purpoſe, we forbear entering into its minutiæ farther than is requiſite in a treatiſe on farriery. We might go on indeed to deſcribe the ſtructure and functions of the different viſcera, of the organs of generation, &c. but theſe diſcuſſions would extend this part of our ſubject to the excluſion perhaps of matter of greater utility: we therefore proceed to ſpeak of the various means by which the prevention of the diſeaſes of horſes may be effected, and of the general effects of medicine on them.

PART II. OF THE MANAGEMENT OF HORSES WITH REGARD TO FOOD AND MEDICINE.

Sect. I. *Of Food, Diet, Exerciſe, &c.*

1. IT ought to be laid down as a general rule, to give horſes as few medicines as poſſible; and by no means to comply with the ridiculous cuſtom of ſome, who are frequently bleeding, purging, and giving balls, though their horſes be in perfect health, and have no indication that requires ſuch treatment.

2. Proper management in their feeding, exerciſe, and dreſſing, will alone cure many diſorders, and prevent moſt; for the ſimplicity of a horſe's diet, which chiefly conſiſts of grain and herbage, when good in kind, and diſpenſed with judgment, ſecures him from thoſe complicated diſorders which are the general effects of intemperance in the human body.

3. In France, Germany, and Denmark, horſes are ſeldom purged; there they depend much on alteratives; the uſe of the liver of antimony we have from the French, which is in general a good medicine for that purpoſe, and may, in many caſes, be ſubſtituted in the room of purging.

4. As hay is ſo material an article in a horſe's diet, great care ſhould be taken to procure the beſt: when it is not extraordinary, the duſt ſhould be well ſhook out before it is put in the rack; for ſuch hay is very apt to prove unwholeſome.

5. Beans afford the ſtrongeſt nouriſhment of all grain; but are fitteſt for laborious horſes, except on particular occaſions. In ſome ſeaſons they contain a kind of inſect called the *red bugs*, which are thought to be dangerous; the beſt method in ſuch a caſe is to procure them well dried and ſplit.

6. Bran ſcalded is a kind of panada to a ſick horſe: but nothing is worſe than a too frequent uſe of it, either dry or ſcalded; for it relaxes and weakens the bowels too much. The botts in young horſes may be owing to too much muſty bran and chaff, given with other foul food to make them up for ſale; particular care therefore ſhould be taken that the bran be always ſweet and new.

7. Oats well ripened make a more hearty and durable diet than barley, and are much better ſuited to the conſtitutions of Britiſh horſes. A proper quantity of cut ſtraw and hay mixed with them, is ſometimes very uſeful to horſes troubled with botts, indigeſtion, &c.

8. Horſes who eat their litter, ſhould particularly have cut ſtraw and powdered chalk given them with their feed; as it is a ſign of a depraved ſtomach.

9. The ſalt marſhes are good paſture for horſes who have been ſurfeited, and indeed for many other diſorders: they purge more by dung and urine than any other paſture, and make afterwards a firmer fleſh; their water is for the moſt part brackiſh,

(*a*) The cavity of the pelvis is all that poſterior part of the abdomen ſurrounded by the bones of the iſchium, ileum, and pubis.

and of courſe, as well as the graſs, impregnated with ſalts from the ſea-water.

10. A ſummer's graſs is often neceſſary; more particularly to horſes glutted with food, and which uſe little exerciſe: but a month or two's running is proper for moſt; thoſe eſpecially that have been worked hard, and have ſtiff limbs, ſwelled legs, or wind-galls. Horſes whoſe feet have been impaired by quittors, bad ſhoeing, or any other accidents, are alſo moſt relieved at graſs. Thoſe lameneſſes particularly require turning out to graſs, where the muſcles or tendons are contracted or ſhrunk; for by the continual gentle exerciſe in the field, with the aſſiſtance of a patten-ſhoe on the oppoſite foot, the ſhortened limb is kept on the ſtretch, the waſted parts are reſtored to their ordinary dimenſions, and the limb again recovers its uſual tone and ſtrength.

11. The fields which lie near great towns and are much dunged, are not proper paſture for horſes; but on obſervation appear very injurious to them, if they feed thereon all the ſummer.

12. Horſes may be kept abroad all the year, where they have a proper ſtable or ſhed to ſhelter them from the weather, and hay at all times to come to. So treated, they are ſeldom ſick; their limbs are always clean and dry; and, with the allowance of corn, will hunt, and do more buſineſs than horſes kept conſtantly within doors.

13. If horſes, when taken from graſs, ſhould grow hot and coſtive, mix bran and chopt hay with their corn; and give them ſometimes a feed of ſcalded bran for a fortnight, or longer: let their exerciſe and diet be moderate for ſome time, and increaſe both by degrees.

14. When horſes are ſoiled in the ſtable, care ſhould be taken that the herbage is young, tender, and full of ſap; whether it be green barley, tares, clover, or any thing elſe the ſeaſon produces; and that it be cut freſh once every day at leaſt, if not oftener.

15. When horſes loſe their fleſh much in ſoiling, they ſhould in time be taken to a more ſolid diet: for it is not in ſoiling as in grazing; where, though a horſe loſes his fleſh at firſt, yet after the graſs has purged him he ſoon grows fat.

16. Young horſes, who have not done growing, muſt be indulged more in their feeding than thoſe come to their maturity; but if their exerciſe is ſo little as to make it neceſſary to abridge their allowance of hay, a little freſh ſtraw ſhould conſtantly be put in their racks to prevent their nibbling the manger, and turning crib-biters; they ſhould alſo be ſometimes ſtrapped back in order to cure them of this habit.

17. It is obvious to every one, what care ſhould be taken of a horſe after violent exerciſe, that he cool not too faſt, and drink no cold water, &c. for which reaſon we ſhall wave particular directions.

18. Moſt horſes fed for ſale have the interſtices of their muſcles ſo filled with fat, that their true ſhapes are hardly known. For which reaſon a horſe juſt come out of the dealer's hands ſhould at firſt be gently uſed. He ought to loſe blood, and have his diet lowered, though not too much: walking exerciſe is moſt proper at firſt, two hours in the day; in a week or fortnight two hours at a time, twice a-day; after this uſage for a month, bleed him again, and give him two or three times a-week ſcalded bran, which will prepare him for purging phyſic, that may now be given ſafely, and repeated at the uſual intervals.

19. When a horſe comes out of a dealer's hands, his cloathing muſt be abated by degrees, and care taken to put him in a moderately warm ſtable; otherwiſe the ſudden tranſition would be attended with the worſt conſequences.

Sect. II. *Of Blood-letting.*

Horses that ſtand much in the ſtable, and are in full feed, will ſometimes require bleeding; eſpecially if their eyes look heavy, red, and inflamed; as alſo when their fleſh feels hotter than uſual, and when they mangle their hay.

Young horſes ſhould alſo be bled when they are ſhedding their teeth, as it takes off thoſe feveriſh heats they are then ſubject to. But the caſes that chiefly require bleeding, are colds, fevers of moſt kinds, falls, bruiſes, injuries of the eyes, ſtrains, and all inflammatory diſeaſes.

It is right to bleed a horſe when he begins to grow fleſhy at graſs, or at any other time when he looks heavy, and it is generally proper to bleed before purging. When it is determined on, let your horſe always be bled by meaſure, that you may know what quantity you take away: two or three quarts are always enough at one time; when you repeat it, allow for the nature of the diſorder and the horſe's conſtitution.

Although the operation of blood-letting is pretty well known, yet there are many untoward accidents that frequently happen from the unſkilful and unexperienced in performing it. The following directions and cautions on this head are extracted from Mr. Clark's very judicious *Treatiſe on the Prevention of Diſeaſes incidental to Horſes.*

As horſes are naturally timorous and fearful, which is too frequently increaſed by bad uſage and improper chaſtiſement, they require in ſome caſes, particularly in this of bleeding, to be taken unawares or by ſurpriſe, and the orifice made into the vein before their fears are alarmed. For this reaſon, the fleam and blood-ſtick, as it is called, have been long in uſe, and in ſkilful hands are not improper inſtruments for the purpoſe; although with many practitioners the ſpring-fleam would be much ſafer, and on that account ought to be preferred. When a lancet is uſed, the inſtant the horſe feels the point of it, he raiſes or ſhakes his head and neck, in order to ſhun the inſtrument before the operator has time to make a proper orifice, which frequently proves too ſmall or too large; for this reaſon, thoſe who have tried the lancet have been obliged to lay it aſide.

Many perſons tie a ligature or bandage round the neck, in order to raiſe the vein, and that they may ſtrike the fleam into it with the greater certainty; but a ſlight view of its effects in preventing this, and its other conſequences, will ſhow the impropriety of the practice.

When a ligature is tied round the neck previous to bleeding in the jugular veins, it is to be obſerved, that it ſtops the circulation in both veins at the ſame time; hence they become turgid and very full of blood, inſomuch that they feel under the finger like a tight cord; and as the parts around them are looſe and ſoft, when the ſtroke is given to the fleam, the vein by its hardneſs or tightneſs ſlips to one ſide, of courſe it eludes the ſtroke; hence a deep wound is made by the fleam to no purpoſe, and this is ſometimes too frequently repeated. Unſkilful people have likewiſe a cuſtom of waving or ſhaking the blood-ſtick before they ſtrike the fleam in view of the horſe, whoſe eye is fixed on that inſtrument; and when they intend to give the ſtroke, they make a greater exertion: hence the horſe being alarmed by its motion, raiſes his head and neck, and a diſappointment follows. The ſtruggle that enſues by this means prolongs the operation; the ligature at the ſame time being ſtill continued round the neck, a total ſtagnation of the blood in the veſſels of the head takes place; and hence it frequently happens, that the horſe falls down in an apoplectic fit. In ſuch caſes the operator being diſconcerted, generally deſiſts from any farther attempts to draw blood at that time, under the idea that the horſe was vicious and unruly, although the very treatment the horſe had juſt undergone rendered bleeding at this time the more neceſſary, in order to make a ſpeedy revulſion from the veſſels of the head. Therefore, a ligature or bandage ought never to be uſed till ſuch time as the opening is made into the

vein; and even then it will not be neceſſary at all times if the horſe can ſtand on his feet, as a moderate preſſure with the finger on the vein will make the blood flow freely; but if the horſe is lying on the ground, a ligature will be neceſſary. But farther, the concuſſion or ſhock the horſe receives from his falling down in the above ſituation, which will always happen if the ligature is too long continued, may cauſe a blood-veſſel within the head to burſt, and death may be the conſequence.

Another cuſtom equally abſurd is allowing the blood to fall in a dunghill amongſt ſtraw, in dry ſand, or in dry duſt, by which means no diſtinct idea can be formed of the quantity that is or ought to be taken away. In ſuch caſes horſes have fallen down in a ſwoon from the loſs of too much blood, before the operator thought of ſtopping the orifice. For this and a variety of other reaſons which might be mentioned, a meaſure, as above obſerved, ought always to be uſed, in order to aſcertain the quantity of blood that is taken away.

In pinning up the orifice, ſome have a cuſtom of raiſing or drawing out the ſkin too far from the vein; hence the blood flows from the orifice in the vein into the cellular ſubſtance between it and the ſkin, which cauſes a large lump or ſwelling to take place immediately: this frequently ends in what is called a *ſwelled neck*; a ſuppuration follows, which proves both tedious and troubleſome to cure. In caſes where a horſe may be tied up to the rack after bleeding in the neck, pinning up the external orifice may be diſpenſed with; but when a horſe is troubled with the gripes or any other acute diſeaſe, in which he lies down and tumbles about, it is neceſſary that the orifice be pinned up with care, in order to prevent the loſs of too much blood.

As the neck or jugular vein on the near ſide is commonly opened for conveniency by thoſe who are right-handed, the young practitioner ſhould learn to perform on both ſides of the neck. This he will find in practice to be not only uſeful but neceſſary, as he may frequently have occaſion to draw blood from horſes in very awkward ſituations; he will likewiſe find his account in it in a variety of caſes, which it is needleſs here to particularize.

The proper place for making the opening in the neck or jugular vein is likewiſe neceſſary to be attended to: for when the orifice is made too low, or about the middle of the neck, where the vein lies deep under the muſcular teguments, the wound becomes difficult to heal, and frequently ends in a ſuppuration, with a jetting out of proud fleſh from the orifice; which, unluckily, is as unſkilfully treated in the common method of cure, *viz.* by introducing a large piece of corroſive ſublimate into the wound: this not only deſtroys the proud fleſh in the lips of the wound, but a conſiderable portion of the fleſh around it; and in farriery it is called *coreing out the vein.* It frequently happens, that this corroſive application deſtroys the vein likewiſe; and ſometimes violent hemorrhages follow, ſo as to endanger the life of the animal.

The moſt proper place for making the opening in the jugular veins is where the teguments are thinneſt, which is about a hand-breadth from the head, and about one inch below the branching or joining of the vein which comes from the lower jaw, and which may be diſtinctly ſeen when any preſſure is made on the main branch of the vein.

In performing the operation with a fleam, the operator ſhould hold the fleam between the fore-finger and thumb of the left hand; with the ſecond finger he is to make a ſlight preſſure on the vein, and before it becomes too turgid or full make the opening; the ſame degree of preſſure is to be continued on the vein, till ſuch time as the quantity of blood to be taken away is received into a proper meaſure.

Another great error, which generally prevails in opening the veins with a fleam, is the applying too great force, or giving too violent a ſtroke to it, by which it is forced through the oppoſite ſide of the vein: hence there is danger of wounding the coats of the arteries, as they generally lie under the veins; or, in ſome particular places, of wounding the tendons, eſpecially when this operation is performed in the legs, thighs, &c. In the veins, commonly called the *plate veins*, under the breaſt, the conſequences are frequently very troubleſome to remove, and in ſome caſes prove fatal. Mr. Gibſon, in his treatiſe on the diſeaſes of horſes, mentions a caſe of a fine horſe that was blooded in the plate veins for a lameneſs of the ſhoulder, which was followed with a hard oval ſwelling about the ſize of a gooſe egg, which extended upwards on the breaſt, and likewiſe down the leg, attended with exceſſive pain, fever, deadneſs in the horſe's looks, and all the other ſymptoms of a beginning mortification.

In order to avoid the conſequences ſometimes attending theſe local operations in the breaſt, legs, &c. and as horſes are more or leſs troubleſome and reſtleſs, whereby accidents of this kind may happen, it will perhaps be adviſeable, in moſt caſes of lameneſs, &c. to draw blood from the larger veins in the neck only, where there is leſs danger of accidents, more eſpecially if a ſpring fleam is uſed: for although it might be of ſome advantage in particular caſes to draw blood as near the affected part as poſſible, yet the bad conſequences frequently attending it ought to counterbalance any advantages that may be expected from it, eſpecially as the quantity of blood drawn from the ſmall veins is but inconſiderable, and of courſe no great benefit can be expected from it in horſes when they are diſeaſed.

The principal view in drawing blood is the leſſening of its quantity, by which the remaining maſs circulates with more freedom in the veſſels; it likewiſe takes off the inflammatory tendency of the blood, removes ſpaſms, &c. and prevents other bad conſequences that may follow, eſpecially in plethoric habits: and it ought always to be remembered, that when the ſigns or ſymptoms of a diſeaſe are taken from the motion of the blood, the diſorders ariſing from it depend upon its circulation being either increaſed or diminiſhed: hence, therefore, all the changes which take place in the texture, quantity, and quality of the blood, are attended with a diminution or increaſe of its velocity.

Although the caſes which may require bleeding are numerous, yet one general caution is neceſſary, namely, never to take away blood but when it is abſolutely neceſſary; for it is a fluid that may be eaſily taken away, but cannot be ſo eaſily replaced; beſides, the practice of bleeding frequently, or at ſtated times, is exceedingly improper, as it diſpoſes the body to become lax, weak, and plethoric. In bleeding, therefore, a due regard muſt always be had to the conſtitution, age, ſtrength, &c. of horſes, and the ſtate or habit of body they are in at the time.

Although we ought to be ſparing of drawing blood from horſes on trifling occaſions when they may be ſaid to be in health, yet when caſes occur that do require it, it may not only ſafely, but uſefully, be recommended to take away a greater quantity at once than is generally done; that is, from ſix to eight pounds, which will be about three or four quarts Engliſh meaſure, according to the urgency of the ſymptoms, &c. at the time, ſtrength and age of the horſe conſidered. For as horſes are very ſubject to inflammatory diſeaſes and thoſe that are of the ſpaſmodic kind, and as bleeding plentifully relaxes the whole ſyſtem in theſe caſes, the taking away a ſmall quantity of blood, about one quart or two pounds, is in fact trifling with the diſeaſe; the horſe is ſaid to have been *blooded*, and that ſatisfies his owner and the farrier; time is loſt; the diſeaſe acquires ſtrength; it will then be beyond the power of art to mitigate or to conquer it: hence the horſe falls a ſacrifice to timidity and ignorance. It is to be remembered, that inflammatory diſeaſes, particularly when the bowels are affected,

make a very rapid progreſs in horſes; and if they are not overcome at the beginning by bleeding plentifully, the horſe commonly dies in 24 or 40 hours of a gangrene and mortification in the inteſtines.

Sect. III. *Of* Purging.

Purging is often neceſſary in groſs full horſes, in ſome diſorders of the ſtomach, liver, &c. but ſhould be directed with caution. Before a purge is given to any horſe, it is neceſſary ſome preparation ſhould be made for it, in order to render the operation more ſafe and efficacious: thus a horſe that is full of fleſh ſhould firſt be bled, and at the ſame time have his diet lowered for a week, eſpecially thoſe that have been pampered for ſale; ſeveral maſhes of ſcalded bran ſhould alſo previouſly be given, in order to open the bowels, and unload them of any indurated excrement, which ſometimes proves an obſtacle to the working of the phyſic, by creating great ſickneſs and griping.

Let it be remembered, that a horſe is purged with difficulty; that the phyſic generally lies 24 hours in the guts before it works; and that the tract of bowels it has to paſs through is above 30 yards, all lying horizontally; conſequently reſinous and other improper drugs may, and often do, by their violent irritation, occaſion exceſſive gripings and cold ſweats, ſhave off the very mucus or lining of the guts, and bring on inflammations, which often terminate in mortifications and death. It is remarkable too, that the ſtomach and guts of a horſe are but thin, compared to ſome other animals of the ſame bulk, and therefore perhaps more liable to irritation.

Horſes kept much in the ſtable, who have not the proper benefit of air and exerciſe in proportion to their food, ſhould in ſpring have a mild purge or two after a previous preparation by bleeding, lowering their diet, and ſcalded maſhes. Horſes that fall off in their appetite, whether it proceeds from too full feeding, or ingendering crudities and indigeſted matter, ſhould have a mild purge or two. Horſes of a hot temperament will not bear the common aloetic purges; their phyſic therefore ſhould be mild and cooling. Purging is always found very beneficial in ſtubborn dry coughs: but mild mercurials joined with them make them yet more efficacious. Horſes of a watery conſtitution, who are ſubject to ſwelling legs, that run a ſharp briny ichor, cannot have the cauſes removed any way ſo effectually as by purging.

The firſt purge you give to a horſe ſhould be mild, in order to know his conſtitution. It is a miſtaken notion, that if a proper prepared purge does not work to expectation, the horſe will be injured by it; for though it does not paſs by ſtool, its operation may be more efficacious as an alterative to purify the blood, and it may paſs by urine or other ſecretions. Purging medicines are very ſucceſsfully given in ſmall quantities, mixed with others; and act then as alteratives. If mercurial phyſic is given, care ſhould be taken that it be well prepared; and warmer clothing and greater circumſpection are then required.

Purges ſhould be given early in the morning upon an empty ſtomach: about three or four hours after the horſe has taken it, he ſhould have a feed of ſcalded bran; and a lock or two of hay may then be put into his rack. The ſame day give him two more maſhes; but ſhould he refuſe warm meat, he may be allowed raw bran. All his water ſhould be milk-warm, and have a handful of bran ſqueezed in it; but if he refuſes to drink white water, give it him without bran. Early the next morning give him another maſh; but if he refuſes to eat it, give him as much warm water as he will drink: let him be properly clothed, and rode gently about. This ſhould be done two or three times a-day, unleſs he purges violently; once or twice will then be ſufficient: at night give him a feed of oats mixed with bran.

During the working, a horſe ſhould drink plentifully; but if he will not drink warm water, he muſt be indulged with cold, rather than not drink at all. We ſhall here inſert ſome general forms of purges.

Take ſocotorine aloes ten drams, jalap and ſalt of tartar each two drams, grated ginger one dram, oil of cloves 30 drops; make them into a ball with ſyrup of buckthorn. Or,

Take aloes and cream of tartar each one ounce, jalap two drams, cloves powdered one dram, ſyrup of buckthorn a ſufficient quantity.

Or the following, which has an eſtabliſhed character among ſportſmen:

Take aloes from ten drams to an ounce and a half, myrrh and ginger powdered each half an ounce, oil of aniſeed half a dram.

When mercurial phyſic is intended, give two drams of calomel over night, mixed up with half an ounce of liquorice powder and a little honey, and the purging ball the next morning.

The following, when it can be afforded, is a very gentle and effectual purge, particularly for fine delicate horſes; and if prepared with the Indian rhubarb, will not be expenſive.

Take of the fineſt ſocotorine aloes one ounce, rhubarb powdered half an ounce or ſix drams, ginger grated one dram; make into a ball with ſyrup of roſes.

The following purging drink may be given with the utmoſt ſafety; it may be quickened or made ſtronger, by adding an ounce more ſenna, or two drams of jalap.

Take ſenna two ounces; boil it in a pint of ſpring water half an hour, or till a third of the liquor is waſted; pour off, and diſſolve in it four ounces of Glauber's ſalts, and two or three of cream of tartar.

This laſt phyſic is cooling, eaſy, and quick in its operation; and greatly preferable in all inflammatory caſes to any other purge, as it operates alſo by urine.

When horſes loſe their appetite after purging, it is neceſſary to give them a warm ſtomach-drink made of an infuſion of camomile-flowers, aniſeeds, and ginger: or the cordial ball may be given for that purpoſe.

Should the purging continue too long, give an ounce of diaſcordium in an Engliſh pint of Port-wine; and repeat it once in 12 hours, if the purging continues. Plenty of gum-arabic water ſhould alſo be given; and in caſe of violent gripes, fat broth clyſters or tripe liquor ſhould be often thrown up, with a teaſpoon-full or two of laudanum in each.

The arabic ſolution may be thus prepared.

Take of gum arabic and tragacanth of each four ounces, juniper-berries and carraway-ſeeds of each an ounce, cloves bruiſed half an ounce; ſimmer gently in a gallon of water till the gums are diſſolved: give a quart at a time in half a pail of water; but if he will not take it freely this way, give it him often in a horn.

When a purge does not work, but makes the horſe ſwell, and refuſe his food and water, which is ſometimes the effect of bad drugs or catching cold, warm diuretics are the only remedy; of which the following are recommended.

Take a pint of white wine, nitre one ounce; mix with it a dram of camphire, diſſolved in a little rectified ſpirit of wine; then add two drams of oil of juniper, and the ſame quantity of unrectified oil of amber, and four ounces of honey, or ſyrup of marſhmallows.

When a horſe ſwells with much phyſic, do not ſuffer him to be rode about till he has ſome vent; but rather lead him gently in hand till ſome evacuation is obtained.

As it is obſerved, that horſes more willingly take ſweet and palatable things than thoſe that are bitter and of an ill taſte, care ſhould be taken that the latter be given in balls, and that their drinks be always contrived to be as little nauſeous as poſ-

fible, and fweetened either with honey or liquorice. Thofe that are prepared with grofs powders are by no means fo agreeable to a horfe as thofe made by infufion; as the former often clam the mouth, irritate the membranes about the palate and throat, and frequently occafion the cough they are intended to prevent.

Balls fhould be of an oval fhape, and not exceed the fize of a pullet's egg: when the dofe is larger, it fhould be divided into two; and they fhould be dipped in oil, to make them flip down the eafier.

The following cathartic balls are recommended by Mr. Taplin; the ingredients of which are differently proportioned, fo as to fuit different circumftances in refpect to ftrength, age, fize, and conftitution:

1. Socotorine aloes one ounce: Indian rhubarb two drachms; jalap and cream of tartar each one drachm; ginger (in powder) two fcruples; effential oil of cloves and anifeed each twenty drops; fyrup of buckthorn a fufficient quantity to form the balls.
2. Socotorine aloes ten drachms; rhubarb, jalap, and ginger, each two drachms; cream of tartar three drachms, and fyrup of buckthorn to make the ball.
3. Barbadoes aloes nine drachms: jalap, Caftile foap, and cream of tartar, of each two drachms; diagrydium and ginger (in powder) each a drachm; fyrup of buckthorn fufficient to make the ball.
4. Barbadoes aloes ten drachms; Caftile foap and jalap (in powder) of each half an ounce; cream of tartar and ginger each two drachms; oil of anifeed forty drops; of cloves twenty drops; which form into a ball with fyrup of rofes.

One remark we cannot help making on the two laft of thefe compofitions of Mr. Taplin, and which indeed applies to many formulæ in our books of farriery; which is, that a great chemical error is committed in joining cream of tartar with *foap*.

Sect. IV. *Of* Clysters.

Clysters adminiftered to horfes, fays Mr. Clark, in his Obfervations, p. 287, are of greater importance in relieving them from many acute complaints, than is generally imagined; and it were to be wifhed, that, in place of the more expenfive cordial drenches, &c. which are but too frequently given in moft of thefe cafes, a fimple clyfter of warm water, or thin water-gruel, were fubftituted in their ftead; the latter proving of great benefit, whilft the former too frequently prove hurtful.

Clyfters ferve not only to evacuate the contents of the inteftines, but alfo to convey very powerful medicines into the fyftem, when perhaps it is not practicable to do it by the mouth: for although they are only conveyed into the larger inteftines, and perhaps hardly penetrate into the fmaller; ftill they are extremely ufeful, by fomenting as it were the latter, and at the fame time by foftening the hardened excrement that is accumulated in the former, and rendering it fo foft as to be expelled out of the body, by which flatulencies or other offending matters that may be pent up in them are likewife expelled. Befides, by their warmnefs and relaxing powers, they act as a fomentation to the bowels: hence they may be of confiderable fervice in removing fpafmodic conftrictions in the bowels, carrying off flatulencies, and in preventing inflammation in the inteftines, &c.; or, by conveying opiates to the parts affected, give fpeedy relief in colics, &c.

The ufe of emollient clyfters in fevers is confiderable. They act by revulfion, and relieve the head when too much affected. Befides, by throwing in a quantity of diluting liquor into the inteftines, it not only relaxes and cleanfes them, but may be faid to cool the body in general; at the fame time, a confiderable portion of the liquid is abforbed and conveyed into the mafs of blood, by which means it is diluted; and, in particular complaints in the bowels, clyfters give almoft immediate relief, as the remedies, when judicioufly prefcribed, pafs immediately to the parts affected, with little or no alteration from the powers of the body.

Nor is the ufe of clyfters confined to medicines only: food and nourifhment may be conveyed into the fyftem in this way, when a horfe is unable to fwallow any thing by the mouth. Horfes have frequently been fupported for feveral days together by nourifhing clyfters, made of thick water-gruel, during violent inflammations or tumors in the throat, till fuch time as they have been difcuffed or fuppurated.

Nor will thefe effects appear ftrange to thofe who have an acquaintance with the anatomical ftructure of the body. For the fake of thofe who have not, it may juft be fufficient to obferve, that certain veffels called lacteals, whofe mouths open into the inner cavity of the inteftines, abforb or drink up the chyle or nourifhment that is produced from the food, and convey it into the mafs of blood. The fame procefs takes place when nourifhment is conveyed into the inteftines by the anus or fundament: only the food requires to be fo far prepared, broken down and diluted with water, as to render it fit to be abforbed by the veffels mentioned above.

In adminiftering clyfters, it ought always to be obferved, that the contents of the clyfter be neither too hot nor too cold, as either of thefe extremes will furprife the horfe, and caufe him to eject or throw it out before it has had time to have any effect. Previous to introducing the clyfter pipe, the operator, after anointing his hand and arm with oil, butter, or hog's-lard, (obferving, at the fame time, that the nails of his fingers are fhort), may introduce it into the rectum, and draw out the hardened dung gradually. This operation, in farriery, is termed *back-racking*; and becomes the more neceffary, as it frequently happens that a great quantity of hardened dung is, in fome cafes, collected in the rectum, and which the horfe cannot void eafily without affiftance of this kind.

The compofition of clyfters fhould be extremely fimple: on that account they will be eafily prepared, and as eafily adminiftered, provided the operator is furnifhed with a fuitable inftrument for the purpofe. The generality of clyfter-pipes that are ufed, are by far too fmall and too fhort: although it may appear a kind of paradox, yet it is a fact, that a clyfter-pipe of a larger fize than the ordinary ones, and of a proper thicknefs, is much eafier introduced into the anus than one that is confiderably fmaller. It is likewife obvious, that when the pipe is too fhort, it renders clyfters of no ufe, becaufe it cannot convey the clyfters fo far up into the inteftines as is neceffary for them to be retained; a fmall fhort pipe of fix or eight inches long, is not capable of conveying the injection to the end of the rectum, which, in a horfe of a middling fize, is about 16 or 18 inches long.

But farther, after the hardened dung is taken out of the rectum by the operation above mentioned, the bladder being diftended and full of urine, it cannot exert its contracting power immediately, fo as to expel its contents; it therefore preffes up the empty rectum, and forms as it were a kind of tumor in it: if the pipe is too fhort, it cannot reach beyond this rifing in the rectum, which forms as it were a declivity back towards the anus; and hence the liquor regurgitates or flows back at the anus as foon as it is difcharged from the pipe.

The fmallnefs of the bag or bladder, which is generally proportioned to that of the pipe, is another very material objection to thefe inftruments, as it feldom contains one quart of liquid; from which circumftance, very little benefit can be derived from the ufe of them in fuch large inteftines as thofe of a horfe. Dr. Bracken, in his firft volume, page 203, has a very judicious remark on the ufe of clyfters. He obferves, that "the colon of a horfe feems to be three guts, by reafon of the two necks of about half a yard each, is drawn up into many cells or purfes by

means of two ligaments, one of which runs along the upper and the other the under side of it, which, with the affiftance of a valve or flap at its beginning, hinder the excrements either from returning back into the fmall guts, or falling too foon downwards, before the chyle or milky fubftance prepared from the food be fent into its proper veffels. And, indeed, the cæcum or blind gut, which is the firft of the three larger guts, feems to be fo contrived in the manner of a valve, to hinder the aliment and chyle from paffing too foon into the colon; for, if the aliment and chyle were not in fome meafure hindered in their paffage through thefe large guts, the body could not be fufficiently fupplied with nourifhment. The firft of thefe colons is about a yard and a half in length, the fecond about a yard, and the third, or that part which joins the inteftinum, rectum near fix yards in length; fo that the colon of a horfe 14 hands high, may be faid to be nearly eight yards and a half long; and, from it, along the rectum or ftraight gut to the anus, where the excrements are difcharged, is not above half a yard; fo that it is plain, clyfters operate moftly in the colon; though I muft fay they are given in too fmall quantities; for what fignifies two quarts of liquor in a gut nine yards long, and four or five inches diameter, in a natural ftate; but in the colic, it is fo diftended with flatulencies, that its diameter exceeds feven or eight inches, as I have frequently obferved in thofe dying of that diftemper."

Large fyringes are frequently ufed for the purpofe of giving clyfters; but of all the inftruments ever invented, they feem the moft improper for horfes. The fhortnefs and fmallnefs of their ivory pipes, are not only a material objection againft the ufe of them, but they are apt to tear and wound the gut; for if a horfe fhould prove reftlefs, either from pain, as in cafes of the gripes, or from vicioufnefs, the fyringe and pipe being quite inflexible, in the ftruggle to throw up the injection the gut may be wounded or hurt, by which a difcharge of blood and other bad confequences may follow. But even if there was not the leaft chance of their hurting the horfe or wounding the gut, yet the force with which they throw up the liquor, always caufes a furprife, of courfe a refiftance, attended with a vigorous effort to throw it out; which indeed frequently happens before the pipe of the fyringe is withdrawn, and frequently upon the operator.

The moft proper inftrument for the giving of clyfters, is a fimple bag or ox-bladder, which will hold two or three quarts, tied to the end of a wooden pipe about 14 or 15 inches long, one inch and a half diameter where the bag is tied, and of a gradual taper to the extremity, where the thicknefs fhould fuddenly increafe, and be rounded off at the point, and made as fmooth as poffible; the perforation or hole through the pipe may be made fufficiently large, fo as to admit the end of a common funnel, for pouring in the liquor into the bag. By the flexibility of the bladder at the end of this inftrument, no danger can happen to the horfe; the clyfter is conveyed fo far up into the inteftines that it will be retained; it caufes no furprife (provided the liquor be neither too hot nor too cold, but milk warm), as no other force is required to throw it up than the holding the bag a little higher than the level of the pipe; by which means the liquor flows gently into the gut, without any furprife to the horfe. After ufing the bag, it may be blown full of wind, a cork put into the pipe, and hung up in fome dry place to prevent it from rotting; by which means it will laft a confiderable time.

Clyfters are diftinguifhed by different names, which denote the quality of the ingredients of which they are compofed, as emollient, laxative, diuretic, anodyne, &c. As the more general ufe of clyfters, in the practice of farriery, would be attended with the moft falutary effects, efpecially in acute difeafes, where the fpeedieft affiftance is neceffary, we fhall here fubjoin fome few formulæ for compofing them, together with the cafes in which they may be adminiftered with advantage.

1. *Emollient clyfter.* Two or three quarts of thin water-gruel, falad oil and coarfe fugar, of each fix ounces. Diffolve the fugar in the water-gruel, then add the falad oil. Give it milk warm.

2. *Laxative clyfter.* Two or three quarts of thin water-gruel, Glauber's falts eight ounces, falad oil fix ounces.

When Glauber's falts are not at hand, common falt may be ufed in its ftead.

A great variety of receipts might be added for making clyfters, compofed of the infufion of different herbs, feeds, &c. But the above ingredients are always eafily got; and they will be found to anfwer all the intentions required under this head, which is to foften the hardened excrements, to lubricate the inteftines, and, by exciting a gentle ftimulus, promote a free difcharge of their contents; which, when once obtained, feldom fails of giving relief in inflammatory cafes, fpafms, &c.

3. *Purging clyfter.* Infufe two ounces of fenna in two quarts of boiling water; ftrain it off; then add fyrup of buckthorn and common oil, of each four ounces.

This clyfter will operate more brifkly than the former, and, on that account, may be preferred when an immediate or fpeedy difcharge is neceffary.

4. *Anodyne clyfter.* The jelly of ftarch, or infufion of linfeed, one pint; liquid laudanum, one ounce or about two table fpoonfuls.

When there is reafon to apprehend inflammation in the bowels, opium may be given in place of laudanum, from 20 to 30 grains, in proportion to the urgency of the fymptoms; it ought to be well triturated or rubbed in a mortar, with a little of the liquid, till it has thoroughly diffolved. The fmallnefs of the quantity of liquid here recommended, gives it the better chance of being the longer retained, as the good effects to be derived from the opium depend entirely on this circumftance. This clyfter is proper to be given in violent gripings, attended with purging, in order to blunt the fharpnefs of the corroding humours, and to allay the pain ufually attending in fuch cafes. The ftarch will in fome meafure fupply the deficiency of the natural mucus, or covering of the inteftines, which has been carried off by violent purging. It may be repeated, if the fymptoms continue violent, only diminifhing the quantity of laudanum or of the opium.

5. *Nourifhing clyfter.* Thick water-gruel three quarts.

When clyfters of this kind are found neceffary, they may be given four or five times in the day, according as circumftances may require; they are of confiderable fervice in cafes where the horfe cannot eat fufficiently to fupport him, or fwallow any thing, from inflammation of the throat, jaws, &c. or in convulfions, attended with a locked jaw, &c.

6. *Diuretic clyfter.* Venice turpentine two ounces; Caftile foap one ounce. Diffolve the foap in two quarts of warm water; then add the turpentine, after it has been well beat up with the yolks of two eggs.

The diuretic clyfter is of great ufe in the ftrangury, and obftructions in the urinary paffages; and as it is immediately applied to the parts affected, it feldom fails of giving relief, and has a much better effect when prefcribed in this manner than when given by the mouth: by this laft way it mixes with the whole mafs of fluids, and may lofe a confiderable portion of its diuretic quality before it reaches the kidneys; but, by being adminiftered in the form of a clyfter, it is readily abforbed by the neighbouring veffels, and promotes a free difcharge of urine.

It would be needlefs to add more forms of clyfters, as thofe above mentioned will anfwer moft cafes, without any material

alteration, but what may be eafily fupplied by the judicious practitioner.

There are a variety of cafes where clyfters may be adminiftered with great fuccefs, befides thofe already hinted at; as in inflammatory fevers, fpafmodic conftrictions, and colicky complaints in the bowels; in recent coughs, apoplexy, convulfions, paralytic complaints, or fwelling of the belly whether from air pent up in the bowels or from hardened excrements; in cafes where horfes are troubled with worms, as the afcarides which lodge in the lower part of the inteftines, or when bott-worms are obferved fticking in the anus, or voided with the dung; in very coftive habits, before laxative or opening medicines are given by the mouth: in wounds which penetrate deep into the mufcular or tendinous parts, or in the belly, &c. in inflammations of the eyes, or when the head feems particularly affected; in inflammatory fwellings on any part of the body, when a horfe cannot fwallow any food, &c. whether it proceeds from fpafm in the mufcles of the throat, inflammations, or fwellings. Clyfters compofed of mucilaginous fubftances, as ftarch, linfeed, &c. are of great benefit in violent diarrhœas or loofenefs, whether it proceeds from a natural difcharge, or from too ftrong purging medicines.

It ought always to be remembered, that clyfters fhould be repeated frequently, till fuch time as the diforder for which they are given is either removed or greatly abated. This injunction may be the more readily complied with, as the adminiftering clyfters to horfes is not attended either with much trouble or difturbance to them.

Sect. V. *Of* Rowels *and* Setons.

The judicious writer laft quoted obferves very juftly, that *rowels* for horfes anfwer the fame purpofe as iffues in the human body. The method of introducing them is by making an incifion through the fkin, about three-eighths of an inch long, and then feparating the fkin from the flefh with the finger, or with a blunt horn, all round the orifice, as far as the finger will eafily reach; then introducing a piece of leather, very thin, fhaped round, about the fize of a crown piece, having a large round hole in the middle of it. Previous to introducing the leather, it fhould be covered with lint or tow, and dipped into fome digeftive ointment; a pledget of tow, dipped in the fame ointments, fhould likewife be put into the orifice, in order to keep out the cold air: the parts around it foon fwell, which is followed with a plentiful difcharge, from the orifice, of yellow ferum or lymph; and, in two or three days at moft, the difcharge turns into thick grofs white matter: the rowel is then faid to fuppurate.

Thefe artificial vents act by revulfion or derivation; and hence they become of great ufe in many cafes, as they empty the furrounding veffels by a regular flow difcharge of their contents, and are even of great fervice when there is a redundancy or fulnefs of humours in general, which may require a gradual difcharge, in preference to greater evacuations by purging medicines, &c. Rowels fhould be placed (efpecially in fome particular cafes) as near the affected part as poffible; and, at all times, they ought to have a depending orifice, in order to admit of a free difcharge of the matter that may be contained in them.

The parts where they ought to be inferted, and where they are found to anfwer beft, are the belly, infide of the thighs, the breaft, and outfide of the fhoulders and hips; they are fometimes, but very injudicioufly, put in between the jaw-bones under the root of the tongue, where they never come to a proper fuppuration, on account of the conftant motion of the parts in eating, &c. neither do they anfwer any good purpofe from being placed in that fituation. In fome diforders it is found neceffary to put in feveral of them at once, in order to make a fudden revulfion from the parts affected; but this fhould be determined by the horfe's age, ftrength, and circumftances that require them.

But though rowels are found very beneficial in fome cafes, yet, like a number of other operations common to horfes, they fometimes, by the improper ufe of them, become hurtful to the conftitution; and, in fome difeafes, they frequently, inftead of fuppurating, turn gangrenous. Thus, in violent fevers, where they are frequently very improperly applied, they never fuppurate properly: whether this proceeds from the quicknefs of the pulfe, together with the violent rapidity with which the fluids in general are then carried through the veffels, or from the violent agitation in which the whole fyftem is thrown, it is difficult to determine; but experience confirms the obfervation, when properly attended to. In fuch cafes, the furrounding parts where the rowel is placed, feldom or never fwell (as in the ordinary courfe, when they fuppurate properly), but appear dry, or much in the fame ftate as when they were firft put in; there is little or no difcharge from the orifice; and the little that does come is thin, ichorous, and bloody. In fuch cafes, they ought to be taken out immediately, and the parts well fomented with a ftrong infufion of camomile, or an emollient poultice applied, if it can be properly fixed, and frequently repeated; at intervals, the parts ought likewife to be bathed with Goulard water, vinegar and water, &c. carefully covering the parts from the external air; and, provided there is no fever at the time, two or three ounces of Peruvian bark may be given through the day, either made into balls or given in a liquid; and this continued till the threatening fymptoms are removed.

Rowels are of great ufe in carrying off rheums or defluxions from the eyes; in great fwellings of the glands, &c. about the throat and jaws, which threaten a fuffocation; or when the head feems particularly affected, as in the vertigo or ftaggers, apoplexy, &c. &c.; in recent lamenefs; fwellings of the legs and heels, attended with a difcharge of thin ichorous matter, &c.; in large and fudden fwellings in any part of the body; or when extravafations of the fluids have taken place, from blows, bruifes, &c. or when a horfe has had a fevere fall, &c. and in a variety of other cafes, which will occur to the judicious practitioner.

Setons are of great ufe in carrying off matter from deep feated tumors or abfceffes in different parts of the body. They ought at all times be ufed in preference to making deep incifions into the mufcular parts, which not only disfigure horfes, but fuch deep incifions are very difficult to heal up in them, on account of the fituation of fome of thefe tumors, and the horizontal pofition of the body, which is unfavourable in many cafes for procuring a depending opening in order to carry off the matter, as in tumors on the back, withers, and upper part of the neck immediately behind the ears, which are very common. Befides the horizontal pofition of the body, the natural reftleffnefs and impatience of horfes renders it impracticable to fix proper bandages on thofe elevated parts; the fituation of them likewife will not admit of proper dreffings being fixed on them with any degree of certainty of their remaining for any length of time; by which means the openings made into fuch tumors or abfceffes are frequently left bare, and expofed to the cold air, &c.: hence fuch openings degenerate into very foul ulcers, and produce a great deal of fungous flefh, and which requires to be repeatedly cut away with the knife, as the ftrongeft cauftics that can be applied are not fufficient to keep it under.

Setons are introduced by long, thin, fharp-pointed inftruments or needles, fhaped like a dart at the point, and having at the other extremity an eye to receive the end of the cord, which is to be left in the tumor. The fize of the inftrument may be determined by that of the tumor, and the thicknefs of the cord

which is to follow it, and which at all times ought to be ſmaller than the perforation made by the point of the needle. Every practitioner in farriery ſhould always have a number of theſe needles by him, of different ſizes, that is, from 6 to 14 or 15 inches long, a little bended on the flat or under ſide. The following is the method of applying them in caſes of tumors, &c. When the matter is found to fluctuate in the tumor, the needle, armed with a cord at the other end, is to be introduced at the upper part of it, and the ſharp point of the inſtrument directed to, and brought out at the under or lowermoſt part of the tumor, including the length of it; or, if needful, through the ſound muſcular fleſh on the under part, in order to make a depending orifice for the matter to run freely off; the cord ſhould be dipped in ſome digeſtive ointment, and then tied together at both ends with a thread, in order to prevent its ſlipping out. But if, from the length of the perforation, the cord ſhould not admit of being tied together at the ends, a ſmall button of wood, or ſome ſuch ſubſtance, may bé fixed at each end: only, from this circumſtance, the cord will require, when ſhifted, occaſionally to be drawn upwards and downwards; whereas, when the ends of it are tied together, it forms a circle, and may always be ſhifted downwards to the lower orifice. When the matter in the tumor appears to be wholly diſcharged or dried up, and no thickneſs appearing but where the cord is, it may then be cut out, and the orifices ſuffered to heal up.

When the needle for introducing the ſeton is to paſs near to any large blood-veſſels or nerves; in order to prevent the chance of their being wounded, it may be concealed in a canula or caſe, open at both ends; and after an opening is made at the upper part of the tumor ſufficient to admit the needle with its caſe, it may then be directed with ſafety to paſs the blood-veſſels, &c. It may then be puſhed forward through the canula and the oppoſite ſide of the tumor, and, having only the common teguments to perforate, all danger will be avoided.

Sect. VI. *Of Alterative Medicines.*

We underſtand by *alteratives*, ſuch medicines as, having no immediate ſenſible operation, gradually improve the conſtitution. Phyſicians have doubted whether any medicines are capable of altering the ſtate of the fluids of an animal; but experience proves that theſe remedies may be beneficially employed, at leaſt where the ſolids are to be acted on.

Nitre and antimony are the two moſt important remedies of this claſs, but we ſhall alſo ſpeak of other remedies that operate favourably in this way. Nitre is exceedingly uſeful in all caſes where the animal ſhews any diſpoſition to general inflammation; and one great advantage which ariſes from the uſe of this medicine over moſt others, is that, as its operation is chiefly by urine, it requires no confinement or clothing; but the horſe may be worked moderately throughout the whole courſe.

The quantity of nitre given at a time ſhould be from two to three ounces a-day; let it be finely powdered, and then mix with it by little at a time as much honey as will form it into a ball: give it every morning faſting three weeks or a month, according to circumſtances. If it be obſerved that the horſe ſhows an uneaſineſs at the ſtomach after taking it, a horn or two of any liquor ſhould be given after it, or it may be diſſolved at firſt in his water, or mixed with his corn; though the ball, where it agrees, is the eaſieſt method of giving it.

When horſes take drinks with great reluctance, powders muſt be given in their feeds: thus crude antimony, or liver of antimony finely powdered, may be given to the quantity of half an ounce, night and morning; but in all ſurfeits, gum guaiacum mixed with antimony is found more efficacious. Thus,

Take of crude antimony finely powdered, or, where it can be afforded, cinnabar of antimony, and gum guaiacum, of each a pound: mix together with an oily peſtle, to prevent the gum's caking: divide the whole into 32 doſes, viz. an ounce each doſe: let one be given every day in the evening-feed.

Or, Take of cinnabar of antimony, gum guaiacum, and Caſtile or Venice ſoap, of each half a pound; ſalt of tartar, four ounces: beat them up into a maſs, and give an ounce every day. To theſe may be added, very advantageouſly, an ounce and an half of camphor.

Here it may be right to obſerve, that the action of antimony on a horſe is materially different from what happens in the human ſubject. In the horſe, antimony in its *crude* ſtate is the moſt active and efficacious form in which it can be adminiſtered; whilſt, in man, it has little or no effect. On the contrary, thoſe preparations in which antimony is joined with an acid, as *tartariſed antimony*, are ſo extremely active in the human ſubject, that not more than a grain or two can be given at a doſe, whilſt the horſe can very well diſpenſe with a doſe of three or four drams. The horſe is incapable of the act of vomiting, and on this peculiarity, very probably, depends this curious fact with regard to antimony.

Æthiops mineral, given to the quantity of half an ounce a-day, is a very good ſweetener and corrector of the blood and juices; but it has been obſerved, after having been taken a week or ten days, to make ſome horſes ſlabber, and unable to chew their hay and oats; and the ſame ſymptoms have ariſen, where only two drams of crude mercury has been given, and continued about the ſame ſpace of time.

In many caſes the ſame ends may be better promoted by *Diet-drinks*, as 1. A decoction of logwood, prepared like that of guaiacum, is ſucceſsfully given in ſurfeits. 2. Lime water, prepared with ſhavings of ſaſſafras and liquorice, is a good diet-drink to ſweeten and correct a horſe's blood; and may be given with the nitre-balls for that purpoſe. 3. Tar-water alſo may in many caſes be well worth trial: but let it be remembered, that all medicines of this kind ſhould be continued a conſiderable time in obſtinate caſes.

Sect. VII. *Of the Prevention and Cure of Colds.*

A cold in a horſe is the ſame ſort of diſeaſe as in a man. It is occaſioned by the ſame expoſure, and to be avoided by the ſame ſort of cautions as we ourſelves think neceſſary. To enumerate the various cauſes of colds would be endleſs: the moſt uſual are, riding horſes till they are hot, and ſuffering them to ſtand in that condition where the air is cold and piercing; removing a horſe from a hot ſtable to a cold one, and too ſuddenly changing his clothing; whence it is that horſes often catch ſuch ſevere colds after they come out of dealer's hands, and are not carefully rubbed down when they come in hot off journeys.

Where there is a conſtant attention and care, the effects of cold are not only ſoon diſcovered, but an obſervation may be very early made to what part it more immediately directs its attack. For inſtance, if the nervous ſyſtem be the moſt irritable, the affection is quickly perceived in the eyes; if the glandular, upon the neck, throat, under the ears, or in the head: or if more particularly the ſyſtem of circulation has been affected, the conſequences are ſoon apparent upon the lungs: and will be exerted more or leſs in a cough, or difficulty of breathing, according to the ſeverity of attack, from the repulſion of perſpirable matter, and its conſequent abſorption into the circulation. As ſoon as the horſe is in this ſtate, a ſymptomatic fever attends; which is to be underſtood as no more than a degree of febrile heat or irritability dependent on the original cauſe, which gradually ceaſes as the primary diſeaſe is found to decline.

From an affection of the different parts above ſpecified, various diſorders enſue, which are treated of in the ſubſequent parts

of this work. Here we have only to confider that kind of cold fixed on the lungs, which produces cough; and which, if taken in its firft ftage, generally yields to very fimple remedies.

As foon as the attack has been obferved, bleeding fhould be inftantly performed, according to fymptoms, fize, ftate, and condition; and the blood preferved a few hours to afcertain its ftate: if livid or black, with a coat of fize upon its furface, there is no doubt of its vifcidity, and of the obftructed circulation of that fluid through the finer veffels of the lungs. In three or four hours after bleeding, give a mafh prepared as follows:

Take of bran and oats, equal parts. Pour on boiling water, a fufficient quantity: then ftir in it anifeed and liquorice powders, each one ounce; honey, four ounces. In two hours after the mafh, give a gallon or fix quarts of foft water, moderately warm, in which has been diffolved two ounces of nitre.

Thefe mafhes Mr. Taplin directs to be "continued every night and morning, giving a moderate feed of dry oats in the middle of the day, good fweet hay in fmall quantities, and the fame proportion of nitre to be repeated in the water after each mafh. To thefe muft be added the neceffary regulations of good dreffing and gentle exercife, which in general foon effect the cure of fuch colds as are counteracted upon the firft attack."

To humour thofe who are not fatisfied without fome formal compofitions, the following may be exhibited when the fever does not run high:

Pectoral Horfe-ball. Take of the frefh powders of anifeed, elecampane, carraway, liquorice, turmerick, and flour of brimftone, each three ounces; juice of liquorice, four ounces, diffolved in a fufficient quantity of mountain; faffron, powdered, half an ounce; falad-oil and honey, half a pound; oil of anifeed, one ounce: mix together with wheat-flour, enough to make them into a pafte.

Or the following, from Dr. Bracken:

Take anifeed, carraway feed, and greater cardamoms, finely powdered, of each one ounce; flour of brimftone, two ounces; turmerick, in fine powder, one ounce and a half; faffron, two drams; Spanifh juice, diffolved in water, two ounces; oil of anifeed, half an ounce; liquorice powder, one ounce and a half; wheat-flour, a fufficient quantity to make into a ftiff pafte, by beating all the ingredients well in a mortar.

Thefe balls confift of warm opening ingredients; and, given in fmall quantities, about the fize of a pullet's egg, will encourage a free perfpiration.

For a horfe loaded with flefh, a rowel may fometimes be neceffary, as may alfo a gentle purge or two, to fome, when the diftemper is gone off.

When the diforder has been neglected, and made a rapid progrefs, fhould the cough be violent and conftant, the horfe very dull and refufing his food, and the fymptomatic fever run high, the blood will confequently prove as before defcribed. In this cafe the fymptoms will not perhaps yield to the above plan fo foon as may be wifhed. It will therefore be neceffary to repeat the bleeding in two or three days at fartheft, according to circumftances. The mafhes may at the fame time be altered to equal parts of malt and bran, fcalded with boiling water; into which, when nearly cool enough for the manger, ftir elecampane, anifeed and liquorice powders, each one ounce: this mafh to be repeated every night and morning; continuing alfo the noon-feed dry, and the nitre two ounces in the water, as before directed. By a due attention to thefe meafures, relief will foon be obtained, and a cure generally effected in the courfe of a few days: Whereas, by delay or neglect, a confirmed cough, afthma, broken wind, or confumption, may be the confequence.

Having proceeded thus far in what may be called the *precautionary* plan of medicine for horfes, we fhall next proceed to confider their difeafes.

PART III. OF THE DISEASES OF HORSES.

Sect. I. *Of Fevers in general.*

1. THE fymptoms of a fever are, great reftleffnefs; the horfe ranging from one end of his rack to the other; his flanks beat; his eyes are red and inflamed; his tongue parched and dry; his breath is hot, and fmells ftrong; he lofes his appetite, and nibbles his hay, but does not chew it, and is frequently fmelling to the ground; the whole body is hotter than ordinary (though not parched, as in fome inflammatory diforders); he dungs often, little at a time, ufually hard, and in fmall bits; he fometimes ftales with difficulty, and his urine is high-coloured; and he feems to thirft, but drinks little at a time and often; his pulfe beats full and hard, to 50 ftrokes and upwards in a minute.

The firft intention of cure is bleeding, to the quantity of two or three quarts, if the horfe is ftrong and in good condition: then give him a pint of the following drink, four times a-day; or an ounce of nitre, mixed up into a ball with honey, may be given thrice a-day inftead of the drink, and wafhed down with three or four horns of any fmall liquor.

Take of baum, fage, and camomile flowers, each a handful; liquorice-root, fliced, half an ounce; falt prunel or nitre, three ounces; infufe in two quarts of boiling water; when cold, ftrain off, and fqueeze into it the juice of two or three lemons, and fweeten with honey.

As the chief ingredient to be depended on in this drink is the nitre, it may perhaps be as well given in water alone; but as a horfe's ftomach is foon palled, and he requires palatable medicines, the other ingredients may in that refpect have their ufe. Soleyfel for this purpofe advifes two ounces of falt of tartar, and one of fal ammoniac, to be diffolved in two quarts of water, and mixed with a pail of common water, adding a handful of bran or barley-flour to qualify the unpleafant tafte: this may be given every day, and is a ufeful medicine.

The following alfo may be given for this purpofe.—Take pearl afhes, one ounce; diftilled vinegar, a pint; water, two pints; honey, four ounces; give a pint of this three or four times a-day. In preparing this, the pearl afhes fhould firft be diffolved in the diftilled vinegar, before the other articles are added.

His diet fhould be fcalded bran, given in fmall quantities; which if he refufes, let him have dry bran fprinkled with water: put a handful of picked hay into the rack, which a horfe will often eat when he will touch nothing elfe; his water need not be much warmed, but fhould be given often and in fmall quantities: his clothing fhould be moderate; too much heat and weight on a horfe being improper in a fever, which fcarce ever goes off in critical fweats, as thofe in the human body terminate, but by ftrong perfpiration.

If in a day or two he begins to eat his bran and pick a little hay, this method with good nurfing will anfwer: but if he refufes to feed, more blood fhould be taken away, and the drinks continued; to which may be added two or three drams of faffron, avoiding at that time all hotter medicines: the following clyfter fhould be given, which may be repeated every day, efpecially if his dung is knotty or dry.

Take two handfuls of marſhmallows, and one of camomile flowers; fennel-ſeed, an ounce; boil in three quarts of water to two; ſtrain off, and add four ounces of treacle, and a pint of linſeed oil, or any common oil.

Two quarts of water-gruel, fat broth, or pot-liquor, with the treacle and oil, will anſwer this purpoſe; to which may be added, a handful of ſalt. Theſe ſorts of clyſters are more proper than thoſe with purging ingredients.

The following opening drink is very effectual in thoſe fevers; and may be given every other day, when the clyſters ſhould be omitted; but the nitre-balls or drink may be continued, except on thoſe days when theſe are taken.

Take of cream of tartar and Glauber's ſalts, each four ounces; diſſolve in barley-water, or any other liquor; an ounce or two of lenitive electuary may be added, or a dram or two of powder of jalap, to quicken the operation in ſome horſes.

Four ounces of Glauber's ſalts, or cream of tartar, with the ſame quantity of lenitive electuary, may be given for the ſame purpoſe, if the former ſhould not open the body ſufficiently.

In four or five days the horſe generally begins to pick his hay, and has a ſeeming reliſh for food; though his flanks will heave pretty much for a fortnight: yet the temper of his body and return of appetite ſhow, that nothing more is requiſite to complete his recovery than walking him abroad in the air, and allowing plenty of clean litter to reſt him in the ſtable. This method of treating a fever is ſimple, according to the laws of nature; and is confirmed by long experience to be infinitely preferable to the hot method. The intention here is to leſſen the quantity of blood, promote the ſecretion of urine and perſpiration, and cool and dilute the fluids in general.

2. But though moſt of the fevers to which the horſe is ſubject are purely inflammatory, yet there is another ſort of fever that happens to horſes, of a more complicated and irregular nature than the former, and which, if not properly treated, often proves fatal.

The ſigns are, a ſlow fever, with languiſhing, and great depreſſions: the horſe is ſometimes inwardly hot, and outwardly cold; at other times hot all over, but not to any extreme; his eyes look moiſt and languid; he has a continual moiſture in his mouth, which is the reaſon he ſeldom cares to drink, and when he does, it is but a little at a time. He feeds but little, and leaves off as ſoon as he has eat a mouthful or two; he moves his jaws in a feeble looſe manner, with an unpleaſant grating of his teeth; his body is commonly open; his dung ſoft and moiſt, but ſeldom greaſy; his ſtaling is often irregular, ſometimes little, at other times profuſe, ſeldom high-coloured, but rather pale, with little or no ſediment.

When a horſe's appetite declines daily, till he refuſes all meat, it is a bad ſign. When the fever doth not diminiſh, or keep at a ſtand, but increaſes, the caſe is dangerous. But when it ſenſibly abates, and his mouth grows drier, the grating of his teeth ceaſes, his appetite mends, and he takes to lie down (which perhaps he has not done for a fortnight), theſe are promiſing ſigns. A horſe in theſe fevers always runs at the noſe, but not the kindly white diſcharge, as in the breaking of a cold, but of a reddiſh or greeniſh duſky colour, and of a conſiſtence like glue, and ſticks like turpentine to the hair on the inſide of the noſtrils: If this turns to a gleet of clear thin water, the horſe's hide keeps open, and he mends in his appetite; theſe are certain ſigns of recovery.

The various and irregular ſymptoms that attend this ſlow fever, require great ſkill to direct the cure, and more knowledge of the ſymptoms of horſes' diſeaſes than the generality of gentlemen are acquainted with. The experienced farrier ſhould therefore be conſulted and attended to, in regard to the ſymptoms; but very ſeldom, as to the application of the remedy, which is generally above their comprehenſion; though it may be readily ſelected, by duly attending to the obſervations here inculcated.

Firſt, then, a moderate quantity of blood, not exceeding three pints, may be taken away, and repeated in proportion to his ſtrength, fulneſs, inward ſoreneſs, cough, or any tendency to inflammation. After this, the fever-drink firſt above-mentioned may be given, with the addition of an ounce of ſnake-root, and three drams of ſaffron and camphor, diſſolved firſt in a little ſpirit of wine; the quantity of the nitre may be leſſened, and theſe increaſed as the ſymptoms indicate.

The diet ſhould be regular; no oats given, but ſcalded or raw bran ſprinkled; the beſt flavoured hay ſhould be given by handfuls, and often by hand, as the horſe ſometimes cannot lift up his head to the rack.

As drinking is ſo abſolutely neceſſary to dilute the blood, if the horſe refuſes to drink freely of warm water or gruel, he muſt be indulged with having the chill only taken off by ſtanding in the ſtable: nor will any inconvenience enſue, but oftener an advantage; for the nauſeous warmth of water, forced on horſes for a time, palls their ſtomachs, and takes away their appetites, which the cold water generally reſtores.

Should the fever after this treatment increaſe, the horſe feed little, ſtale often, his urine being thin and pale, and his dung ſometimes looſe, and at other times hard; ſhould the moiſture in his mouth continue, his ſkin being ſometimes dry and at others moiſt, with his coat looking ſtarting and ſurfeited: upon theſe irregular ſymptoms, which denote great danger, give the following balls, or drink; for in theſe caſes there is no time to be loſt.

Take of contrayerva-root, myrrh, and ſnake-root, powdered, each two drams; ſaffron, one dram; mithridate, or Venice treacle, half an ounce; make into a ball with honey, which ſhould be given twice or thrice a-day, with two or three horns of an infuſion of ſnake-root ſweetened with honey; to a pint and a half of which may be added, half a pint of treacle-water or vinegar, which latter is a medicine of excellent uſe in all kinds of inflammatory and putrid diſorders, either external or internal.

Should theſe balls not prove ſucceſsful, add to each a dram of camphor, and, where it can be afforded, to a horſe of value, the ſame quantity of rhubarb. Or the following drink may be ſubſtituted in their ſtead for ſome days:

Take contrayerva and ſnake-root, of each two ounces; liquorice-root, one ounce; ſaffron, two drams; infuſe in two quarts of boiling water, cloſe covered, for two hours; ſtrain off, and add half a pint of diſtilled vinegar; four ounces of ſpirit of wine, wherein half an ounce of camphor is diſſolved, and two ounces of mithridate, or Venice treacle; give a pint of this drink every four, ſix, or eight hours.

Should the horſe be coſtive, recourſe muſt be had to clyſters, or the opening drink: ſhould he purge, take care not to ſuppreſs it, if moderate; but if, by continuance, the horſe grows feeble, add diaſcordium to his drinks, inſtead of the mithridate; if it increaſes, give more potent aſtringents.

Let it be remembered, that camphor is a very powerful and effectual medicine in theſe kinds of putrid fevers; being both active and ſedative, and particularly calculated to promote the ſecretions of urine and perſpiration.

Regard ſhould alſo be had to his ſtaling; which, if in too great quantities, ſo as manifeſtly to depreſs his ſpirits, ſhould be controlled by proper reſtringents, or by preparing his drinks with lime-water. If, on the contrary, it happens that he is too remiſs this way, and ſtales ſo little as to occaſion a fulneſs and ſwelling of the body and legs, recourſe may be had to the following drink:

Take of nitre, one ounce; juniper-berries, and Venice tur-

pentine, of each half an ounce: make into a ball with oil of amber.

Give him two or three of thefe balls at proper intervals, with a decoction of marfh-mallows fweetened with honey.

But if, notwithftanding the method we have laid down, a greenifh or reddifh gleet is difcharged from his noftrils, with a frequent fneezing; if he continues to lofe his flefh, and becomes hide-bound; if he altogether forfakes his meat, and daily grows weaker; if he fwells about the joints, and his eyes look fixed and dead; if the kernels under his jaws fwell, and feel loofe: if his tail is raifed, and quivers; if his breath fmells ftrong, and a purging enfues, with a difcharge of fetid dark-coloured matter; his cafe may then be looked on as defperate, and all future attempts to fave him will be fruitlefs.

The figns of a horfe's recovery are known by his hide keeping open, and his fkin feeling kindly; his ears and feet will be of a moderate warmth, and his eyes brifk and lively; his nofe grows clean and dry; his appetite mends, he lies down well, and both ftales and dungs regularly.

Be careful not to overfeed him on his recovery: let his diet be light, feeds fmall, and increafed by degrees as he gets ftrength; for, by overfeeding, horfes have frequent relapfes or great furfeits, which are always difficult of cure.

If this fever fhould be brought to intermit, or prove of the intermitting kind, immediately after the fit is over, give an ounce of the powder of yellow bark, and repeat it every fix hours till the horfe has taken four or fix ounces: fhould eruptions or fwellings appear, they ought to be encouraged; for they are good fymptoms at the decline of a fever, denote a termination of the diftemper, and that no further medicines are wanted.

The true reafons, perhaps, why fo many horfes mifcarry in fevers, are, that their mafters, or doctors, will not wait with patience, and let nature have fair play: that they generally neglect bleeding fufficiently at firft; and are conftantly forcing down fugar fops, or other food, in a horn, as if a horfe muft be ftarved in a few days if he did not eat: then they ply him twice or thrice a-day with hot medicines and fpirituous drinks, which (excepting a very few cafes) muft be extremely pernicious to a horfe, whofe diet is naturally fimple, and whofe ftomach and blood, unaccuftomed to fuch heating medicines, muft be greatly injured, and without doubt are often inflamed by fuch treatment.

Dilute the blood with plenty of water, or white drink; let his diet be warm bran-mafhes, and his hay fprinkled. Should the fever rife, which will be known by the fymptoms above defcribed, give him an ounce of nitre thrice a-day in his water, or made up in a ball with honey. Let his body be kept cool and open, with the opening drink, given twice or thrice a-week; or an ounce of falt of tartar may be given every day, diffolved in his water, for that purpofe, omitting then the nitre. After a week's treatment in this manner, the cordial ball may be given once or twice a day, with an infufion of liquorice-root fweetened with honey; to which may be added, when the phlegm is tough, or cough dry and hufky, a quarter of a pint of linfeed or fallad oil, and the fame quantity of oxymel of fquills.

The following cooling purge is very proper to give at the decline of the diftemper, and may be repeated three or four times:

Take two ounces of fenna; anifeed; and fennel, bruifed, each half an ounce; falt of tartar, three drams: let them infufe two hours in a pint of boiling water; ftrain off, and diffolve in it three ounces of Glauber's falt, and two of cream of tartar; give for a dofe in the morning.

This purge generally works before night very gently; and in fevers, and all inflammatory diforders, is infinitely preferable to any other phyfic.

Before we clofe this fection on fevers, it may be no improper hint to the curious, to take notice, that a horfe's pulfe fhould more particularly be attended to than is cuftomary, as a proper eftimate may thereby be made both of the degree and violence of the fever prefent, by obferving the rapidity of the blood's motion, and the force that the heart and arteries labour with to propel it round. The higheft calculation that has been made of the quicknefs of the pulfe in a healthy horfe, is, that it beats about 40 ftrokes in a minute; fo that in proportion to the increafe above this number, the fever is rifing; and if farther increafed to above 50, the fever is very high.

How often the pulfe beats in a minute may eafily be difcovered, by meafuring the time with a ftop-watch or minute fand-glafs, while your hand is laid on the horfe's near fide, or your fingers on any artery: thofe which run up on each fide the neck are generally to be feen beating, as well as felt, a little above the cheft; and one within fide each leg may be traced with the finger.

A due attention to the pulfe is fo important an article, in order to form a proper judgment in fevers, that it would appear amazing it has fo much been neglected, if one did not recollect, that the generality of farriers are fo egregioufly ignorant, that they have no manner of conception of the blood's circulation, nor in general have they ability enough to diftinguifh the difference between an artery and a vein. With fuch pretty guardians do we intruft the healths and lives of the moft valuable of animals!

Sect. II. *Of Pleurify, and Peripneumony, or Inflammation of the Lungs, &c.*

1. These diforders have fcarce been mentioned by any writer on farriery before Mr. Gibfon; who, by frequently examining the carcafes of dead horfes, found them fubject to the different kinds of inflammations here defcribed.

In order to diftinguifh thefe diforders from others, we fhall defcribe the fymptoms in Mr. Gibfon's own words.

"A pleurify, then, which is an inflammation of the pleura, and a peripneumony, which is an inflammation of the lungs, have fymptoms very much alike; with this difference only, that in a pleurify a horfe fhows great uneafinefs, and fhifts about from place to place; the fever, which at firft is moderate, rifes fuddenly very high; in the beginning he often ftrives to lie down, but ftarts up again immediately, and frequently turns his head towards the affected fide, which has caufed many to miftake a pleuretic diforder for the gripes, this fign being common to both, though with this difference: in the gripes, a horfe frequently lies down and rolls; and, when the pain is violent, he will alfo have convulfive twitches, his eyes being turned up, and his limbs ftretched out, as if he were dying; his ears and feet are fometimes occafionally hot, and fometimes as cold as ice; he falls into profufe fweats, and then into cold damps; ftrives often to ftale and dung, but with great pain and difficulty; which fymptoms generally continue till he has fome relief: but, in a pleurify, a horfe's ears and feet are always burning hot, his mouth parched and dry, his pulfe hard and quick: even fometimes, when he is nigh dying, his fever is continued and increafing; and though in the beginning he makes many motions to lie down, yet afterwards he reins back as far as his collar will permit, and makes not the leaft offer to change his pofture, but ftands panting with fhort ftops, and a difpofition to cough, till he has fome relief or drops down.

"In an inflammation of the lungs, feveral of the fymptoms are the fame; only in the beginning he is lefs active, and never offers to lie down during the whole time of his ficknefs; his fever is ftrong, breathing difficult, and attended with a fhort cough: and whereas, in a pleurify, a horfe's mouth is generally parched and dry; in an inflammation of the lungs, when a

horſe's mouth is open, a ropy ſlime will run out in abundance; he glee's alſo at the noſe a reddiſh or yellowiſh water, which ſticks like glue to the inſide of his noſtrils.

" In a pleuriſy, a horſe heaves and works violently at his flanks, with great reſtleſſneſs, and for the moſt part his belly is tucked up: but in an inflammation of the lungs, he always ſhows fulneſs; the working of his flanks is regular, except after drinking and ſhifting his poſture; and his ears and feet are for the moſt part cold, and often in damp ſweats."

2. The cure of both theſe diſorders is the ſame. In the beginning a ſtrong horſe may loſe three quarts of blood, the next day two quarts more; and, if ſymptoms do not abate, the bleedings muſt be repeated, a quart at a time; for it is ſpeedy, large, and quick-repeated bleedings that are in theſe caſes chiefly to be depended on. But if a horſe has had any previous weakneſs, or is old, you muſt bleed him in leſs quantities, and oftener. Mr. Gibſon recommends rowels on each ſide the breaſt, and one on the belly; and a bliſtering ointment to be rubbed all over his briſket upon the foremoſt ribs.

The diet and medicines ſhould be both cooling, ſedative, relaxing, and diluting. After the operation of bleeding, therefore, Mr. Taplin directs " to have ready ſome bran and very ſweet hay cut ſmall, and ſcalded together; which place hot in the manger, that the fumes may be imbibed as an internal fomentation to relax the rigidity of the glands, and excite a diſcharge from the noſtrils ſo ſoon as poſſible. The very nature of this caſe, and the danger to which the horſe is expoſed, ſufficiently point out the propriety and conſiſtency of exerting all poſſible alacrity to obtain relief, or counteract the diſeaſe in its firſt ſtage: therefore let the fumigation of ſcalded bran and hay be repeated every four or five hours, and the following decoction prepared without delay:

" Pearl barley, raiſins ſplit, and Turkey figs ſliced, each ſix ounces; ſtick liquorice, bruiſed, two ounces. Boil theſe in a gallon of water, till reduced to three quarts; ſtrain off; and, while hot, ſtir in one pound of honey, and, when cold, a pint of diſtilled vinegar; giving an ounce of nitre in a pint of this decoction every four, five, or ſix hours, according to the ſtate and inveteracy of the diſeaſe.

" If relief is not obtained ſo ſoon as expected, and the horſe is coſtive, give a clyſter, with

" Two quarts of common gruel; coarſe ſugar, ſix ounces; Glauber ſalts, four ounces; tincture of jalap, two ounces; and a quarter of a pint of olive oil. This muſt be repeated every 24 hours, or oftener, if neceſſary.

" Should the ſymptoms ſtill continue violent, without diſcovering any ſigns of abatement, after waiting a proper time for the effect of previous adminiſtrations, let the bleeding be repeated, in quantity proportioned to the urgency of ſymptoms, continuing the decoction and nitre every three or four hours, and repeating the clyſter, if plentiful evacuations have not been obtained by the former injection.

" The diluting drink, before preſcribed, is introduced here in preference to a ball, that its medicinal efficacy may be expeditiouſly conveyed to the ſeat of diſeaſe. So ſoon as the wiſhed-for advantages are obſerved, and the predominant and dangerous ſymptoms begin to ſubſide, when he labours leſs in reſpiration, is briſker in appearance, heaves leſs in the flanks, dungs frequently, ſtales freely, runs at the noſe, eats his warm maſhes of ſcalded bran, with four ounces of honey to each, and will drink thin gruel for his common drink (in each draught of which ſhould be diſſolved two ounces of cream of tartar); in ſhort, ſo ſoon as every appearance of danger is diſpelled, the management may be the ſame as in a common cold; giving one of the following balls every morning for a fortnight, leaving off the maſhes and diluting drink by degrees, and varying the mode of treatment as circumſtances may dictate.

" Castile ſoap, ſix ounces; gum ammoniacum, two ounces; aniſe and cummin ſeeds (in powder), each four ounces; honey, ſufficient to form the maſs, which divide into a dozen balls.

" To prevent any ill effects that may ariſe from the bad condition of the matter that has ſo long overloaded the veſſels of the lungs, ſuch as the formation of ulcers, knots, or tubercles, the beſt method will be, ſo ſoon as the horſe (with great care, gentle exerciſe, moderate and regular feeding) has recovered in a tolerable degree his natural ſtrength, to put him upon the following gentle courſe of phyſic; and it will become more immediately neceſſary, where the horſe bears about him remnants of the diſtemper, either in a gleet from the noſe, rattling in his throat, difficulty of breathing, or heaving in the flanks.

" Socotorine aloes, nine drams; rhubarb and jalap, each a dram and a half; gum ammoniacum, calomel, and ginger, each a dram; oil of juniper, ſixty drops; ſyrup of buckthorn, ſufficient to make a ball.

" Six clear days or more, if the horſe is weak, ſhould be allowed between each doſe."

There is alſo an external pleuriſy, or inflammation of the muſcles between the ribs, which, when not properly treated, proves the foundation of that diſorder called the *cheſt-founder*; for, if the inflammation is not diſperſed in time, and the viſcid blood and juices ſo attenuated by internal medicines that a free circulation is obtained, ſuch a ſtiffneſs and inactivity will remain on theſe parts, as will not eaſily be removed, and which is generally known by the name of *cheſt-founder*. The ſigns of this inflammation, or external pleuriſy, are a ſtiffneſs of the body, ſhoulders, and fore-legs; attended ſometimes with a ſhort dry cough, and a ſhrinking when handled in thoſe parts.

Bleeding, ſoft pectorals, and gentle purges, are the internal remedies; and, externally, the parts affected may be bathed with equal parts of ſpirit of ſal ammoniac and common oil. Theſe outward inflammations frequently fall into the inſide of the fore-leg, and ſometimes near the ſhoulder; forming abſceſſes, which terminate the diſorder.

Sect. III. *Of a Cough, and Aſthma.*

The conſequences of colds neglected or injudiciouſly treated, are ſettled habitual coughs, aſthmas, broken-wind, and conſumption. Of *coughs*, two kinds are chiefly diſtinguiſhed. The one is looſe, almoſt continual, and increaſing to violence upon the leaſt motion: the other is a ſhort dry cough, preceded by a huſky hollow kind of wheezing, as if reſpiration was obſtructed by fragments of hay or corn retained in the paſſage. This laſt is the kind of cough called *aſthma* by moſt writers, and for which mercurial purges have been recommended. Theſe, however, Mr. Taplin obſerves, may perhaps be exhibited with more propriety after the adminiſtration of a courſe of the following balls, ſhould they fail in the deſired effect. Bleeding muſt be firſt performed, and occaſionally repeated in ſmall quantities, till the glandular inflammation and irritability are allayed, and the blood ſo attenuated by the conſtant uſe of nitre, as to render the circulation free through the finer veſſels of the lungs, from the obſtructions in which all the difficulties proceed. Bleeding having taken place with the neceſſary circumſpection as to quantity, let two ounces of nitre be given punctually every night and morning in the water, as particularized under the article *colds*, continuing one of the following balls every morning for a fortnight or three weeks, that a fair and deciſive trial may be obtained.

Detergent Pectoral Ball.—Take of Caſtile ſoap, aniſeed, and liquorice powders, each five ounces; Barbadoes tar,

six ounces; gum ammoniacum, three ounces; balsam of Tolu, one ounce; honey (if required) to make a mass; which divide into a dozen balls.

If there should appear no abatement of the symptoms after the above trial, bleeding must be repeated, and mercurials had recourse to. Mr. Taplin advises "two doses of mercurial physic to be given eight days apart, and prepared by the addition of a dram and a half of calomel to either of the purging balls (under the articles of purging) best calculated for the horse's strength and condition. After these repeat the above pectoral balls, with the addition of gum myrrh, Benjamin and Venice turpentine, each two ounces; dividing the mass into balls of two ounces each, repeating them every morning till the above proportion (with these additions) are totally consumed."

The other kind, or that long loud hollow cough which is almost incessant, and continually increasing upon the least hurry in exercise, proceeds equally from irritability and the action of the slimy mucus upon the air vessels in respiration, as well as the viscidity and sluggish motions of the blood through the finer passages; but yields to medicine with much less difficulty than the asthmatic. In this case, as in the other, bleeding must be premised, and followed by a mash compounded of equal parts of bran and oats, into which must be stirred and dissolved, while hot, honey, four ounces. This mash must be repeated, with two ounces of nitre in the water, without intermission, every night and morning: giving also every morning the following ball, being an improvement by Mr. Taplin upon the *cordial ball* of Bracken.

Take Turkey figs, Spanish liquorice, aniseed, and liquorice powders, each four ounces; carraway seeds, elecampane, and anisated balsam of sulphur, each two ounces; ginger (in powder), and oil of aniseed, each six drachms; honey sufficient to form the mass; and divide into twelve balls; of which let one be given every morning.

The figs and ginger are to be beat into a paste in the mortar, previous to their incorporation with the other articles; the Spanish liquorice is to be softened over the fire by boiling a small quantity of spring-water, and the whole of the ingredients mixed in a proper manner. "These balls (says our author) are powerfully cordial and restorative; they promote glandular excretion, warm and stimulate the stomach to the expulsion of wind, enliven the circulation, and invigorate the whole frame, as has been sufficiently ascertained by their instantaneous effect in the chase, where their excellence has been repeatedly established; but more particularly in deep swampy countries, when, after a severe burst, or a repetition of strong leaps, the horse has been so off his wind, or, in fact, nature so exhausted, as not to be able to proceed a stroke farther; the immediate administration of a single ball has not only afforded instant relief, but the horse gone through the day with his usual alacrity."

Before we close this section, it may be necessary to observe, that some young horses are subject to coughs on cutting their teeth; their eyes also are apt to be affected from the same cause. In these cases, always bleed; and if the cough is obstinate, repeat it, and give warm mashes; which, in general, are alone sufficient to remove the complaint.

Sect. IV. *Of Broken Wind in Horses.*

Most writers attribute the cause of this disorder to injudicious or hasty feeding of young horses for sale; by which means the growth of the lungs, and all the contents within the chest, are so preternaturally increased, and in a few years so enlarged, that the cavity of the chest is not capacious enough for the performance of the necessary functions. There is great reason to disbelieve this doctrine altogether: but at least those who consider a broken wind in this light must own, that it ranks among the incurable diseases of horses; and that all the boasted pretensions to cure are vain and frivolous, since the utmost skill can amount to no more than now and then palliating the symptoms, and mitigating their violence.

A much more probable cause of broken wind has of late been assigned by the anatomical professor at the Veterinary College, and one which is supported by the appearances on dissection. This is the *breaking of the air vessels into each other*, so that a number of cells shall form one common bag, sometimes nearly the size of a hazel nut.

Hitherto, unfortunately, no remedy for this disease has been hit upon; we shall therefore only lay down such methods as may probably prevent this disorder, when pursued in time. But if they should not succeed, we shall offer some remedies and rules for mitigating the complaint, and making a horse as useful as possible under this malady.

It is usual, before a broken wind appears, for a horse to have a dry obstinate cough, without any visible sickness or loss of appetite; but, on the contrary, a disposition to foul-feeding, eating the litter, and drinking much water. In order to prevent, as much as possible, this disorder, bleed him, and give him the mercurial physic before prescribed, which should be repeated two or three times. The following balls are then to be taken for some time, which have been found extremely efficacious in removing obstinate coughs.

Take aurum mosaicum, finely powdered, eight ounces; myrrh and elecampane, powdered, each four ounces; aniseeds and bay-berries, each an ounce; saffron, half an ounce; make into balls with oxymel squills.

The aurum mosaicum is made of equal parts of quicksilver, tin, sal ammoniac, and sulphur. We give this medicine, as strongly recommended by Mr. Gibson; but how far the aurum mosaicum may contribute to its efficacy, may perhaps justly be disputed: as a substitute, therefore, we recommend the same quantity of squills, in their recent state, or gum ammoniacum, or equal parts of each united.

Broken-winded horses should eat sparingly of hay, which, as well as their corn, may be wetted with water; as this will make them less craving after water.

Garlic is often found efficacious in these cases; two or three cloves given at a time in a feed, or three ounces of garlic bruised, and boiled in a quart of milk and water, and given every other morning for a fortnight, having been found very serviceable; for by warming and stimulating the solids, and dissolving the tenacious juices which choke up the vessels of the lungs, these complaints are greatly relieved.

Careful feeding and moderate exercise have greatly relieved broken-winded horses. Horses, sent to grass in order to be cured of an obstinate cough, have often returned completely broken-winded, where the pasture has been rich and succulent, so that they have had their bellies constantly full. As the ill consequences, therefore, are obvious, where you have not the convenience of turning out your horse for a constancy, you may soil him for a month or two with young green barley, tares, or any other young herbage. To pursive thick-winded horses, Barbadoes and common tar have often been given with success, to the quantity of two spoonfuls, mixed with the yolk of an egg, dissolved in warm ale, and given fasting two or three times a-week, especially those days you hunt or travel.

But in order to make broken-winded horses of any real service, the most material point is to have a particular regard to their diet, observing a just economy both in that and their exercise; giving but a moderate quantity of hay, corn, or water, at a time, and moistening the former, to prevent their requiring too much of the latter, and never exercising them but with moderation, as has before been observed. The following alterative ball may be given once a fortnight or three weeks; and as it operates very gently, and requires no confinement but on

thofe days it is given (when warm meat and warm water are neceffary), it may be continued for two or three months.

Take focotorine aloes, fix drams; myrrh, galbanum, and ammoniacum, of each two drams; bay-berries, half an ounce: make into a ball, with a fpoonful of oil of amber, and a fufficient quantity of fyrup of buckthorn.

Mr. Taplin very properly ridicules the idea of overgrown lungs, and fuggefts the poffibility of effecting a cure of *thick wind* in horfes, provided the attempt be made upon the firft appearance of the difeafe; though he does not hold out the probability where the original caufe has been of long ftanding, and no attempts made to relieve.

In attempting the cure, the natural and obvious indications are, to promote the neceffary evacuations in the firft inftance, to attenuate the vifcidity of the glutinous obftructed matter, and to deterge the paffages by a ftimulation of the folids. Bleeding is therefore the firft meafure; and it ought to be repeated at proper intervals in moderate quantities, till diverted of the coat of fize and livid appearance that are certain figns of the lungs being obftructed either by vifcidity or inflammation. After bleeding, the horfe muft go through a regular courfe of the mild purging balls prefcribed after recovery from pleurify. They are flightly impregnated with mercurial particles, and, blended with the gums, form a moft excellent medicine for the purpofe. In three days after the operation of the third dofe, Mr. Taplin directs to begin upon the following detergent balfamics, and continue to give one ball every morning, fo long as may be thought neceffary to form a fair opinion whether any advantage is gained, or relief likely to be obtained.

Take of the beft white foap, eight ounces; gum guaiacum and ammoniacum, each three ounces; myrrh and benjamin, anifeed and liquorice, each two ounces; balfam of Peru, Tolu, and oil of anifeed, each half an ounce; Barbadoes tar, fufficient to make a mafs, which divide into twenty balls.

It is neceffary to be ftrictly obferved, that during this courfe hay and water are to be difpenfed with a very fparing hand, fo as to prevent too great an accumulation in the ftomach or inteftines, that an obfervation may be made with the greateft certainty, whether any hopes of fuccefs from medicine may be juftly entertained; if not, farther expence will be unadvifable, as it will appear, after fuch trial, an incurable malady at all events, and only fufceptible of palliation.

Sect. V. *Of a* Consumption.

When a confumption proceeds from a defect in a horfe's lungs or any principal vifcus, the eyes look dull; the ears and feet are moftly hot; he coughs fharply by fits; fneezes much, and frequently groans with it; his flanks have a quick motion: he gleets often at the nofe, and fometimes throws out a yellowifh curdled matter; and he has little appetite to hay, but will eat corn, after which he generally grows hot.

As to the cure, one of the principal things is bleeding in fmall quantities, from a pint to a pint and a half, which fhould be repeated as often as the breath is more than ordinarily oppreffed. Pectorals may be given to palliate prefent fymptoms; but as diffections have difcovered both the glands of the lungs and mefentery to be difeafed and indurated, the whole ftrefs lies on mercurial purges, and the following alteratives, given intermediately.

Take cinnabar of antimony, one pound, and add the fame quantity of gum guaiacum and nitre in powder; give the horfe an ounce of this twice a-day, wetting his feeds.

The fpring-grafs is often extremely ferviceable; but the falt mafhes are to be preferred, and to be more depended on than medicines; for great alterations are thereby made in the conftitution, and no fmall benefit arifes from air and proper exercife.

Sect. VI. *Of* Apoplexy *or* Staggers, Lethargy, Epilepsy, *and* Palsy.

It is common with farriers to include all diftempers of the head under two denominations, viz. *ftaggers* and *convulfions*, wherein they always fuppofe the head primarily affected. But in treating thefe diforders, we ftill diftinguifh between thofe that are peculiar to the head, as having their fource originally thence; and thofe that are only concomitants of fome other difeafe.

In an *apoplexy* a horfe drops down fuddenly, without other fenfe or motion than a working at his flanks. The previous fymptoms are, drowfinefs; watery eyes, fomewhat full and inflamed; a difpofition to reel; feeblenefs; a bad appetite; the head almoft conftantly hanging, or refting on the manger; fometimes with little or no fever, and fcarce any alteration in the dung or urine; the horfe is fometimes difpofed to rear up, and apt to fall back when handled about the head; which is often the cafe with young horfes, to which it does not fuddenly prove mortal, but with proper help they may fometimes recover. If the apoplexy proceeds from wounds or blows on the head, or matter on the brain; befides the above fymptoms, the horfe will be frantic by fits, efpecially after his feeds, fo as to ftart and fly at every thing. Thefe cafes feldom admit of a perfect recovery; and when horfes fall down fuddenly, and work violently at their flanks, without any ability to rife after a plentiful bleeding, they feldom recover.

All that can be done is to empty the veffels as fpeedily as poffible, by ftriking the veins in feveral parts at once, bleeding to four or five quarts; and to raife up the horfe's head and fhoulders, fupporting them with plenty of ftraw. Producing a fudden blifter on the head, by pouring on it a little boiling water, though a fevere, is an excellent remedy. If he furvives the fit, cut feveral rowels: give him night and morning clyfters, prepared with a ftrong decoction of fenna and falt, or the purging clyfter mentioned in the directions; blow once a day up his noftrils a dram of powder of afarabacca, which will promote a great difcharge; afterwards two or three aloetic purges with calomel fhould be given; and to fecure him from a relapfe, give him an ounce of equal parts of antimony, fulphur, and gum guaiacum.

If the fit proceeds only from fulnefs of blood, high feeding, and want of fufficient exercife, or a fizy blood (which is often the cafe with young horfes, who, though they reel, ftagger, and fometimes fuddenly fall down, yet are eafily cured by the above method), an opening diet with fcalded bran and barley will be neceffary for fome time; and the bleeding may be repeated in fmall quantities.

As to the other diforders of the head, fuch as lethargy, epilepfy or falling-ficknefs, vertigo, frenzy, and madnefs, convulfions, and paralytical diforders, as they are moft of them to be treated as the apoplexy and epilepfy, by bleeding and evacuations, with the alteratives there directed, we fhall wave treating of them feparately; but mention fome particular rules to diftinguifh them, according to the plan laid down; and then offer fome general remedies for the feveral purpofes.

In an epilepfy or falling ficknefs, the horfe reels and ftaggers; his eyes are fixed in his head, he has no fenfe of what he is doing, he ftales and dungs infenfibly, he runs round and falls fuddenly; fometimes he is immoveable, with his legs ftretched out as if he was dead, except only a quick motion of his heart and lungs, which caufes a violent working of his flanks; fometimes he has involuntary motions, and fhaking of his limbs, fo ftrong, that he has not only beat and fpurned his litter, but the pavement with it; and with thefe alternate fymptoms a horfe has continued more than three hours, and then has as furprifingly recovered: at the going off of the fit, he generally foams at the

mouth, the foam being white and dry, like what comes from a healthful horſe when he champs on the bit.

But in all kinds of gripes, whether they proceed from diſorders in the guts or retention of urine, a horſe is often up and down, rolls and tumbles about; and when he goes to lie down, generally makes ſeveral motions with great ſeeming carefulneſs, which ſhows he has a ſenſe of his pain; and if he lies ſtretched out for any time, it is generally but for a ſhort ſpace.

Epilepſies and convulſions may ariſe from blows on the head, too violent exerciſe, and hard ſtraining; and from a fulneſs of blood, or impoveriſhed blood, and ſurfeits; which are ſome of the cauſes that denote the original diſorder.

In lethargic diſorders, the horſe generally reſts his head with his mouth in the manger, and his pole often reclined to one ſide; he will ſhow an inclination to eat, but generally falls aſleep with his food in his mouth, and he frequently ſwallows it whole without chewing: ſtimulating clyſters are extremely neceſſary in this caſe, with the nervous balls recommended for the ſtaggers and convulſions; ſtrong purges are not requiſite, nor muſt you bleed in too large quantities, unleſs the horſe be young and luſty. In old horſes, rowels and large evacuations are improper; but volatiles of all kinds are of uſe when they can be afforded: the alterative purge mentioned at the end of this ſection may be given and repeated on amendment.

This diſtemper is to be cured by theſe means, if the horſe is not old and paſt his vigour. It is a good ſign if he has a tolerable appetite, and drinks freely without ſlabbering, and if he lies down and riſes up carefully, though it be but ſeldom.

But if a lethargic horſe does not lie down; if he is altogether ſtupid and careleſs, and takes no notice of any thing that comes near him; if he dungs and ſtales ſeldom, and even while he ſleeps and dozes, it is a bad ſign: if he runs at the noſe thick white matter, it may relieve him; but if a viſcid gleet, that ſticks to his noſtrils like glue, turn to a profuſe running of ropy, reddiſh, and greeniſh matter, it is an infallible ſign of a great decay of nature, and that the caſe will prove fatal.

Young horſes from four to ſix years are very ſubject to convulſions, from botts in the ſpring; and the large coach breed more than the ſaddle. They are ſeized without any previous notice; and if botts and worms are diſcovered in their dung, the cauſe ſeems to be out of doubt, more eſpecially if they have lately come out of a dealer's hands.

When this convulſion proceeds from a ſpaſmodic affection of the heart, or any of the principal viſcera, it is to be diſtinguiſhed from botts and vermin by previous ſymptoms; the horſe falls off his ſtomach, and grows gradually weak, feeble, and diſpirited, in his work, and turns ſhort-breathed with the leaſt exerciſe.

The juſt deſcription of that univerſal cramp or convulſion, called by ſome the *ſtag evil*, which ſeizes all the muſcles of the body at once, and locks up the jaws, ſo that it is impoſſible almoſt to force them open, we ſhall give in Mr. Gibſon's words, who ſays: "As ſoon as the horſe is ſeized, his head is raiſed with his noſe towards the rack, his ears pricked up, and his tail cocked, looking with eagerneſs as an hungry horſe when hay is put down to him, or like a high-ſpirited horſe when he is put upon his mettle; inſomuch, that thoſe who are ſtrangers to ſuch things, when they ſee a horſe ſtand in this manner, will ſcarce believe any thing of conſequence ails him; but they are ſoon convinced, when they ſee other ſymptoms come on apace, and that his neck grows ſtiff, cramped, and almoſt immoveable: and if a horſe in this condition lives a few days, ſeveral knots will ariſe on the tendinous parts thereof, and all the muſcles both before and behind will be ſo much pulled and cramped, and ſo ſtretched, that he looks as if he was nailed to the pavement, with his legs ſtiff, wide, and ſtraddling; his ſkin is drawn ſo tight on all parts of the body, that it is almoſt impoſſible to move it; and if trial be made to make him walk, he is ready to fall at every ſtep, unleſs he be carefully ſupported; his eyes are ſo fixed with the inaction of the muſcles, as gives him a deadneſs in his looks; he ſnorts and ſneezes often, pants continually with ſhortneſs of breath; and this ſymptom increaſes continually till he drops down dead; which generally happens in a few days, unleſs ſome ſudden and very effectual turn can be given to the diſtemper."

In all theſe caſes the horſe ſhould firſt be bled plentifully, unleſs he is low in fleſh, old, or lately come off any hard continued duty; then you muſt be more ſparing of his blood; afterwards give the following ball:

Take aſafetida, half an ounce; camphor and opium, each one dram; valerian root, powdered, one ounce; make into a ball, with honey and oil of amber.

This ball may be given twice a-day at firſt; and then once, waſhed down with a decoction of miſletoe or valerian, ſweetened with liquorice or honey: an ounce of aſafetida may be tied up in a piece of ſtrong coarſe linen rag, and put behind his grinders to champ on.

The calomel purges and emollient clyſters ſhould be given intermediately to keep the body open; but when the former balls have been taken a week or ten days, the following may be given once a-day with the valerian decoction:

Take cinnabar of antimony, ſix drams; aſafetida, half an ounce; ariſtolochia, myrrh, and bay-berries, of each two drams; make into a ball, with treacle and oil of amber.

This is the moſt effectual method of treating theſe diſorders; but when they are ſuſpected to ariſe from botts and worms, which is generally the caſe, mercurial medicines muſt lead the way, thus:

Take mercurius dulcis and philonium, of each half an ounce; make into a ball, with conſerves of roſes, and give the horſe immediately: half the quantity may be repeated in four or five days.

The following infuſion ſhould then be given, to the quantity of three or four horns, three or four times a-day, till the ſymptoms abate; when the above nervous balls may be continued till they are removed.

Take penny-royal and rue, of each two large handfuls; camomile flowers, one handful; aſafetida and caſtor, of each half an ounce; ſaffron and liquorice-root, ſliced, of each two drams; infuſe in two quarts of boiling-water; pour off from the ingredients as wanted.

If the caſtor is omitted, add an ounce of aſafetida.

The following ointment may be rubbed into the cheeks, temples, neck, ſhoulders, ſpine of the back, and loins, and wherever there is the greateſt contraction and ſtiffneſs.

Take lard and marſhmallow ointment, of each four ounces; oil of amber, two ounces; with a ſufficient quantity of camphorate ſpirit of wine; make a liniment.

When the jaws are ſo locked up, that medicines cannot be given by the mouth, it is more eligible to give them by way of clyſter: for forcing open the jaws by violence often puts a horſe into ſuch agonies, that the ſymptoms are greatly increaſed.

In this caſe alſo he muſt be ſupported by nouriſhing clyſters, made of milk-pottage, broths, &c. which muſt be given to the quantity of three or four quarts a-day: clyſters of this kind will be retained, and abſorbed into the blood; and there have been inſtances of horſes thus ſupported for three weeks together, who muſt otherwiſe have periſhed.

Mr. Gibſon mentions ſome extraordinary inſtances of ſucceſs in caſes of this ſort by theſe methods, and repeated frictions, which are extremely ſerviceable in all convulſive diſorders, and often prevent their being jaw-ſet; they ſhould be applied with unwearied diligence every two or three hours, wherever any

ftiffnefs or contractions in the mufcles appear; for a horfe in this condition never lies down till they are in fome meafure removed.

The ufe of rowels in thefe cafes is generally unfuccefsful, the fkin being fo tenfe and tight, that they feldom digeft kindly, and fometimes mortify: fo that, if they are applied, they fhould be put under the jaws, and on the breaft.

The red-hot iron fo frequently run through the foretop and mane, near the occipital bone, for this purpofe, has often been found to have deftroyed the cervical ligament.

In paralytic diforders, where the ufe of a limb or limbs is taken away, the internals above recommended fhould be given, in order to warm, invigorate, and attenuate the blood; and the following ftimulating embrocation fhould be rubbed into the parts affected:

> Take oil of turpentine, four ounces; Barbadoes tar, and oil of bays, of each two ounces; camphor, rubbed fine, one ounce; rectified oil of amber, three ounces; tincture of cantharides, one ounce.

With this liniment the parts affected fhould be well bathed for a confiderable time, to make it penetrate; and when the hind parts chiefly are lame, the back and loins fhould be well rubbed with the fame. To the nervous medicines above recommended may be added fnake root, contrayerva, muftard-feed, horfe radifh root, fteeped in ftrong beer, or wine where it can be afforded. Take the following for an example, which may be given to the quantity of three pints a-day alone, or two horns full may be taken after the nervous balls.

> Take fnake root, contrayerva, and valerian, of each half an ounce; muftard-feed and horfe-radifh root, fcraped, of each two ounces; long pepper, two drams: infufe in three pints of ftrong wine.

When the horfe is recovering from any of the above diforders, the following alterative purge may be repeated two or three times, as it operates very gently.

> Take focotorine aloes, one ounce; myrrh, half an ounce; afafetida and gum ammoniacum, of each two drams; make into a ball with any fyrup.

Where a retention of dung is the caufe of this diforder, the great gut fhould firft be raked thoroughly with a fmall hand, after which plenty of emollient oily clyfters fhould be thrown up, and the opening drink given, till the bowels are thoroughly emptied of their imprifoned dung. Their diet fhould for fome days be opening, and confift chiefly of fcalded bran, with flowers of brimftone, fcalded barley, &c.

We fhall conclude this article with an obfervation from a late Treatife by Mr. Proffer. In the ftaggers and other convulfive difeafes, where the horfe beats himfelf about, and expofes not only himfelf but the attendants to great danger, it is a very ufeful practice to fling the animal in the fame way as is ufual when conveyed on board a fhip. A fketch is given of the manner of doing this, for which fee plate 22. By this means he will be eafily managed, and the neceffary medicines or other remedies may be adminiftered with very little inconvenience.

Sect. VII. *Of the* Strangles, *and* Vives.

1. The *Strangles* is a diftemper to which colts and young horfes are very fubject. The fymptoms and progrefs of this difeafe are as follow: A dull heavinefs and inactivity, lofs of appetite, and a hollow hufky cough, occafioned by the irritability of the inflamed glandular parts in the throat and about the root of the tongue. To excite a degree of moifture in the mouth that may allay this difagreeable fenfation, the horfe is often picking his hay, but eats little or none: a degree of fymptomatic heat comes on, and a confequent clamminefs and thirft is perceptible. As the diftemper advances, he becomes proportionally languid and inattentive; a fwelling (with fometimes two or three fmaller furrounding it) is now difcovered to have formed itfelf between the jaw bones, which is at firft very hard, exceeding painful, and vifibly increafing; he now fwallows with difficulty, heaves in the flanks, and his whole appearance gives figns of the greateft diftrefs.

The firft object for confideration is the ftate of the fubject: if the evacuations are regular (as they generally are), and the feverifh fymptoms moderate, let the fwelling be examined, and its fuppuration promoted. For this purpofe (firft clipping away all the long or fuperfluous hairs that cover or furround the part), foment with fmall double flannels, dipt in a ftrong decoction of camomile, marfh-mallows, or rofemary, for ten minutes, as hot as can be conveniently fubmitted to; and then apply a poultice prepared as follows:

> Take of coarfe bread, barley meal, and camomile or elder flowers, each a handful; boil over the fire in a fufficient quantity of milk, or in the decoction for the fomentation; into which ftir about a third (of the whole quantity) of white-lily root, wafhed clean and pounded to a pafte; adding linfeed and fenugreek (in powder) of each an ounce; ftirring in, while hot, of turpentine two ounces, and laying it on moderately warm, and bandaging fufficiently. This will ferve for two poultices.

Both the fomentation and poultice muft be repeated every night and morning, till an opening in the fwelling is effected, which generally happens in the courfe of five or fix days. Upon the appearance of difcharge, the aperture may be a little enlarged with a biftoury or the point of any fharp inftrument adequate to the purpofe, though this will be unneceffary if the difcharge is produced freely and eafily of itfelf. The part fhould then be dreffed with the following ointment fpread on tow, ftill continuing the poultice over it to promote the digeftion, and prevent any remaining hardnefs.

> Take rofin and Burgundy pitch, of each a pound and a half; honey and common turpentine, each eight ounces; yellow wax, four ounces; hog's-lard, one pound; verdigris, finely powdered, one ounce; melt the ingredients together, but do not put in the verdigris till removed from the fire; and it fhould be ftirred in by degrees till the whole is grown ftiff and cool.

If the fever and inflammation run high, and the fwelling be fo fituated as to endanger fuffocation, a moderate quantity of blood muft be taken away.

In this diforder, mafhes muft be the conftant food, in fmall proportions, to prevent wafte: in each of them Mr. Taplin directs to put of liquorice and anifeed powders half an ounce, and about two ounces of honey, or in lieu of this laft, a quart of malt: the drink, confifting of warm water impregnated with a portion of fcalded bran or water-gruel, fhould be given in fmall quantities and often. The head muft be kept well covered with flannel, as the warmth will greatly tend to affift in promoting the neceffary difcharge; though, unlefs circumftances and weather forbid, the horfe need not be confined, but fhould have the advantage of air and fome gentle exercife. Nor fhould regular dreffing, and the accuftomed courfe of ftable difcipline, be omitted, but only ufed in a lefs degree than when in health.

This diftemper is feldom dangerous, unlefs from neglect, ignorant treatment, or cruel ufage. It generally terminates with a running at the nofe, in a greater or lefs degree; which fhould be frequently cleanfed from the infide of the noftrils, by means of a fponge fufficiently moiftened in warm water, to prevent its acquiring an adhefion to thofe parts, of a foulnefs that would fhortly become acrimonious.

If a hardnefs remains after the fores are healed up, it may be anointed with the following mercurial ointment:

> Take of crude mercury or quickfilver, one ounce; Venice turpentine, half an ounce; rub together in a mortar till the globules of the quickfilver are no longer vifible; then add, by little and little, two ounces of hog's-lard, juft

warm and liquefied; and let the whole be kept close covered for use. When the horse has recovered his strength, purging will be necessary.

If a copious and offensive discharge from the nostrils should continue after the abscess is healed up, there will be reason to suspect the disease called *glanders*, treated of in a subsequent section.

2. The *Vives* or Ives differ from the strangles only in this; that the swellings of the kernels seldom gather or come to matter, but by degrees are carried off and dispersed by means of warm clothing, anointing with the marshmallow ointment, a moderate bleeding, and a dose or two of physic. But should the inflammation continue notwithstanding those means, a suppuration must be promoted by the methods recommended in the strangles.

When these swellings appear in an old or full-aged horse, they are signs of great malignity, and often of an inward debility, as well as forerunners of the glanders.

Sect. VIII. *Of the Diseases of the* Eyes.

In this very important part of Farriery some considerable improvements have been practised of late at the Veterinary College. As the diseases of the eye, to which horses are so remarkably subject, are, in general, to be attributed to too great a derivation of blood to that organ, the experiment has been made in some cases, of taking up the carotid artery on the side of the affected eye. This has been attended with various degrees of success, yet sufficient to recommend it to the notice of every practitioner, who is desirous of improving the art of Farriery in this very material respect. We shall here enumerate the opinions of different writers on diseases of the eyes.

1. The cases that most frequently occur, requiring medical aid, or admitting of cure, are generally the effects either of *cold*, or of *blows*, *bites*, or other *external injuries*. In those proceeding immediately from cold, there is perceived an inflammation upon the globe of the eye, and internal surrounding parts, as the edges of the eye-lids, &c. Instead of its former transparency, the eye has a thick cloudy appearance upon its outer covering, and is constantly discharging an acrid serum, which in a short time almost excoriates the parts in its passage. The horse drops his ears, becomes dull and sluggish, is frequently shaking his head as if to shake off the tears, and in every action discovers pain and disquietude. In this case, after bleeding, the treatment prescribed in the section of *Colds* must be adopted and persevered in; and to cool the parts, and allay the irritation occasioned by the scalding serum, let the eyes and surrounding parts be gently washed twice or thrice every day with a sponge or tow impregnated with the following solution: or the same may be injected into the eye with a syringe.

Sugar of lead, one dram; white vitriol, two scruples; spring water, half a pint; brandy or camphorated spirits, one ounce or two table-spoonfuls.

If the inflammation should not seem likely to abate, but to wear a threatening appearance, the following diuretic medicine must be administered.

Castile soap, twelve ounces; yellow rosin and nitre (in powder), each eight ounces; powdered camphire, one ounce; and oil of juniper, six drams; mixed with a sufficient quantity of syrup or honey. The mass is to be divided into 12 balls, rolled up in liquorice or aniseed powder; one of which is to be given every morning, using also gentle work or moderate exercise.

2. The effects arising from blows or bites form different appearances, according to the severity of the injury sustained. Should inflammation and swelling proceed from either cause, bleeding will be necessary without delay, and may be repeated at proper intervals till the symptoms appear to abate; and let the parts be plentifully embrocated four times a-day with the following preparation of Goulard.

Extract of lead, three drams; camphorated spirits, one ounce; river or pond water, one quart. The extract to be first mixed with the spirits, and then the water to be added.

If a large swelling, laceration, or wound, attends; after washing with the above, apply a warm poultice of bread, milk, and a little of the lotion, softened with a very small portion of lard or olive oil. In cases of less danger, or in remote situations where medicines are not easily procured, the following may be used as a substitute.

Distilled vinegar, half a pint; spring water, a pint; and brandy, a wine glass full or half a gill.

3. As to the *gutta serena*, *cataract*, *film*, &c. these are cases in which relief is very seldom obtained.

The gutta serena is a partial or universal loss of sight, where no palpable defect or fault appears in the eye, except that the pupil is much more enlarged than natural. The appearances of this blemish are various, as well as the causes and effects, some of its subjects being totally blind, and others barely enabled to distinguish between light and darkness. The signs are a blackness of the pupil, an alteration of the size of the pupil, and its not contracting or dilating upon a sudden exposure to any degree of light. In order to the cure, it is necessary to attend to the cause, and to apply such remedies as that may indicate: though in truth it is a disorder in which, from whatever cause originating, no great expectation can be formed from medicine either internally or externally; more particularly from the former, the seat of disease being so far out of the reach of medicinal action. If the defect should be owing to a contraction of or compression upon the optic nerve, very little can be done with any expectation of success; and much less if it arises from a palsy of that or any neighbouring part.

A *cataract* is a defect in the crystalline humour of the eye, which, becoming opaque, prevents the admission of those rays upon the retina that constitute vision. The disorder called *moon eyes*, are only cataracts forming. These generally make their appearance when a horse is turned five coming six: at which time one eye becomes clouded, the eye-lids being swelled, and very often shut up; and a thin water generally runs from the diseased eye down the cheek, so sharp as sometimes to excoriate the skin; the veins of the temple, under the eye, and along the nose, are turgid and full: though sometimes it happens that the eye runs but little. This disorder comes and goes till the cataract whitens; then all pain and running terminate, and the horse becomes totally blind, which is generally in about two years. During this time some horses have more frequent returns than others; which continue in some a week or more, in others three or four; returning once in two or three months, and they are seldom so long as five without a relapse. There is another kind of *moon-blindness* which is also the forerunner of cataracts, where no discharge or weeping attends. The eye is never shut up or closed here, but will now and then look thick and troubled, at which time the horse sees nothing distinctly: when the eyes appear sunk and perishing, the cataracts are longer of coming to maturity; and it is not unusual in this case for one eye to escape. These cases generally end in blindness of one, if not of both eyes. The most promising signs of recovery are when the attacks come more seldom, and their continuance grows shorter, and that they leave the cornea clear and transparent, and the globe plump and full.

In all blemishes or defects, where a thickening of some one of the coats, membranes, or humours of the eye, has formed an appearance of cataract or film, it has been an established custom among most farriers to bestow a plentiful application of corrosive powders, unguents, and solutions, for the purposes of obliteration; without reflecting (as Mr. Taplin observes) upon the absurdity of endeavouring to destroy by corrosion, what is absolutely separated from the surface by a variety of membranous coverings, according to the distinct seat of disease; with which it is impossible to bring the intended remedy into contact, without

first destroying the intervening or surrounding parts by which the inner delicate structure is so numerously guarded. But in all disorders of this sort, whether moon-eyes or confirmed cataracts with a weeping, general evacuations with internal alteratives can only take place. Indeed the attempts to cure cataracts have hitherto generally produced only a palliation of the symptoms, and sometimes have proved entirely destructive. Yet early care, it is said, has in some instances proved successful. To this end rowelling is important, with bleeding at proper intervals, from scarifications on the inside of the eyelid, &c. It is also directed, during the violence of the symptoms, to observe a cooling treatment; giving the horse two ounces of nitre every day mixed into a ball with honey; and bathing the parts above the eye with verjuice or vinegar wherein rose-leaves are infused, to four ounces of which half a drachm of sugar of lead may be added. The swelling on the lid may afterwards be bathed with a sponge dipt in equal parts of Hungary and lime water mixed together; and the following cooling physic should be given every fourth day, till the eye becomes clear:

Lenitive electuary and cream of tartar, of each four ounces; Glauber's salts, three ounces; syrup of buckthorn, two ounces.

When the weeping is by these means removed, the *alterative powders* should be given every day, till two or three pounds are taken, and after an interval of three months the same course should be repeated. This method, it is affirmed, has often been attended with success, where the eyes have been full and no way perished.

4. The *haws* is a swelling and sponginess that grows in the inner corner of the eye, so large sometimes as to cover part of the eye. The remedy here is easily performed by cutting part of it away; but the farriers are apt to cut away too much. The wound may be dressed with honey of roses; and if a fungus or spongy flesh arises, it should be sprinkled with a little burnt alum.

Sect. IX. *Of the* Glanders.

In treating on this disease, M. de la Fosse has distinguished seven different kinds of glanders, four of which are incurable. The first proceeds from ulcerated lungs, the purulent matter of which comes up the trachea, and is discharged through the nostrils, like a whitish liquor, sometimes appearing in lumps and grumes: in this disorder, though the matter is discharged from the nostrils, yet the malady is solely in the lungs. The second is a wasting humour, which usually seizes horses at the decline of a disease, caused by too hard labour; this defluxion also proceeds from the lungs. The third is a malignant discharge, which attends the strangles sometimes, falls upon the lungs, and then runs off by the nostrils. The fourth is, when an acrimonious humour in the farcy seizes these parts, where it soon makes terrible havock. The fifth kind we shall describe by and by, as arising from taking cold. The sixth kind is a discharge from the strangles, which sometimes vents itself at the nostrils. In the seventh sort, which he calls the *real glanders*, the discharge is either white, yellow, or greenish, sometimes streaked or tinged with blood: when the disease is of long standing, and the bones are fouled, the matter runs blackish, and becomes very fetid; and is always attended with a swelling of the kernels or glands under the jaws; in every other respect the horse is generally healthy and sound, till the distemper has been of some continuance.

It is always a bad sign when the matter sticks to the inside of the nostrils like glue or stiff paste; when the inside of the nose is raw, and looks of a livid or lead colour; when the matter becomes bloody, and fetid; and when it looks of an ash-colour. But when only a limpid fluid is first discharged, and afterwards a whitish matter, the gland under the jaw not increasing, and the disorder of no long continuance, we may hope for a cure; for in this case, which arises from taking cold after a horse has been overheated, the pituitary membrane is but slightly inflamed, the lymph in the small vessels condensed, and the glands overloaded, but not yet ulcerated.

Our author affirms this disease to be altogether local; and that the true seat of it is in the pituitary membrane which lines the partition along the inside of the nose, the maxillary sinuses or cavities of the cheek-bones on each side the nose, and the frontal sinuses or cavities above the orbits of the eyes: that the viscera, as liver, lungs, &c. of glandered horses, are in general exceeding sound; and consequently that the seat of this disorder is not in those parts, as has been asserted by some authors. But on nicely examining by dissection the heads of such horses, he found the cavities above mentioned more or less filled with a viscous slimy matter; and the membrane which lines both them and the nostrils inflamed, thickened, and corroded with foul ulcers, which in some cases had eaten into the bones.

It is an erroneous remark of M. de la Fosse, that the sublingual glands, or the kernels situated under the jaw-bone, which are always swelled in this disease, do not discharge their lymph into the mouth, as in man, but into the nostrils; and that he constantly found their obstruction agreed with the discharge: if one gland only was affected, then the horse discharged from one nostril only; but if both were, then the discharge was from both. The seat of this disorder thus supposed, the mode of treatment he had recourse to was by trepanning these cavities, and taking out a piece of bone, by which means the parts affected might be washed with a proper injection, and in fine the ulcers deterged, healed, and dried up; and his success, by his own account, was very flattering.

But as, from the observations since made by this gentleman, there are different species of the glanders; so the cure of the milder kinds may first be attempted by injections and fumigations. "Thus, after taking cold, should a horse for 15 or 20 days discharge a limpid fluid or whitish matter from one or both nostrils, the glands under the jaw rather growing harder than diminishing, we may expect it will degenerate into a true glanders. To prevent which, after first bleeding, and treating him as we have directed for a cold, let an emollient injection, prepared with a decoction of linseed, marsh-mallows, elder, camomile flowers, and honey of roses, or such-like, be thrown up as far as possible with a strong syringe, and repeated three times a-day: should the running not lessen or be removed in a fortnight by the use of this injection, a restringent one may now be prepared with tincture of roses, lime-water, &c. and the nostrils fumigated with the powders of frankincense, mastich, amber, and cinnabar, burnt on an iron heated for that purpose; the fume of which may easily be conveyed through a tube into the nostrils." Such is the method recommended by Bartlet, which he says has been found successful when used in time. But a more particular course of procedure will be described hereafter.

With regard to the operation as well as the doctrine of M. de la Fosse, Mr. Taplin condemns not only that, but also his distinction of the disorder into different species; considering the various symptoms that appear, as only marking different stages of the same disease. The fact according to him appears to be, "that any corrosive matter discharged from the nostrils, and suffered to continue for a length of time, so as to constitute ulcerations and corrode the bones, will inevitably degenerate into and constitute the disease generally understood by the appellation of glanders; every stagnant, acrimonious, or putrid matter is possessed of this property, and more particularly when lodged (or by sinuses confined) upon any particular part. Divested of professional trick, chicanery, and deception, this is the incontrovertible explanation, whether proceeding from an ulceration of the lungs, or the inveterate glandular dis-

charges from the head (where the cafe is of long ftanding, and the bone carious) they are equally incurable." Neverthelefs, a *fingle inftance* has occurred in the Veterinary College, of a gentleman's coach horfe having been perfectly *cured* of the glanders by the internal ufe of *calomel*, which was perfifted in till the mouth was affected and for fome time afterwards. The fame method has been taken in other cafes, but not with the fame refult. The fingle cafe we allude to, however, ought to have the effect of encouraging a farther trial of mercury in the glanders. Various directions have been given by different writers for fumigating the noftrils, and for treating the fwelled glands in the throat; but fo long as the difeafe itfelf is incurable, the knowledge of palliative remedies is of very little importance.

Sect. X. *Of the* Gripes, *and other painful Affections of the Bowels.*

Amongst the many difeafes to which horfes are fubject, there feems to be none fo little underftood by the common farrier as the colic or gripes in horfes, one general remedy or method ferving them in all cafes. But as this diforder may be produced by very different caufes, the method of cure fhould alfo vary; otherwife the intended remedy, injudicioufly applied, will not only aggravate the complaint, but perhaps make it fatal. We fhall divide this diforder into three different fpecies: the *flatulent* or windy, the *bilious* or *inflammatory*, and the *dry gripes*; each of which we fhall diftinguifh by their different fymptoms, and then point out the proper remedies.

1. The flatulent or *windy colic* may in general be readily diftinguifhed by the rumbling of the confined air through the inteftines: the horfe is often lying down, and as fuddenly rifing again with a fpring; he ftrikes his belly with his hinder feet, ftamps with his fore-feet, and refufes his meat; when the gripes are violent, he will have convulfive twitches, his eyes be turned up and his limbs ftretched out as if dying, his ears and feet being alternately very hot and cold; he falls into profufe fweats, and then into cold damps; ftrives often to ftale, and turns his head frequently to his flanks; he then falls down, rolls about, and often turns on his back; this laft fymptom proceeds from a ftoppage of urine, that almoft always attends this fort of colic, which may be increafed by a load of dung preffing on the neck of the bladder.

Thefe are the general fymptoms of colic and gripes, from wind, drinking cold water when hot, and when the perfpirable matter is retained, or thrown on the bowels by catching cold; in all which cafes they are violently diftended. Cribbing horfes are faid to be more particularly fubject to this complaint, on a fuppofition that they are conftantly fucking in great quantities of air.

The firft intention is to empty the ftrait gut with a fmall hand dipped in oil, which frequently makes way for the confined wind to difcharge itfelf; and by eafing the neck of the bladder, the fuppreffion of urine is taken off, and the horfe ftales and gets eafe.

The following ball and clyfter feldom fail of giving relief in thefe cafes:

Take Strafburgh or Venice turpentine, and juniper-berries pounded, of each half an ounce; falt prunella or faltpetre, an ounce; oil of juniper, one drachm; falt of tartar, two drachms: make into a ball with any fyrup; it may be given whole, and wafhed down with a decoction of juniper-berries, or a horn or two of ale.

If the horfe does not break wind, or ftale plentifully, he will find no relief: therefore in an hour or two give him another ball, and add to it a drachm of falt of amber; which may be repeated a third time, if found neceffary. During the fit the horfe may be walked and trotted gently; but fhould by no means be haraffed beyond his ability, or moved about till he is jaded.

The following clyfter may alfo be given, between the balls, or alone, and repeated occafionally:

Take camomile flowers, two handfuls; anife, coriander, and fennel feeds, of each an ounce; long pepper, half an ounce; boil in three quarts of water to two; and add Daffy's elixir, half a pint; oil of amber, half an ounce, and oil of camomile, eight ounces.

The figns of a horfe's recovery are his lying quiet, without ftarting or tumbling, and his gathering up his legs, and ceafing to lafh out; and if he continues an hour in this quiet pofture, you may conclude all danger is over.

2. The next fpecies of colic is the bilious or *inflammatory*. This, befides moft of the preceding fymptoms, is attended with a fever, great heat, panting, and drynefs of the mouth: the horfe alfo generally throws out a little loofe dung, with a hot fcalding water; which, when it appears blackifh, or of a reddifh colour, and fetid fmell, denotes an approaching mortification.

In this cafe the horfe fhould immediately be bled to the quantity of three quarts; and it fhould be repeated, if the fymptoms do not abate in a few hours. The emollient clyfter, with two ounces of nitre diffolved in it, fhould be thrown up twice a-day, to cool the inflamed bowels; plenty of gum arabic water fhould be taken; and a pint of the following drink given every two or three hours till feveral loofe ftools are procured, and then it fhould be given only night and morning till the diforder is removed.

Take fenna, three ounces; falt of tartar, half an ounce; infufe in a quart of boiling water an hour or two; then ftrain off, and add two ounces of lenitive electuary, and four of Glauber's falts.

If this diforder is not removed by thefe means, but the inflammation and fever increafe, attended with a difcharge of the flefh-coloured water above defcribed, the event will moft probably be fatal; and the chief thing to be depended on now, muft be a ftrong decoction of Jefuit's bark, given to the quantity of a pint every three hours, with a gill of red portwine.

A quart of the fame may be ufed for a clyfter, with two ounces of Venice turpentine, diffolved with the yolks of two eggs, an ounce of diafcordium, and a pint of red wine, and given twice a-day: if the horfe recovers, give two or three mild rhubarb purges.

3. The *dry gripes*, or colic which arifes often from coftivenefs, is difcovered by the horfe's frequent and fruitlefs motion to dung, the blacknefs and hardnefs of the dung, the frequent and quick motion of his tail, the high colour of his urine, and his great reftleffnefs and uneafinefs.

In this cafe the ftrait gut fhould be examined and emptied with a fmall hand, oiled properly for that purpofe; the emollient oily clyfter fpoken of elfewhere fhould be thrown up twice a day; and the above purging drink given, till the bowels are unloaded, and the fymptoms removed.

The diet for a horfe in the gripes fhould be fcalded bran, warm water-gruel, or white water, made by diffolving four ounces of gum-arabic in a quart of water, and mixing it with his other water.

5. From this hiftory and divifion of gripes and colics, with their different treatment, it appears how abfolutely neceffary it is they fhould be well underftood, in order to be managed fkilfully: it is plain, too, that violent hot medicines fhould in every fpecies of this diforder be guarded againft, and given with great caution and difcretion, even in the firft kind of flatulent colic, where indeed they can only be allowed; yet too often, when prepared by the farriers with oil of turpentine, geneva, pepper, and brine, &c. they even increafe that diforder, by ftimulating the neck of the bladder, too forcibly heating the blood,

and inflaming the bowels, till a mortification is brought on them. Theſe are, in general, the conſtant appearances in horſes that die of this diſorder; whoſe bowels, being examined for that purpoſe, have been found inflamed, full of red and livid ſpots, and ſometimes quite black, from the quantity of blood with which the veſſels were loaded.

Sect. XI. *Of a* Diarrhœa *and* Scouring.

It is ſometimes a nice matter to form a proper judgment when to control or to encourage a looſeneſs; but theſe general rules may be a direction: If a healthy full horſe, on taking cold, or upon hard riding, overfeeding, eating unwholeſome food, or with a ſlight fever, ſhould have a moderate purging, by no means think of ſtopping it; but rather encourage it with an open diet, and plenty of warm gruel: but if it continues long, with gripings, the mucus of the bowels coming away, and the horſe loſing his appetite and fleſh, recourſe muſt be had to proper medicines. If he voids great quantities of ſlime and greaſy matter, give him the following drench, and repeat it every other day for three times:

Take lenitive electuary and cream of tartar, of each four ounces; yellow roſin, finely powdered, one ounce; and four ounces of ſweet oil; mix with a pint of water gruel.

The following alterative ball alone has been found ſucceſsful for this purpoſe when given twice a-week, with ſcalded bran and warm gruel:

Take ſocotorine aloes, half an ounce; diapente, one ounce; make into a ball, with the juice of Spaniſh liquorice diſſolved in water, and a ſpoonful of oil of amber. To this may be added, two drams of myrrh, and a dram of ſaffron, and (where it can be afforded) half an ounce of rhubarb.

When the purging is attended with a fever, rhubarb ſhould firſt be given to the quantity of half an ounce, with an ounce and a half of lenitive electuary; at night, after the working, give half an ounce or more of diaſcordium, in a pint of red wine mulled with cinnamon: and repeat it every day, and the rhubarb ball once in two or three.

But if the diſtemper increaſes, the horſe's flanks and belly look full and diſtended, and he appears griped and in pain, let this clyſter be given, and the quantity of diaſcordium increaſed an ounce in his night drink:

Take camomile flowers, one handful; red roſes, half a handful; pomegranate and balauſtines, of each an ounce; boil in two quarts of water to one; ſtrain off, and diſſolve in it two or three ounces of diaſcordium, and one of mithridate; to which may be added, a pint of port wine. Repeat it once a-day.

If the flux continues violent, give a dram of roch-alum, with an ounce and a half of bole, twice a-day; or, diſſolve double this quantity with two ounces of diaſcordium, and the cordial ball, in two quarts of hartſhorn drink; to which may be added a pint of port; and give the horſe, three or four times a-day, a pint of this drink. For this purpoſe alſo a ſtrong decoction of oak-bark may be given, with either of the above remedies, and to the ſame quantity; even by itſelf, it will be found on trial no inconſiderable remedy.

When the diſcharge is attended with an acrid mucus or ſlime, the griping and pains are very ſevere, the common lining of the bowels being waſhed away; in this caſe the following clyſter ſhould frequently be injected warm:

Take of tripe-liquor or thin ſtarch, two quarts; oil of olives, half a pint; the yolk of ſix eggs well broke, and two or three ounces of coarſe ſugar.

Some horſes, having naturally weak ſtomachs and bowels, throw out their aliment undigeſted; their dung is habitually ſoft and of a pale colour; they feed poorly, and get no fleſh: to remedy this complaint, give the following purge two or three times; and then the infuſion to the quantity of a pint every morning.

Take ſocotorine aloes, ſix drams; rhubarb, powdered, three drams; myrrh and ſaffron, each a dram: make into a ball with ſyrup of ginger.

Infuſion.—Take zedoary, gentian, winter's-bark, and orange-peel, of each two ounces; pomegranate-bark and balauſtines of each an ounce; camomile-flowers and centaury, each a handful; cinnamon and cloves, each an ounce: infuſe in a gallon of port or ſtrong beer.

When horſes are apt to be coſtive, from whatever cauſe it ariſes, gentle openers ſhould be given. Scalded bran or barley, with an ounce of fenugreek and linſeed, occaſionally given, will prevent this complaint; but where it is conſtitutional, as ſometimes happens, if the horſe is in perfect health, no inconvenience will ariſe from it; and it is obſerved that ſuch horſes are able to endure great fatigue and labour.

Sect. XII. *Of* Worms *and* Botts.

There have been deſcribed by authors three different ſorts of worms that affect horſes, viz. *Botts*, which young horſes are often troubled with in the ſpring; the *Rotundi*, or thoſe reſembling earth-worms; and the *Aſcarides*, or thoſe about the ſize of the largeſt ſewing needle, with flat heads. See plate 29. of Vol. I.

The botts which breed in the ſtomachs of horſes appear to be very large maggots, compoſed of circular rings, with little ſharp prickly feet along the ſides of their bellies. They adhere to a part of the ſtomach which is naturally deſtitute of the villous covering that ſpreads over the reſt of its cavity, and the inſtrument by which they are held, is a ſort of barb or double fiſh-hook, the points after entering diverging in oppoſite directions, ſo as to render it impoſſible for the contents of the ſtomach, or even a much greater force than could be applied in that ſituation, to diſlodge them. There they breed and draw their nouriſhment, and are not looſened from ſuch adheſion before they come to maturity. The eggs from whence theſe botts are produced, are diſperſed in cluſters all round the lower orifice of the ſtomach, and are laid under the inner coat or thin membrane of the ſtomach; ſo that when the animals come to form and life, they burſt through this inner coat with their breech and tail ſtraight outwards, and their trunks ſo fixed into the muſcular or fleſhy coat of the ſtomach, that it ſometimes requires a good pull to diſengage them: from the blood of this laſt coat they draw their nouriſhment, which they ſuck like ſo many leeches, every one ulcerating and purſing up the part where it fixes, like a honey-comb; and they ſometimes even deſtroy the horſe.

The ſymptoms of worms are various. The botts that many horſes are troubled with in the beginning of the ſummer, are always ſeen ſticking on the ſtrait gut, and are often thruſt out with the dung, with a yellowiſh coloured matter like melted ſulphur: they are no ways dangerous there; but are apt to make a horſe reſtleſs and uneaſy, and rub his breech againſt the poſts. The ſeaſon of their coming is uſually in the months of May and June; after which they are ſeldom to be ſeen, and rarely continue in any one horſe above a fortnight or three weeks. Thoſe that take their lodgment in the ſtomach, are dangerous by ſometimes cauſing convulſions; and are ſeldom diſcovered by any previous ſigns before they come to life, when they throw a horſe into violent agonies. The other kinds are more troubleſome than dangerous, but are known by the following ſigns: The horſe looks lean and jaded, his hair ſtares, and nothing he eats makes him thrive; he often ſtrikes his hind-feet againſt his belly; is ſometimes griped, but without the violent ſymptoms that attend a colic and ſtrangury; for he never rolls and tumbles, but only ſhows uneaſineſs, and generally lays

himfelf down quietly on his belly for a little while, and then gets up and falls a-feeding; but the fureft fign is when he voids them with his dung.

For the cure of botts in the ftomach, calomel fhould firft be given in fufficient quantities, and repeated at proper intervals: æthiops mineral, or fome of the undermentioned forms, may be given afterwards.

But botts in the rectum may alfo be cured by giving the horfe a fpoonful of favin, cut very fmall, once or twice a-day in his oats or bran, moiftened; and three or four cloves of garlic may be added to advantage. Give alfo an aloetic purge between whiles; the following has been recommended:

Take fine foeotorine aloes, ten drams; frefh jalap, one dram; ariftolochia, or birthwort, and myrrh powdered, of each two drams; oil of favin and amber, of each one dram; fyrup of buckthorn enough to form into a ball.

But as the fource of worms in general proceeds from a vitiated appetite and a weak digeftion, recourfe muft firft be had to mercurials, and afterwards to fuch things as are proper to ftrengthen the ftomach, and promote digeftion. Thus, two drams of calomel may be given with half an ounce of diapente, and mixed up with conferve of wormwood, over night; and the next morning the above purge: thefe may be repeated in fix or eight days.

The various preparations of antimony and mercury muft be given feveral weeks together, in order to get entirely rid of thefe vermin. Æthiops mineral may be given to the quantity of half an ounce a-day; or the mercurius alkalifatus to two drachms a day, incorporated with a bit of cordial ball. The cinnabar powders, as directed in the farcy, are no lefs effectual: and when worms are bred from high feeding, or unwholefome food, rue, garlic, tanfy, favin, box, and many other fimples, may be given fuccefsfully; being for that purpofe mixed with the food. Cut tobacco, from half an ounce to an ounce a-day, has been given, and where the worms are fituated in the rectum the fmoke of tobacco by way of clyfter is very ufeful.

Sect. XIII. *Of the* Jaundice.

Horses are frequently fubject to this complaint; which is known by a dufky yellownefs of the eyes; the infide of the mouth and lips, the tongue, and bars of the roof of the mouth, looking alfo yellow. The horfe is dull, and refufes all manner of food; the fever is flow, yet both that and the yellownefs increafe together. The dung is often hard and dry, of a pale yellow, or light pale green. His urine is commonly of a dark dirty brown colour; and when it has fettled fome time on the pavement, it looks red like blood. He ftales with fome pain and difficulty; and, if the diftemper is not checked foon, grows delirious and frantic. The off-fide of the belly is fometimes hard and diftended; and in old horfes, when the liver has been long difeafed, the cafe is unmanageable, and ends fatally with a wafting diarrhœa: but when the diftemper is recent, and in young horfes, there is no fear of a recovery if the following directions are obferved:

Firft of all bleed; and give a laxative clyfter, as horfes are apt to be very coftive in this complaint; and the next day give the horfe this purge:

Take rhubarb, powdered, one ounce; calomel, one dram; focotorine aloes, fix drams; fyrup of buckthorn, a fufficient quantity.

This may be repeated two or three times, giving intermediately the following balls and drink.

Take of æthiops mineral, half an ounce; Caftile foap, one ounce; make into a ball, and give one every day, and wafh it down with a pint of the following decoction:

Take madder-root and turmerick, of each four ounces; burdock-root, fliced, half a pound; monk's rhubarb, four ounces; liquorice, fliced, two ounces; boil in a gallon of forge-water to three quarts; ftrain off, and fweeten with honey.

By thefe means the diftemper generally abates in a week, which may be difcovered by an alteration in the horfe's eyes and mouth; but the medicines muft be continued till the yellownefs is entirely removed.

Should the diftemper prove obftinate, and not fubmit to this treatment, you muft try more potent remedies, viz. mercurial phyfic, repeated two or three times at proper intervals; and then the following balls:

Take falt of tartar, two ounces; cinnabar of antimony, four ounces; filings of fteel, three ounces; common foap, half a pound; make into balls, the fize of a pullet's egg, with honey; and give one night and morning, with a pint of the above drink.

It will be proper, on his recovery, to prevent coftivenefs.

Sect. XIV. *Of the Difeafes of the* Kidneys *and* Bladder.

The fymptoms of an affection of the kidneys are, a weaknefs of the back and loins, difficulty of ftaling, faintnefs, lofs of appetite, and deadnefs in the eyes; the urine is thick, foul, and fometimes bloody, efpecially after a violent ftrain. A horfe difeafed in his kidneys can feldom *back*, that is, move ftraight backwards, without pain, which is vifible as often as he is put to trial: the fame thing is obfervable indeed in horfes whofe backs have been wrung and wrenched; but with this difference, that in the latter there is feldom any defect or alteration in the urine, except that it is higher coloured. The confequences of a difordered ftate of the urinary organs are principally two, ftrangury and diabetes.

1. *Strangury*, or an obftruction of urine, may arife from different caufes. When it is not owing to wind, or hardened dung preffing upon the neck of the bladder (as was obferved in the fection on *Colics*), it may proceed from inflammation in the bladder or kidneys, ulcerations there, or fpafm upon any particular part. When owing to inflammation or fpafm, the general indications of cure are, to leffen the ftricture upon the parts; to reduce the inflammation; and to promote the evacuation of urine. The firft of thefe intentions may be anfwered by a moderate lofs of blood; the fecond, by the ufe of internal emollients; and the third, by gentle ftimulants and mild diuretics.

In ftrangury from inflammation or fpafm in the parts, the horfe makes frequent motions to ftale, ftands wide and ftraddling, appears full in the flank, and fomewhat dejected. The firft meafure, as already obferved, is bleeding; and that more or lefs plentifully according to the urgency of the fymptoms. In a convenient time after this operation, Mr. Taplin recommends to throw up the following emollient clyfter:

"Take of thin gruel, three pints; nitre, two ounces; gum arabic, one ounce and an half; olive oil, four ounces; let it be injected moderately warm, and retained in the body as long as poffible.

"So foon after this clyfter as the horfe is inclined by appetite to receive it, give a mafh of two parts malt and one bran, they having been fcalded together and ftirred till of a moderate warmth; after this, if the fubject has not ftaled in confequence of bleeding, clyfter, and mafh, have the following balls expeditioufly prepared to forward the evacuation:

"Take Caftile foap, ten drachms; fal prunella, one ounce; camphire, two drachms; anifeed powder, fix drachms; oil of juniper, one drachm and an half; fyrup of marfhmallows, fufficient to make the mafh: which divide into two equal parts, giving one in fix hours after the other, if the former is not fuccefsful.

"These are very safe, mild, and efficacious, in general producing the desired effect without any uneasy sensations. Where a drink is preferred, as coming into a more applicable mode of administration, the following will prove equally serviceable:

"Take juniper berries, (bruised) two ounces; boil in a pint and a half of water for some time; then strain (to produce by squeezing the berries three quarters of a pint); to this add of nitre and gum arabic, (in powder) each an ounce.

"This drink, or the above ball, to be repeated at distinct periods of four hours each (if a repetition of the first at the end of six hours does not effect the desired purpose), till relief is obtained by plentiful evacuations."

As a suppression of urine arises sometimes from an inflammation of the parts, so at others from a paralytic affection, particularly of the kidneys, disabling them in their office of separating the urine from the blood: in this latter case, a general suppression taking place, the bladder is usually empty, so that a horse will make no motion to stale; and if he survives a few days in this condition, his body will swell to a great degree, break out in blotches all over, and death will soon close the scene.

Strangury sometimes also arises from an ulceration of the parts; which is a case almost as desperate as the preceding. The symptoms are: a visible disquietude; the evacuation not totally suppressed, being only at times obstructed; the urine frequently altering its appearance, being sometimes thick, depositing a turbid sediment as if impregnated with membranous matter; and at other times tinged with blood, the evident effect of a corroded solution of the diseased part. In this instance the following balls or drink are recommended by Mr. Taplin as the only probable means of relief:

"Take of myrrh, one ounce; Castile soap, and Locatelli's balsam, each three ounces; nitre and aniseed, (in powder) each two ounces; balsam of Peru, six drachms; mix together with syrup of marshmallows, and divide into six balls, giving one every morning.

In case spasm of the parts be also suspected, the following ball may be given, and repeated at such times as the circumstances of the case may render proper:

"Take of Castile soap, half an ounce; nitre, rosin, and compound powder of gum tragacanth, each two drachms; opium, (in powder) ten grains; oil of juniper, 30 drops. Mix.

"The following drink may be substituted with equal effect, if a liquid form is preferred:

"Take thin gruel, three quarters of a pint; gum arabic and nitre, (in powder) each one ounce; liquid laudanum, three drachms. Mix.

"This (as the ball above) may be occasionally repeated."

2. Horses subject to a *diabetes*, or profuse staling, if old, or of a weak constitution, are seldom cured; they soon lose their flesh and appetite, grow feeble, their coat staring, and they die shortly. Of a young horse there are more hopes; but he must not be indulged with too much water or moist food. Give him the following:

Take jesuits bark, four ounces; bistort and tormentil-root, of each two ounces; boil in two gallons of lime-water to the consumption of half, and give a pint three times a-day.

As this disorder generally proceeds from too violent exercise, over-straining, &c. repeated bleedings in small quantities are absolutely necessary, till the complaint is got the better of.

Sect. XV. *Of* Molten-Grease.

By the term molten-grease is meant, a kind of fat discharge voided with the dung. It is always attended with a fever, heat, restlessness, starting and tremblings, great inward sickness, shortness of breath, and sometimes with the symptoms of a pleurisy. His dung will be extremely greasy, and he will fall into a scouring; his blood will have a thick skin or buff over it when cold; the congealed part will look like a mixture of size and grease, which makes it so extremely slippery, that it will not adhere to the fingers, and the small portion of serum feels also slippery and clammy. The horse soon loses his flesh and fat; and those that survive this shock commonly grow hide-bound for a time, their legs swelling both before and behind, and they continue in this state till the complaint is removed, or some more obstinate disease, such as the farcy, follows.

In the first place bleed plentifully, and repeat it for two or three days successively in smaller quantities; two or three rowels should also be immediately put in, and the cooling emollient clysters mentioned in other cases, daily thrown up to abate the fever, and drain off the greasy matter from the intestines. By the mouth give plenty of warm water or gruel, with cream of tartar or nitre, to dilute and attenuate the blood, which in this case is greatly disposed to run into grumes, and endanger a total stagnation.

When the fever is quite gone off, and the horse has recovered his appetite, gentle aloetic purges should be given once a-week, for a month or six weeks, in order to bring down the swelled legs. To this end give the following; which, repeated for some time, will entirely remove this disorder.

Take of socotorine aloes, six drams; of gum guaiacum, powdered, half an ounce; of diaphoretic antimony and powder of myrrh, each two drams; make into a ball with syrup of buckthorn.

These will seldom take a horse from his business above two or three days in a week; neither will he lose his flesh or appetite with them, but on the contrary mend in both; which cannot be obtained by any other method of purging, and gives this greatly the preference in many cases.

Sect. XVI. *Of* Hide-bound, Surfeits, *and* Mange.

1. The signs of *Hide-bound* are, "a want of flexibility in the skin, which is pervaded by a general stiffness that seems to form an entire adhesion to the flesh, without the least partial separation or distinction. There is a kind of dusty scurf, plainly perceived underneath the hair, that raises it up in different parts; and, giving it another hue, the coat in many places forms an appearance of two or three colours; conveying, even in this trifling circumstance, a very forcible idea of poverty in both food and raiment. The horse is generally languid, dull, heavy, and weak; his excrement is dark, foul, and offensive; he sweats much upon very moderate exertions; then his coat stares, the hair turns different ways (which in its effluvia is disagreeable), and affords evident proof of weakness.

Bad food and want of stable care are, in general, the only probable reasons that can be assigned for this complaint. Long lank grass in low swampy land in autumn, and musty hay or bad oats at any season, may in some degree allay the hunger, but not gratify the appetite; for, being in itself destitute of the effect and quality of superior food, no nutritive contribution can be conveyed for the generating of blood or formation of flesh. The sources for the supply of chyle being thus obstructed, the lymphatics are deprived of their due proportion of nutritive fluid that should pass through these smaller vessels; and they become not only in some measure contracted, but in a great degree inactive, which, with the want of proper external care and dressing, contribute to an almost universal obstruction of the cutaneous pores. These, from the preternatural debilitation of the general system, are thrown open by the most moderate exercise.

In reſpect to its cure very few directions will be neceſſary, the caſe being no more than a temporary inconvenience, rather than a diſeaſe. Therefore, by way of affording ſome little change to the circulation, take away a ſmall quantity of blood; and in three or four hours after, increaſe its *impetus* by a maſh of malt, oats, and bran, equal parts. Continue this maſh every night for a fortnight, ſtirring in two ounces of flowers of brimſtone every other night; and for his other feeds (morning and noon) give equal parts of oats and bran, with half a pint of old beans in each, to prevent relaxing the body too much by the maſhes. At the ſame time, regular and ſubſtantial dreſſing, air, exerciſe, ſound oats, ſweet hay, and good ſoft water, will greatly contribute to promote the cure. And when by theſe means he has viſibly improved in hide, coat, and condition, let him have twice in a week a bruſhing gallop, to produce a moderate ſweat and promote the circulation; taking great care not to ſtand ſtill till he is perfectly cool; when his dreſſings ſhould be thoroughly gone through with attention, care, and perſeverance, every night and morning. If this method ſhould be unattended with ſucceſs, there will be reaſon to ſuſpect ſome unknown cauſe lurking behind; in which caſe go through a mild courſe of phyſic, feeding well between the doſes.

2. Of *ſurfeits*, according to Mr. Taplin, there are two kinds, originating from different cauſes: one being no more than a very advanced ſtage of the caſe laſt deſcribed; which being long neglected, all its ſymptoms increaſe, till the entire maſs of blood being at laſt affected, the virulence of the diſorder diſplays itſelf upon the ſurface of the body.

The other kind of ſurfeit, differing from the former in cauſe, but very little in effect, is that where, from ignorance or inattention, a horſe is ſuffered to drink immoderately of cold water, when in a violent perſpiration, and the blood conſequently in the higheſt degree of circulation.

The circulating fluid being ſo inſtantaneouſly checked by the influence of the frigid element and the ſudden contraction of the ſolids, the craſſamentum becomes immediately thickened and inflamed; while the ſerum or watery part, ſeparating from the other, extravaſates itſelf; and, by an effort of nature, is propelled to the ſkin for tranſpiration, where the pores (having been inſtantly collapſed at the time of the water's taking effect) are ſo cloſely obſtructed that its paſſage to the ſurface is rendered impracticable. In this ſituation it becomes united with the perſpirable matter already confined there; and is, in the courſe of time, compelled by the progreſs of internal inflammation to make its way through the ſkin; upon which it at laſt appears in a variety of forms and different ſymptoms, aſſuming diſtinct degrees of malignancy, according to the ſtate, habit, and conſtitution of the ſubject at the time of attack.

Such, in ſubſtance, is Mr. Taplin's account of this diſorder. The indications of cure are, to reſolve the inflammatory crudities, remove cutaneous obſtruction, correct the acrimony of the blood, and gently quicken the circulation. The better to effect theſe, he directs to take away a moderate quantity of blood, that the impetus may be encouraged; to open the body with a few warm maſhes; and according to the mildneſs or inveteracy of its appearance, to give either two or three mercurial purges, compoſed of the following ingredients:

Barbadoes aloes, one ounce; jalap in powder, three drams; calomel, ſoap, and ginger in powder, of each two drams; with ſyrup of buckthorn ſufficient to make a ball.

The doſes muſt be given at proper intervals; and in three days after the laſt doſe, a courſe of alteratives muſt be entered upon, as follows.

Antimony levigated, and ſulphur, each half a pound; æthiops mineral and cream of tartar, each four ounces. Theſe are to be mixed well together, and divided into twelve equal parts of two ounces each, for twelve doſes; one of which muſt be given every night with the feed of corn; the latter being firſt ſprinkled with water, the better to retain the powders.

Theſe muſt be continued with the utmoſt punctuality for a month; and ſhould any trifling eſchars, ſcabs, or excoriations, prove obſtinate upon any part of the body, they may be waſhed with equal parts of lye (procured from the ſoap-boilers) and lime-water.

If in the courſe of a month no conſiderable advantage ſhould be produced by the above preſcriptions, the doſes muſt be gradually increaſed from two ounces to two and an half or more.

3. *Mange* is a diſtemper ſo univerſally known as to render a particular deſcription unneceſſary. It proceeds chiefly from poor feeding: hence it is very little ſeen amongſt horſes of any eſtimation; but is almoſt entirely confined to the ſtables of the lower claſs of people.

In a mangy horſe the ſkin is generally tawny, thick, and full of wrinkles, eſpecially about the mane, the loins, and tail; and the little hair that remains in thoſe parts ſtands almoſt always ſtraight out or briſtly; the ears are commonly naked and without hair, the eye and eye-brows the ſame; and when it affects the limbs, it gives them the ſame aſpect: yet the ſkin is not raw, nor peels off, as in the ſurfeit.

Where this is caught by infection, if taken in time it is very eaſily cured: and an ointment of ſulphur and tar is the moſt effectual for that purpoſe, rubbed in every day. To purify and cleanſe the blood, give antimony and ſulphur for ſome weeks after. There are a great variety of external remedies for this purpoſe, ſuch as train-oil and gunpowder, tobacco ſteeped in chamber lye, &c. but as good an application as moſt, is the citrine ointment. Soleyſel recommends the following, which has been well ſpoken of:

Take burnt alum and borax, in fine powder, of each two ounces; white vitriol and verdigris, powdered, of each four ounces; put them into a clean earthen pot, with two pounds of honey, ſtirring till they are incorporated; when cold, add two ounces of ſtrong aquafortis.

But when this diſorder, as is generally the caſe, is contracted by low feeding and poverty of blood, the diet muſt be mended, and the horſe properly indulged with hay and corn. With this view, there muſt be a conſtant ſupply of warm maſhes, prepared with half malt and half bran, or equal parts of oats and bran, with four ounces of honey diſſolved in each: let theſe be given night and morning, with a feed of dry corn every day at noon. During this treatment (which muſt be continued a week, to ſheathe the acrimony of the fluids, and ſoften the rigidity of the ſkin) give one ounce of ſulphur in each maſh, and one ounce of nitre in water every night and morning. In a week or ten days, when the frame becomes more invigorated, diſcontinue the maſhes, and let the diet be changed to good oats and ſweet hay; giving, in the morning and evening feeds, one of the following powders, intermixed with the corn firſt ſprinkled with water:

Sulphur and prepared antimony each a pound, rubbed well together in a mortar, and then divided into 24 equal parts for as many doſes.

Or, Antimony levigated, and ſulphur, of each 12 ounces; liver of antimony and cream of tartar, each half a pound.—Theſe to be mixed well together, and divided into the ſame number of doſes as the former.

As to the external treatment; previous to the commencement of the maſhes, procure a pail of warm water and a quarter of a pound of ſoft ſoap (tied up in a linen rag), and with this, forming a ſtrong lather, let every infected part be thoroughly waſhed and cleanſed, ſo that no ſcurf or filth be left upon the ſurface; then rub tenderly dry with a coarſe cloth or ſeparated haybands; and on the following morning begin to

rub in upon every part affected a due portion of the following ointment:

> Weak mercurial ointment, half a pound; quickfilver, four ounces; white hellebore (in powder) three ounces; black pepper (in powder) and oil of tartar, each one ounce; with olive oil fufficient to make it of a proper foftnefs.

The unction muft be repeated for feven days, ten days, or a fortnight, according to the urgency of the fymptoms; and let the powders before mentioned, with the nitre alfo, be continued for three weeks or a month. Laftly, as foon as the horfe appears in a condition to bear it, take away a moderate quantity of blood, and give him afterwards two very mild dofes of phyfic.

Sect. XVII. *Of the* Farcy.

The farcy is a diforder of the fkin and its blood-veffels; by which, when inveterate, the coats and integuments inflame and are fo thickened, that they become like fo many cords. At firft, one or more fmall round buds, like grapes or berries, fpring out over the veins, and are often exquifitely painful to the touch; in the beginning they are hard, but foon turn into foft blifters, which when broke difcharge a glairy or bloody ichor, and turn into very foul and ill-difpofed ulcers. In fome horfes it appears on the head only; in fome on the external jugular; in others on the plate-vein, and runs downwards on the infide of the fore-arm towards the knee, and very often upwards towards the brifket. In fome the farcy fhows itfelf on the hind-parts, about the pafterns, and along the large veins on the infide of the thigh, rifing upwards into the groin, and towards the fheath; and fometimes it makes its appearance on the flanks, and fpreads by degrees towards the lower belly, where it often becomes very troublefome.

When the farcy appears on the head only, it is not fo difficult of cure; efpecially when it is feated on the cheeks and fore-head: but it is more difficult when it affects the lips, the noftrils, the eyes, the glands under the jaws, and other foft and loofe parts, efpecially if the abforbents about the neck become corded. When it begins on the outfide of the fhoulder or hips, the cure is feldom difficult; but when the farcy arifes on the plate-vein, and that vein fwells much, and cords are to be felt there, and the glands under the arm-pit are affected, it is hard to cure; but ftill more fo when the crural veins withinfide of the thigh are corded, and befet with buds, which affects the kernels of the groin and the cavernous body of the penis. When the farcy begins on the pafterns or lower limbs, it often becomes very uncertain, unlefs a timely ftop is put to it; for the fwelling in thofe depending parts grows fo exceffively large in fome, and the limbs are fo much disfigured with foul fores, that fuch a horfe is feldom fit for any thing afterwards but the meaneft drudgery; but it is always a promifing fign, wherever the farcy happens to be fituated, if it fpreads no further. It ufually affects only one fide at a time; but when it paffes over to the other, it fhows great malignancy: when it arifes on the fpines, it is then for the moft part dangerous; and is always more fo to horfes that are fat and full of blood, than to thofe that are in a more moderate cafe. When the farcy is epidemical, as fometimes happens, it rifes on feveral parts of the body at once, forms nafty foul ulcers, and makes a profufe running of greenifh bloody matter from both noftrils; and foon deftroys the animal.

When the farcy makes its firft appearance on the head, it rifes on the cheeks and temples, and looks like a net-work, or fmall creeping twigs full of berries. Sometimes it inflames the eye, and fometimes little blifters or buds run along the fide of the nofe. It arifes often on the outfide of the fhoulder, running along the fmall veins with heat and inflammation; and fometimes a few fmall buds appear near the withers, and on the outfide of the hip. In all thefe appearances, the difeafe being fuperficial, is eafily conquered by the following method, when taken in time; for the fimpleft farcy, if neglected, may degenerate into the worft fort.

In this difeafe, when the horfe happens to be fat and full of blood, he fhould be bled. This always checks the inflammatory ftage of a farcy, but is of fmall fervice afterwards; and if a horfe is low in flefh, it proves injurious. After bleeding, let the horfe have four ounces of cream of tartar and lenitive electuary; which may be given every other day for a week; and then give nitre two ounces a-day for three weeks or a month, and anoint the buds or fwellings with the following ointment twice a-day:

> Take hogs lard, four ounces; oil of turpentine, two ounces; fugar of lead, half an ounce; white vitriol, powdered, two drams; mix them together in a gally-pot.

The buds fometimes by this method are difperfed, leaving only little bald fpots which the hair foon covers again. When they break and run, if the matter be thick and well digefted, they will foon be well: but in order to confirm the cure, and to difperfe fome little lumps which often remain for fome time on the fkin without hair, give the liver of antimony for a month; two ounces a-day for a fortnight, and then one ounce a-day for the other fortnight: by following this method, a farcy which affects the horfe but flightly, may be ftopped in a week or ten days, and foon after totally eradicated.

When the farcy affects certain parts which we have defcribed, the cure is more difficult; but let it always be attempted early; therefore, on the abforbents near the plate, thigh, or neck-veins appearing corded, bleed immediately on the oppofite fide, and apply the following to the part:

> Take oil of turpentine in a pint-bottle, fix ounces; oil of vitriol, three ounces; drop the oil of vitriol into the oil of turpentine, by little at a time, otherwife the bottle will burft; when it has done fmoking, drop in more oil of vitriol, and fo on till all is mixed.

This mixture is one of the beft applications in a beginning farcy that can be ufed; but where it is feated in loofe flefhy parts, as the flanks or belly, equal parts of the oil of vitriol and turpentine are neceffary. Rub the parts firft with a woollen cloth, and then apply fome of the mixture over the buds, and wherever there is any fwelling, twice a-day. Give the cooling phyfic every other day, and two or three ounces of nitre every day for fome time.

When the farcy begins on the flanks, or towards the lower belly, it often takes its rife from a fingle puncture of a fharp fpur. The pain and fmarting is one fure fign to diftinguifh the farcy from common accidents; the ftaring of the hair, which ftands up like a tuft all round the buds or blifters, and the matter that iffues from the buds, which is always purulent and of a clammy greafy confiftence, are other certain figns. After bathing with the liniment above mentioned till the ulcers are fmooth and healing, fhould the fwelling not fubfide, to prevent the fpreading of the buds, and to difperfe them, bathe with either of thefe mixtures as far as the centre of the belly; and at the fame time give a courfe of antimonials, as will prefently be prefcribed.

In the lower limbs the farcy lies fometimes concealed for a great while; and makes fo flow a progrefs, that it is often miftaken for greafe, or for a blow or kick, and goes by the general appellation of *a humour* fettled there. In order to diftinguifh the one from the other, we fhall obferve, that a kick or bruife is generally attended with a fudden fwelling, or a contufed wound, which for the moft part digefts eafily: the greafe is alfo a fmooth fwelling that breaks out above the bending of the pafterns backwards; but the farcy begins on the paftern joint ufually with one bud, and runs upwards like a knotty crab-tree.

Very fimple means have fometimes ftopped it, before it has

begun to ſpread; a poultice with bran and verjuice bound round the part, and renewed once a-day, will often alone ſucceed; and if excreſcences ariſe, touch them with oil of vitriol, or aquafortis, an hour before you apply the poultice; for when the diſtemper is local, as we ſuppoſe it here, it is to be conquered by outward applications.

The following balls are proper in every ſtate of the farcy; and when the diſtemper has been in its infancy, before the ſkin was much defaced, have often cured it in a week or two, by giving them only once or twice a day: but in an old farcy they ſhould be given for two or three months together.

Take of cinnabar of antimony, eight ounces; long birthwort and gum guaiacum powdered, of each four ounces: make into a paſte with honey, and form into balls of the ſize of a large walnut, and roll them in liquorice-powder.

The tedioufneſs of this courſe has encouraged the giving of mercurials, and introducing them into the blood, without operating on the ſtomach and bowels. To do this effectually, Mr. Barſlet obſerves, they muſt be given in ſmall quantities; and taken in this manner, they will mix gradually with the blood and juices, and operate both effectually and ſafely.

The knots and cords ſhould be rubbed with mercurial ointment, in order to diſperſe them. If they break, it will be right to dreſs the ſores with equal parts of Venice turpentine and quickſilver; if by theſe means the mouth ſhould become ſore, treat as above. This method ſeems to be promiſing, if proper care be taken.

The following is alſo recommended by the ſame writer:

Take butter of antimony and bezoar mineral, of each one ounce; beat up with half a pound of cordial ball: and give the bigneſs of a walnut, or three quarters of an ounce, every day for two or three weeks, faſting two or three hours after it.

The following mode of treatment and forms of medicine are preſcribed by Mr. Taplin. Upon the very earlieſt appearance of the diſorder, blood is to be taken away in ſufficient quantity. If the horſe is in high condition and full of fleſh, give him maſhes through the day of bleeding and the next day; and on the following morning a purging ball, compoſed of ſocotorine aloes, ten drachms; calomel and jalap (in powder) each two drachms and a half; rhubarb and ginger, of each a drachm and a half; with ſyrup of buckthorn or roſes, ſufficient to form the ball. Let the purge be carefully attended to, and duly worked off. If the phyſic works favourably, and ſets well, let his feed (if his appetite is keen) for four clear days be plentiful, and on the fifth or ſixth at fartheſt repeat his purging ball. If the attack has been violent, or the diſorder makes rapid progreſs, a third doſe muſt be given in like manner. In two days after the courſe is completed, it is directed to begin upon the following antimonial alteratives, aſſiſted by a regular adminiſtration of nitre; both to be continued a month without the moſt trifling intermiſſion:

Prepared antimony, one pound; common ſulphur, twelve ounces; cream of tartar, eight ounces; and cinnabar of antimony, ſix ounces:

Which being incorporated well in a mortar, is to be divided into twenty equal parts. Of theſe, one is to be given every night in the corn, firſt ſprinkling with water to inſure its adheſion, and two ounces of nitre are to be mixed with the water every morning, at which time he will generally drink it with the greater avidity as being moſt thirſty. The buds or ſwelling upon their firſt appearance may be well waſhed with the following twice every day, viz. with a lotion compoſed of extract of Saturn, two ounces; camphorated ſpirit of wine, eight ounces; and diſtilled vinegar, a pint; mixed well together, and kept cloſe ſtopped for uſe.

In a more advanced or inveterate ſtage of the diſtemper, moderate bleeding ſhould be repeated at proper intervals between the phyſic; and upon the ſcabs or eſchars peeling from the buds, waſh them well occaſionally with the following:

To two drachms of corroſive ſublimate diſſolved in half a pint of Britiſh brandy, add a pint of white-wine vinegar, half a pint of ſpring water, and two ounces of tincture of myrrh; ſhaking well together.

Or, ſugar of lead and white vitriol, each an ounce; diſtilled vinegar and ſpring water, each one pint; ſtyptic tincture, three ounces; well mixed together.

If the ulcers ſhould continue foul, and their edges become callous, very ſmall quantities of the ſtrong mercurial ointment muſt be gently rubbed into the centre of the moſt inveterate, once in three or four days, cleanſing them occaſionally with one of the waſhes before mentioned. In this caſe, one of the following balls muſt be given regularly every morning for a month, or longer if neceſſary. The proportion of nitre muſt be altered to three ounces, and given in the water every evening, the ball being adminiſtered in the morning.

Mercurial alterative Ball. Take æthiops mineral, four ounces; flowers of brimſtone, prepared antimony, cream of tartar, and cinnabar of antimony, each five ounces; honey, ſufficient to make a maſs; which divide into a dozen equal balls, and roll up in liquorice or aniſeed powder.

It may not be improper now to add the ſymptoms of an incurable farcy, that the owners of ſuch horſes may ſave themſelves unneceſſary expence and trouble in their endeavours to obtain a cure. When a farcy, by improper applications, or by neglect, has ſpread and increaſed, or after long continuance reſiſted the medicines above recommended; if freſh buds are continually ſprouting forth, while the old ones remain foul and ill-conditioned; if they riſe on the ſpines of the back and loins; if the horſe grows hide-bound, and runs at the noſe; if abſceſſes are formed in the fleſhy parts between the interſtices of the large muſcles; if his eyes look dead and lifeleſs; if he forſakes his food, and ſcours often, and his excrements appear thin and of a blackiſh colour; if the plate or thigh vein continue large and corded after frictions and other proper applications; theſe ſymptoms denote the diſtemper to have penetrated internally, and that it will degenerate into an incurable conſumption: it is moſt probable alſo that the whole maſs of fluids is tainted, and become irremediable by art.

Before cloſing this ſection, it is proper to take notice of what is called the *water-farcy*; which has no reſemblance to a true farcy either in its cauſe, ſymptoms, or effects, but has only obtained this name through cuſtom and ignorance.—This water-farcy, then, is nothing more than an œdema of the ſkin, which often happens in epidemical colds. In ſome caſes it appears more generally dropſical, and the water is not confined to the belly and limbs, but ſhows itſelf in ſeveral parts of the body by ſoft ſwellings yielding to the preſſure of the finger. This laſt kind uſually proceeds from foul feeding, or from the latter graſs. In the former caſe, we ſee the limbs and whole body enormouſly ſwell, and become very hard, the belly and ſheath greatly diſtended; yet theſe may be reduced by ſlight ſcarifications withinſide the leg and thigh with a ſharp penknife, and three or four ſtrokes on the ſkin of the belly on each ſide the ſheath. A few purges afterwards will generally complete his recovery. In both caſes the curative intentions are to diſcharge the water, and brace up the relaxed ſolids throughout the whole body. To this end purge once a-week or ten days; and give intermediately either of the following:

Take black hellebore, freſh gathered, two pounds; waſh, bruiſe, and boil it in ſix quarts of water to four; and then ſtrain out the liquor, and put two quarts of white-wine on the remaining hellebore, and let it infuſe warm

48 hours: then ſtrain off, mix both together, and give the horſe a pint night and morning.

Take nitre, two ounces; ſquills powdered, three drams or half an ounce; camphor, one dram; honey enough to form into a ball, to be given once a-day alone, or waſhed down with a horn or two of the above drink.

Sect. XVIII. *Of* Strains.

It uniformly happens, that in all ſtrains, the muſcular or tendinous fibres are overſtretched; and ſometimes ruptured or broke. Accidents of this kind which happen to the ligaments that connect the bones together, eſpecially thoſe of the thigh, require time, and turning out to graſs, for a perfect recovery. External applications can avail but little here, the parts affected lying too deep, and ſo ſurrounded with muſcles that medicine cannot penetrate to them. The ſooner, in theſe caſes, a horſe is turned out to graſs then, the better; as the gentle motion in the field will prevent the ligaments and ſynovia from thickening, and of courſe the joint itſelf from growing ſtiff.

When a horſe's ſhoulder is overſtrained, he does not put out that leg as the other; but, to prevent pain, ſets the ſound foot hardily on the ground to ſave the other; even though he be turned ſhort on the lame ſide, which motion tries him the moſt of any. When trotted in hand, inſtead of putting his leg forward in a right line, he forms a circle with the lame leg; and when he ſtands in the ſtable, that leg is advanced before the other.

In order to cure this lameneſs, firſt bleed him, and let the whole ſhoulder be well bathed three times a-day with hot verjuice or vinegar, in which is diſſolved ſome ſal armoniac; but if the lameneſs continues without ſwelling or inflammation, after reſting two or three days, let the muſcles be well rubbed for a conſiderable time, to make them penetrate, with good opodeldoc, or the following mixture:

Take camphorated ſpirit of wine, two ounces; oil of turpentine, one ounce; this proportion will not occaſion the hair to come off.

While the inflammation continues and the ſhoulder is very much ſwelled, it ſhould be fomented with woollen cloths (large enough to cover the whole) wrung out of hot verjuice; or a fomentation prepared with a ſtrong decoction of wormwood, bay-leaves, and roſemary in vinegar, may be uſed in its ſtead: or a poultice of bran and verjuice may be applied to the part.

A rowel in the point of the ſhoulder in this caſe often does great ſervice; eſpecially if the ſtrain has been very violent, and the ſwelling very large: but as to boring up the ſhoulder with a hot iron, and afterwards inflating it, it is both a cruel and abſurd treatment: and the pegging up the ſound foot, or ſetting on a patten ſhoe, to bring the lame ſhoulder on a ſtretch, is a moſt prepoſterous practice, and directly calculated to render a horſe incurably lame; for it can only be ſuitable in caſes the very oppoſite to this, where the muſcles are no longer in an inflamed ſtate, but have been long contracted, and we want to ſtretch them out.

Where poultices can be applied, they are at firſt undoubtedly very effectual, after bathing with hot vinegar or verjuice; and are to be preferred greatly to cold charges, which, by drying ſo ſoon on the part, keep it ſtiff and uneaſy: let them be prepared with oat-meal, rye-flour, or bran mixed up in vinegar, ſtrong beer or red-wine lees, without any lard or greaſe, as theſe prevent the proper effect of the poultice; and when by theſe means the inflammation and ſwelling are brought down, bathe the part twice a-day with the above mixture, opodeldoc, or camphorated ſpirit of wine; and roll the part three or four inches, both above and below, with a ſtrong linen roller of about two fingers width; which contributes not a little to the recovery, and perhaps is more to be depended on than the applications themſelves.

In ſtrains of the *coffin joint*, that have not been diſcovered in time, there will grow ſuch a ſtiffneſs in the joint, that the horſe will only touch the ground with his toe; and the joint cannot be played with the hand: the only method here is repeated bliſtering, and then firing ſuperficially.

Strains of the *back ſinews* are very common; and are eaſily diſcovered by the ſwelling, which extends ſometimes from the back-ſide of the knee down to the heel, but for the moſt part the horſe ſets that foot before the other. The tendon ſhould be well bathed three or four times a-day with hot vinegar; and if much ſwelled, apply the poultices above recommended; and when the ſwelling ſubſides, bathe with the mixtures above, or with camphorated ſpirit of wine and oil of amber, in which is diſſolved as much camphor as the ſpirits will take up; and roll up the part with a proper bandage or laced ſtocking; which laſt, properly fitted to the limb, might be worn to great advantage, not only in this ſort of injuries, but in moſt others, where there is a diſpoſition to the greaſe, or other ſwellings of the limbs, from weak and relaxed fibres. Curriers' ſhavings wetted with vinegar have been found uſeful for this purpoſe; as has alſo tar and ſpirit of wine: but where the tendons have ſuffered by repeated injuries of this kind, the caſe will demand bliſtering, firing, and proper reſt.

Strains of the *knees* and *paſterns* ariſe frequently from kicks or blows: if they are much ſwelled, apply the poultices firſt; and when the ſwelling is abated, bathe with the above, or the following:

Take vinegar, one pint; camphorated ſpirit of wine, four ounces; white vitriol diſſolved in a little water, two drams.

Or, Take the white of three or four eggs, beat them into a froth with a ſpoon; to which add an ounce of roch alum, finely powdered; ſpirit of turpentine and of wine, of each half an ounce; mix them well together.

As great weakneſs remains in the paſterns after violent ſtrains, the beſt method is to turn the horſe out to graſs till he is perfectly recovered; when this cannot be complied with, the general way is to bliſter and fire.

When a horſe is lame in the *ſtifle*, he generally treads on his toe, and cannot ſet the heel to the ground. Treat him at firſt with the vinegar and cooling reſtringents: but if a large ſwelling, with puffineſs, enſues, foment it well with the diſcutient fomentation till it diſperſes; and then bathe the part with any of the above medicines.

A lameneſs in the *whirl-bone* and hip, is diſcovered by the horſe's dragging his leg after him, and dropping backward on his heel when he trots. If the muſcles of the hip are only injured, this kind of lameneſs is cured eaſily; but when the ligaments of the joint are affected, the cure is often very difficult, tedious, and uncertain. In either caſe, at firſt bathe the parts well with the cooling remedies, four or five times a-day: in the muſcular ſtrain, this method alone may ſucceed; but in the ligamentous, it is reſt and time only can reſtore the injured parts to their proper tone.

Strains in the *hock* are to be treated by ſoking the parts with coolers and ſedatives; but when the ligaments are hurt, and they are attended with great ſwelling and pain, uſe the fomentation. If a hardneſs ſhould remain on the outſide, it may be removed by repeated bliſtering; if within, it may be out of the power of any external applications to remove: however, the joint ſhould be fired gently with ſmall razes or lines pretty cloſe together, and then covered with a mercurial plaſter. To the diſcutient fomentation above mentioned may be added crude ſal ammoniac, with a handful of wood-aſhes boiled in it.

The bliſtering ointment for the above purpoſes may be

found in the fection of *Bone-fpavin*; but the fublimate fhould be omitted.

The *firing*, fo generally ufed for the ftrengthening relaxed finews or tendons, is made to act upon different parts according to the different notions of the operator. Moft ufually it is intended to act only on the fkin, which, by contracting and hardening all round the finews, compreffes them more firmly like a bandage. The bowmen of old, it is alleged, fubmitted to this operation, in order to give ftrength to the mufcles and tendons of their arms. Upon this principle, a proper degree of fkill is very requifite to perform it effectually on a horfe; for a due medium fhould be obferved, and the inftrument neither fo flightly applied as to fcarify the fkin only fuperficially, nor fo deep as to wound or cauterife the finew or its fheath. The lines fhould be drawn pretty clofe together, on each fide of the joint or finew, following the courfe of the hair; no crofs lines fhould be made, as they but disfigure the horfe afterwards, without any real ufe. The firing inftrument, or knife, ought to be a little rounded on the edge, gradually thickening to the back, that it may retain the heat for fome time, but fhould not be applied till the flaming rednefs is partly gone off. The cauterized parts may be bathed with fpirit of wine at firft; and anointed afterwards with bees-wax and oil, which alone is fufficient to complete the cure. But, in every view, this operation deferves to be condemned, upon the following judicious obfervations of Ofmer. "Between the tendon and the fkin of the leg, as nothing intervenes but a thin membrane, what hand can determine betwixt the boundaries of thofe bodies, whofe appearance, by the heat of the iron, is made undiftinguifhable to the eye? Now mark the event of firing. If the fire reaches no further than the fkin, little advantage can accrue to the tendon, but the fibres of the fkin will be contracted and lefs pliant; if the fire reaches the membrane or fheath of the tendon, fome of its glands are deftroyed, and the tendon becomes more or lefs rigid. If the tendon be burnt, the confequence will be ftill worfe; and in either cafe the freedom of motion will be impeded: on all thefe occafions the horfe fhould be turned to grafs and indulged with proper reft, that the difeafed parts may recover their former firmnefs, tone, and ftrength."

Sect. XIX. *Of* Tumours, Abscesses, *and* Ulcers.

Tumours may arife either from external injuries or internal caufes.

1. Swellings caufed by external accidents, as blows and bruifes, fhould at firft be treated with reftringents: thus, let the part be bathed frequently with warm vinegar or verjuice, or with lead water; and, where it will admit of bandage, let a flannel wetted with the fame be rolled loofely on. If by this method the fwelling does not fubfide, apply, efpecially on the legs, a poultice of red wine lees, ftrong beer grounds, and oatmeal, or one with vinegar and oatmeal, alone, or with the addition of a little extract of lead. Either of thefe may be continued twice a-day, after bathing, till the fwelling abates; when, in order to difperfe it entirely, the vinegar fhould be changed for camphorated fpirit of wine, to four ounces of which may be added, one of fpirit of fal ammoniac; or it may be bathed with a mixture of two ounces of crude fal ammoniac diffolved in a quart of chamber-lye twice a-day, and rags dipped in the fame be rolled on.

Where there is inflammation, a fomentation made by wringing flannels out of boiling water, is of great fervice; efpecially if the injury has affected the joints. But in bruifes, where the extravafated blood does not readily difperfe, the fhorteft way is to open the fkin, and let out the coagulum.

Critical abfceffes, which terminate fevers, fhould by no means be difperfed; except when they fall on the paftern or coffin joints, fo as to endanger them: in this cafe difcutient fomentations fhould be applied three or four times a-day, and a cloth or flannel frequently wrung out of vinegar or verjuice, fhould be bound on, in order to keep the joint continually moift.

But all tumours tending to certain fuppuration, from whatever caufe they originate, fhould be expeditioufly affifted by fomentation as already directed; and, after each time of ufing the fomentation, the ripening fhould be encouraged by fuppurating poultices wherever they can be applied. It may anfwer this purpofe to employ the poultice recommended in the fection on *Strangles*. Thefe applications muft be regularly continued till the matter is perceived to fluctuate under the fingers, when it ought to be let out by a free incifion made in the fofteft and moft depending part of the tumour.

Pledgets of tow or lint fhould then be applied alone, but afterwards fpread with black or yellow bafilicon, and dipped in the fame, melted down with a fifth part of oil of turpentine. Thefe fhould be applied to the bottom of the fore, and filled up lightly with lint, without cramming. It may be thus dreffed once or twice a-day, if the difcharge is great, till a proper digeftion is procured. But if the cavity does not fill up kindly, this fhould be changed for pledgets fpread with the red precipitate ointment, applied in the fame manner.

Should the fore not digeft kindly, but run a thin water and look pale, foment, and apply over your dreffing the ftrong-beer poultice, and continue this method till the matter grows thick, and the fore florid.

The following ointments will generally anfwer in all common cafes; and may be prepared either with or without the verdigreafe:

Take Venice turpentine and bees-wax, of each a pound; olive oil, one pound and a half; yellow rofin, 12 ounces; when melted together, two or three ounces of verdigreafe, finely powdered, may be ftirred in, and kept fo till cold, to prevent its fubfiding.

Take of yellow bafilicon, or the above ointment, without verdigreafe, four ounces; red precipitate, finely levigated, half an ounce: mix them together cold with a knife or fpatula.

Wounds that look florid and fill up favourably whilft dreffed with lint, will probably need no other application. If you drefs too long with digeftives, the flefh will rife faft, and if the fore is on a part where bandages cannot be applied, with compreffes of linen cloth, thefe methods will be neceffary to keep the granulations down, and to encourage the growth of the fkin. The popular notion refpecting *proud flefh* in healthy wounds, is a mifchievous and vulgar error, which has led, both in the human and brute fubject, to an abfurd and cruel practice of employing efcarotic and cauftic dreffings where they were not neceffary.

We then obferve here, once for all, that the cure of moft fores is effected by the fimpleft methods; and that it is often of much more confequence to know how to drefs a fore, than what to drefs it with. And in this confifts indeed the chief art of this branch of furgery: for the moft eminent in that profeffion have long fince difcovered, that variety of ointments and falves are unneceffary in the cure of moft wounds and fores; and they have accordingly difcarded the greateft part formerly in repute for that purpofe; repeated obfervations having taught them, that, after all obftacles are removed, nature is generally difpofed to heal up the wound faft enough herfelf.

On the other hand, if a hollow wound or fore be crammed with tents, or if the dreffings are applied too hard, the tender fhoots of flefh from the bottom are prevented pufhing up; and the fides of the fore, from this diftenfion, may in time grow horny and turn fiftulous. Hence we may juftly conceive how little ftrefs is to be laid on famous ointments if unfkilfully ap-

plied; for, unlefs this due medium is obferved in the manner of dreffing, no fore can heal up favourably.

As foon as a good digeftion is procured (which is known by the thicknefs and whitenefs of the matter difcharged, and the florid red colour at the bottom of the fore), the fore may be covered fuperficially with dry lint alone; and when the flefh has rifen to a level with the furrounding edges, pledgets may be applied dipped in lime-water, with a little honey, tincture of myrrh, or brandy, about a fifth part of the latter articles to one of the lime-water; and by this means the healing of the ulcer will be promoted.

3. *Scrofulous tumours* are fuch as originate in fcorbutic or hereditary taints, and increafe or diminifh according to the ftate or acrimony of the blood. For thefe the principal application is the ftrongeft mercurial unguent, thus prepared:

> Quicksilver, two ounces; lard, fix ounces; balfam of fulphur, half an ounce. The quickfilver to be rubbed with the balfam in a metal mortar till the globules difappear; then the lard (firft made warm) to be added by degrees.

The ufe of this unguent muft be affifted by a courfe of mercurial and antimonial alteratives.

3. The other tumours that may be here noticed are the *fteatomatous*, and *encyfted*. Encyfted tumours are fuch as originate in a cyft or bag, containing a kind of ichor or gelatinous fluid, which being evacuated, the cyft does not always fubmit to digeftives or efcharotics, but muft be extirpated with the knife, and cured as a common wound.

The fteatomatous are thofe tumours that form under the fkin on different parts, and pafs in general under the denomination of *wens*, though in fact they alfo are cyfts, containing, when opened, a fubftance not unlike fuet when hardly cold.

Neither of the above are expected to fubmit to any topical application, unlefs upon the very firft obfervation; when an attempt may be made by a fmall portion of the above mercurial ointment rubbed in every night, for a confiderable length of time; but no radical cure can be in general obtained but by extirpation, which generally fucceeds if well performed, and the wound be afterwards treated rationally. A feton is a good remedy for the cure of encyfted tumours of confiderable fize. It fhould be paffed quite through, from the higheft to the loweft part, and fuffered to remain till the fides of the cyft are united, after which it fhould be withdrawn.

Sect. XX. *Of* Wounds *in General.*

In all frefh wounds made by cutting inftruments, there is nothing more required than bringing the lips of the wound into contact by future, or a bandage, provided the part will allow of it; for on wounds of the hips, or other prominent parts, and acrofs fome of the large mufcles, the ftitches are apt to burft on the horfe's lying down and rifing up in the ftall. In fuch cafes, the lips fhould not be brought clofe together: one ftitch is fufficient for a wound two inches long: but in large wounds, they fhould be at an inch or more diftance; and if the wound is deep in the mufcles, care fhould be taken to pafs the needles proportionably deep, otherwife the wound will not unite properly from the bottom.

Should the wound bleed much from an artery divided, the firft ftep fhould be to fecure it, by paffing a crooked needle underneath, and tying it up with a waxed thread: if the artery cannot be got at this way, apply a button of lint or tow to the mouth of the bleeding veffels, dipped in a ftrong folution of blue vitriol, ftyptic water, oil of vitriol, or oil of turpentine, powdered vitriol, or colcothar, &c. and remember always to apply it clofe to the mouth of the bleeding veffels, and take care that it is kept there by proper comprefs and bandage till an efchar is formed; otherwife it will bleed again.

In a memoir prefented to the Royal Academy of Sciences by M. La Foffe, he gives an account of the fuccefs he had met with in ftopping the bleedings of very confiderable arteries in horfes, by the application of the powder of puff-balls, the arteries cicatrizing by this means only, without any fucceeding hemorrhage. The lycoperdon, or *Puff*-ball, was made ufe of for this purpofe in human fubjects, about 170 years ago, by Felix Wurtz, a famous old furgeon in Germany; but he does not feem to have thought of trufting to it in fuch confiderable arteries as M. La Foffe mentions, *viz.* thofe of the leg and thigh, the bleedings from which divided veffels he ftopped in a few minutes by the ufe of this powder only. The agaric of the oak may alfo be ufed for this purpofe, where it can be retained by a proper bandage.

Thefe applications, as indeed all ftyptics, feem to act by conftringing the extremity of the veffel, or choking it up, till a clot of blood is formed internally, which plugs up the orifice; and has been found to adhere to it fo as to conftitute one body with the veffel.

We avoid fetting down any famous receipts for frefh wounds, whether infallible ointments, or balfams, being well affured, that, in a healthy found conftitution, nature furnifhes the beft means of cure, though that is often attributed to the medicine. The lips of the wound then being brought together by the needle, or, what is better, by a bandage, it needs only to be covered with dry lint, or a pledget of fine tow; obferving the directions ftated in the preceding remarks, and keeping the wounded part as much as poffible from motion.

Wounds by puncture from thorns, or any other thing, fhould be treated in the fame manner; applying a fimple poultice over the part, till fome figns of digeftion appear; and fomenting the part well every day. This method is alfo very fuccefsfully ufed to thofe fwellings which often arife on the neck from an inflammation of the vein after bleeding.

In *gun-fhot* wounds, when the ball has not penetrated too deep, it fhould be extracted, if it can be fetched away without difturbance, together with any extraneous bodies that may have paffed in with it; the wound fhould be dreffed with dry lint, and a poultice made with lead-water, rye meal and bran. The horfe fhould alfo be bled and have cooling purges given him. This practice would fave nine-tenths of the number of military horfes that are loft after a battle. It is the vile practice of our common farriers to widen the wound, ftuff tents into it, and pour in plenty of oil of turpentine, &c. in confequence of which, inflammation and mortification come on, and death enfues of courfe.

In fcalds, or burns from gunpowder, or any other caufe, when the fkin remains entire, bathe the part well, and keep it foaked with rags dipped in fpirit of wine and camphor. Lead water bound on the part has been found very effectual for this purpofe; and indeed all faline and fpirituous applications excel others, while the fkin is yet unbroke; but when the fkin is feparated, anoint the part, and keep it conftantly fupple with linfeed oil and lime-water. Should the horfe be feverifh from the pain, bleed him, give cooling clyfters, and treat him as we have directed in fimple fevers.

There are certain wounds which occur much more frequently than any other, and which from that circumftance, though in themfelves not at all dangerous, deferve particular notice. Among thefe are broken knees, over-reaches, and lacerations between hair and hoof. In refpect to the firft, it is a misfortune, whenever it happens, that not only reduces the horfe very much in his value, but is confidered as an indelible ftigma of imperfection. This misfortune may fometimes be occafioned by unavoidable accident; but Mr. Taplin is juftly of opinion, that more horfes are thrown down and irremediably injured by the careleffnefs and fhameful inattention of bad riders on bad

roads, or when they are more cruelly exhaufted with labour and fatigue, than by any other means in the whole lift of accidents.

In relieving broken knees, the firft ftep is to wafh the parts well with a fponge and warm water, thoroughly cleanfing the lacerations from gravel or fand: for thefe will certainly irritate and inflame the tender parts, and be productive of a difcharge, which may often be entirely prevented by gently wiping them dry after the ufe of the fponge, and embrocating them with a lotion compofed of a fpoonful of extract of lead to a pint of water, bandaging over a pledget of tow wet with the fame, and repeating it once or twice if circumftances fhould render it neceffary. This fhould be continued, that an efchar or cicatrix may be formed to render unctuous or greafy applications unneceffary; but fhould the wound or laceration be fo violent as to produce great inflammation, fuppuration muft enfue. As to *over-reaches* and other injuries in the feet, they are treated of in their order, under *Difeafes of the Feet*.

What has been obferved in this fection is fufficient to point out what ought to be done in the cafe of a fimple *ulcer*. All *finufes*, or cavities, that happen in ulcers of a more complicated kind, if no tendinous parts intervene, fhould be inftantly laid open to their utmoft extent, and properly filled with pledgets of lint. They may be afterwards dreffed with warm digeftive, and after a fecond or third dreffing, fhould the infide of the cavity prove callous, or hard in fubftance, it muft be taken away by the knife, or deftroyed by the means before defcribed. If it be fo fituated that the parts forbid an entire feparation, found with the probe, and at its extremity make a counter incifion through the integuments to meet the probe, till, by paffing through, it removes any lodgement that may have been left for the matter to corrode, which it will very foon do, fo as in many cafes to affect the bone itfelf.

Where the cavity penetrates deep into the mufcles, and a counter opening is impracticable or hazardous, liquids may be injected, and will frequently be attended with fuccefs. The following is particularly recommended by Mr. Taplin:

Take honey and vinegar, each two ounces; liquefy over the fire; and when cool, add tincture of myrrh and tincture of cantharides, each one ounce.

When the ulcer is by thefe means divefted of its virulence and bad fmell, the callofity floughed off or extracted, and a favourable appearance of granulation comes on, the dreffings may be changed, from the precipitate digeftive before prefcribed, to pledgets fpread with fimple digeftive.

Thefe finufes, or cavities, frequently degenerate into *fiftulæ*, that is, grow pipy, having the infide thickened, and lined, as it were, with a horny callous fubftance. In order to their cure, they muft be laid open, and the hard fubftance all cut away; where this is impracticable, fcarify them well, and apply red precipitate, butter of antimony, or equal parts of quickfilver and aquafortis, fo as to bring on digeftion.

When a foul bone is an attendant of an ulcer, the flefh is generally loofe and flabby; the difcharge oily, thin, and ftinking; and the bone difcovered to be carious, by its feeling rough to the probe paffed through the wound for that purpofe. In order to produce a cure, the bone muft be laid bare, that the rotten part of it may be removed; after which, drefs with dry lint. The throwing off the fcale is generally a work of nature, which is effected in more or lefs time, and in proportion to the depth the bone is affected; but burning the foul bone with a red-hot iron is one means of haftening its feparation.

Where the cure does not properly fucceed, mercurial phyfic fhould be given, and repeated at proper intervals: and to correct and mend the blood and juices, the antimonial and alterative powders, with a decoction of guaiacum and lime-water, are proper for that purpofe.

Sect. XXI. *Of a* Bone-Spavin.

Without entering at all into the caufe of this diforder, which is a bony excrefcence, or hard fwelling, growing on the infide of the hock of a horfe's leg, we fhall content ourfelves with defcribing the different kinds thereof by their fymptoms, and then fpeak of the cure.

A fpavin, that begins on the lower part of the hock, is not fo dangerous as that which puts out higher, between the two round proceffes of the leg-bone; and a fpavin near the edge is not fo bad as that which is more inward toward the middle, as it does not fo much affect the bending of the hock.

A fpavin that comes by a kick or blow is at firft no true fpavin, but a bruife on the bone, or membrane which covers it; therefore not of that confequence as when it proceeds from a natural caufe: and thofe that put out on colts and young horfes, are not fo bad as thofe that happen to horfes in their full ftrength and maturity; for in very old horfes they are generally incurable.

The ufual method of treating this diforder is by blifters and firing; without any regard to the fituation, or caufe whence it proceeds. Thus, if a fulnefs on the fore-part of the hock comes upon hard riding or any other violence, which threatens a fpavin; in that cafe, fuch coolers and repellers are proper, as are recommended in ftrains and bruifes. Thofe happening to colts and young horfes are generally fuperficial, and require only the milder applications; for it is better to wear them down by degrees, than to remove them at once by fevere means.

Various are the prefcriptions for the bliftering ointment; but the following, on proper experience, has been found to anfwer, and ftands well recommended:

Take hogs lard and marfh mallow ointment, of each two ounces; quickfilver, one ounce, thoroughly reduced with an ounce of Venice turpentine; Spanifh flies powdered, a dram and a half; fublimate, one dram; oil of origanum, two drams.

The hair is to be cut as clofe as poffible, and then the ointment applied pretty thick over the part; this fhould be done in the morning, and the horfe kept tied up all day without any litter till night; when he may be untied, in order to lie down; and a pitch or any fticking plafter may be laid over it, and bound on with a broad tape or bandage to keep all clofe.

After the blifter has done running, and the fcabs begin to dry and peel off, it may be applied a fecond time, in the fame manner as before: this fecond application generally taking greater effect than the firft, fometimes in colts and young horfes makes a perfect cure.

When the fpavin has been of long ftanding, it will require to be renewed, perhaps five or fix times: but after the fecond application, a greater diftance of time muft be allowed, otherwife it might leave a fcar, or caufe a baldnefs; to prevent which, once a-fortnight or three weeks is often enough; and it may in this manner be continued fix or feven times, without the leaft blemifh, and will generally be attended with fuccefs.

But the fpavins that put out on older or full-aged horfes are apt to be more obftinate, as being feated more inward; and when they run towards the cavity of the joint, they are for the moft part incurable, as they then lie out of the reach of applications, and are arrived to a degree of inveteracy for which there is no remedy.

The ufual method in thefe cafes is to fire directly, or to ufe the ftrongeft kind of cauftic blifters; and fometimes to fire and lay the blifter immediately over the part: but this way feldom fucceeds farther than putting a ftop to the growth of the fpavin, and is apt to leave both a blemifh and ftiffnefs behind; befides the great rifk run (by applications of thefe fiery and cauftic medicines to the nervous and tendinous parts about the

joints) of exciting violent pain and anguiſh, and deſtroying the limb.

The beſt and ſafeſt way, therefore, is to make trial of the bliſtering ointment above, and to continue it according to the directions there laid down, for ſome months, if found neceſſary; the horſes in the intervals working moderately: the hardneſs will thus be diſſolved by degrees, and wear away inſenſibly.

Where the ſpavin lies deep, and runs ſo far into the hollow of the joint that no application can reach it, neither firing nor medicines can avail, for the reaſons above mentioned; though bold ignorant fellows have ſometimes ſucceeded in caſes of this ſort (by men of judgment deemed incurable) by the application of cauſtic ointments with ſublimate, which act very forcibly, enter deep, and make a large diſcharge, and by that means deſtroy ſome of the ſubſtance, and diſſolve away the remainder. But, whoever is acquainted with the nature of theſe medicines, muſt know how dangerous in general their operation is on theſe occaſions; and that a proper prepared cautery, made like a fleam, under the direction of a ſkilful hand, may be applied with leſs danger of injuring either tendons or ligaments. After the ſubſtance of the ſwelling has been properly penetrated by the inſtrument, it muſt be kept running by the precipitate medicine, or mild bliſtering ointment. Where the ſpavin lies not deep in the joint, and the bliſtering method will not ſucceed, the ſwelling may be ſafely fired with a thin iron forced pretty deep into the ſubſtance, and then ſhould be dreſſed as is above directed.

Sect. XXII. *Of a* Curb *and* Ring-bone.

1. As a ſpavin riſes among the bones on the fore-part of the hock, ſo a *curb* takes its origin from the junctures of the ſame bones, and riſes on the hind-part, forming a pretty large tumour over the back part of the hind-leg, attended with ſtiffneſs, and ſometimes with pain and lameneſs.

A curb proceeds from the ſame cauſe that produces ſpavins; viz. hard riding, ſtrains, blows, or kicks. The cure at firſt is generally eaſy enough effected by bliſtering, repeated two or three times, or oftener. If it does not ſubmit to this treatment, but grows exceſſively hard, the quickeſt and ſureſt way is to fire with a thin iron, making a line down the middle from top to bottom, and drawing ſeveral lines in a penniform manner pretty deep; and then to apply a mild bliſtering plaſter or ointment over it. This method will often entirely remove it.

There is another ſwelling taken notice of on the outſide of the hock, which is called a *jarden*. This commonly proceeds from blows and kicks of other horſes; but frequently happens to maneged horſes, from ſetting them on their haunches. It is ſeldom attended with much lameneſs, unleſs it has been neglected, or ſome little proceſs of the bone be broke. It ſhould firſt be treated with the coolers and repellers already ſpoken of; but if any ſwelling continues hard and inſenſible, the beſt way is to bliſter or fire; but the mild bliſters alone generally ſucceed.

2. The *ring-bone* is a hard ſwelling on the lower part of the paſtern, which generally reaches half way round the fore-part, and from its reſemblance to a ring has its denomination. It often ariſes from ſtrains, &c.; and, when behind, from putting the horſe too early upon his haunches; for in that attitude a horſe throws his whole weight as much, if not more, upon his paſterns, than on his hocks.

When it appears diſtinctly round the paſtern, and does not run downwards to the coronet, ſo as to affect the coffin-joint, it is eaſily cured: but if it takes its origin from ſome ſtrain or defect in the joint originally, or if a calloſity is found under the round ligament that covers that joint, the cure is generally dubious, and ſometimes impracticable; as it is apt to turn to a quittor, and in the end to form an ulcer upon the hoof.

The ring-bones that appear on colts and young horſes, will often inſenſibly wear off of themſelves, without the help of any application; but when the ſubſtance remains, there needs no other remedy beſides bliſtering, unleſs when by long continuance it is grown to an obſtinate hardneſs, and then it may require both bliſtering and firing.

To fire a ring-bone ſucceſsfully, let the operation be performed with a thinner inſtrument than the common one, and let the lines or razes be made not above a third of an inch diſtant, croſſing them obliquely, ſomewhat like a chain: apply a mild bliſter over all, and, when quite dried up, a ſtimulating plaſter; and then turn the horſe to graſs for ſome time.

Sect. XXIII. *Of* Splents.

These are hard excreſcences that grow on the ſhank-bone, and are of various ſhapes and ſizes. Some horſes are more ſubject to ſplents than others; but young horſes are moſt liable to them, though they will often wear off and diſappear of themſelves. Few horſes put out ſplents after they are ſeven or eight years old, unleſs they meet with blows or accidents.

A ſplent that ariſes in the middle of the ſhank-bone is nowiſe dangerous; but thoſe that ariſe on the back part of this bone, when they grow large and preſs againſt the back ſinew, always cauſe lameneſs or ſtiffneſs, by rubbing againſt it: the others, except they are ſituated near the joints, ſeldom occaſion lameneſs.

As to the cure of ſplents, the beſt way is not to meddle with them, unleſs they are ſo large as to disfigure a horſe, or are ſo ſituated as to endanger his going lame.

Splents in their infancy, and on their firſt appearance, ſhould be well bathed with vinegar, or old verjuice; which, alone, will often put a ſtop to their growth: for the membrane covering the bone, and not the bone itſelf, is here thickened. In ſome conſtitutions purging, and afterwards diuretic drinks, will be requiſite.

Various are the remedies preſcribed for this diſeaſe: the uſual way is to rub the ſplent with a round ſtick or the handle of a hammer till it is almoſt raw, and then touch it with oil of origanum. Others lay on a pitch-plaſter, with a little ſublimate or arſenic, to deſtroy the ſubſtance; ſome uſe oil of vitriol; ſome tincture of cantharides: all which methods have at times ſucceeded; only they are apt to leave a ſcar, with the loſs of hair. Thoſe applications that are of a more cauſtic nature often do more hurt than good, eſpecially when the ſplent is grown very hard, as they occaſion a ſore, which keeps running ſeveral months before the ulcer can be healed, and then leaves an ugly ſcar.

According to Mr. Taplin, the only expectation of cure, "without anxiety and difficulty, is to be careful in obſerving ſuch appearances in their earlieſt ſtate; and then ſeeing that frequent friction is uſed for a conſiderable time, twice every day, with the utmoſt force of the operator's hands, letting the part be well moiſtened, after each time of rubbing, with a proportion of the following liniment, leaving a pledget of tow wet with the ſame, bound on pretty firm with two yards of wide tape as a roller:

"Take camphorated ſpirits of wine, and ſpirits of turpentine, of each four ounces (a quarter of a pint). Mix together.

"Or, Oil of origanum and ſpirits of turpentine, each half an ounce; camphorated ſpirits of wine, two ounces. Mix.

"When this plan has been perſevered in for ten days or a fortnight, you will then be able to judge whether any perceptible advantage has been obtained from the force of theſe power-

ful repellents: if not, procure two ounces of the ſtrongeſt mercurial ointment, and let the ſize of a hazel-nut be well rubbed in upon the part affected, every night and morning, till the whole is conſumed, uſing the roller each night, and taking it off in the morning. If this does not ſucceed, the beſt and moſt ſpeedy method will be the immediate extirpation, by making a longitudinal inciſion (' without bruiſing, hammering,' &c.) through the integuments, diſſecting and extracting the ſubſtance, completing the cure by taking up a couple of ſtitches, and treating it as a ſuperficial wound; for which directions will be found under that head."

Sect. XXIV. *Of the* Poll-evil; Fistula, *and* Bruises *on the* Withers; Warbles *on the* Back, *and* Sitfasts.

1. The *poll-evil* is an abſceſs near the poll of a horſe, formed in the ſinuſes between the poll-bone and the uppermoſt vertebra of the neck. If it proceeds from a blow or any external violence, at firſt bathe the ſwelling often with warm vinegar; and if the hair be fretted off with an oozing through the ſkin, make uſe of two parts of vinegar and one of ſpirit of wine; but if there be an itching, with heat and inflammation, the ſafeſt way is to bleed, and apply poultices with bread, milk, and elder flowers: this method, with the aſſiſtance of phyſic, will frequently diſperſe the ſwelling and prevent this evil.

But when the tumour is critical, and has all the ſigns of matter, the beſt method then is to forward it by applying the ripening poultices already taken notice of, till it comes to maturity, and burſts of itſelf; or if opened with a knife, great care ſhould be taken to avoid the tendinous ligament that runs along the neck under the mane: when matter is on both ſides, the opening muſt be made on each ſide, and the ligament remain undivided.

If the matter flows in great quantities, reſembles melted glue, and is of an oily conſiſtence, it will require a ſecond inciſion, eſpecially if any cavities are diſcovered by the finger or probe; theſe ſhould be opened by the knife, the orifices made depending, and the wound dreſſed with the common digeſtive of turpentine, honey, and tincture of myrrh, and, after digeſtion, with the precipitate ointment; or inject the following, made warm:

Vinegar, or ſpirit of wine, half a pint; white vitriol, diſſolved in ſpring water, half an ounce; tincture of myrrh, four ounces.

This may be made ſharper by adding more vitriol. With this waſh alone Mr. Gibſon has cured this diſorder without any other formality of dreſſing, waſhing with it twice a day, and laying over the part a quantity of tow ſoaked in vinegar and the white of eggs beat together.

The lateſt practice however in the cure of the poll-evil, and certainly the beſt, is that of paſſing a ſeton through the cavity, in ſuch a way as to make a depending opening; and this will generally cure without any other remedy.

2. *Bruiſes* on the *withers* frequently ſuppurate, and for want of care turn fiſtulous. They ariſe often from pinches of the ſaddle, and ſhould be treated with repellers: for this purpoſe bathe the tumour well with hot vinegar three or four times a day; if that does not ſucceed alone, an ounce of oil of vitriol may be put to a quart of vinegar, or half an ounce of white vitriol diſſolved in a little water, and added to the ſame quantity. Theſe are generally held as very effectual repellers for this purpoſe in horſes, and will frequently prevent impoſthumation: when the ſwelling is attended with heat, ſmarting, and little hot watery pimples, the following mixture will then be more proper to bathe with:

Take two ounces of crude ſal-ammoniac, boiled in a quart of lime-water; where that cannot be had, a handful of pearl or wood aſhes may be boiled in common water: pour off the decoction when ſettled, and mix with it half a pint of ſpirit of wine: anoint the part afterwards with linſeed oil, to ſoften and ſmooth the ſkin.

But when the ſwellings are critical, the conſequence of a fever ſettled on this part, you muſt avoid the repelling method, and aſſiſt in bringing the ſwelling to matter, by means of ſuppurating poultices: experienced farriers adviſe, never to open theſe tumours, but let them break of themſelves: for, if they are opened before they are ripe, the whole ſore will be ſpongy, and diſcharge a bloody ichor, which ſoon degenerates into a ſordid ulcer. But take care to enlarge the openings, and dilate the lips, that your dreſſings may be applied eaſily; and avoid the ligament which runs along the neck to the withers: if a gathering forms on the oppoſite ſide, open it in the ſame manner; but take care they incline downwards, for the ſake of depending orifices, and letting the matter flow off eaſily. For the method of dreſſing, we muſt refer to the former part of this Section; and if the bones ſhould be found foul, they muſt be dreſſed with the tincture of myrrh till they ſcale off. If the fungus is very troubleſome, and the diſcharge oily, yellow, and viſcid, pledgets ſoaked in the following, made hot, have been found very effectual, bathing the ſwelling round with ſpirit of wine and vinegar:

Take half an ounce of blue vitriol, diſſolved in a pint of water; oil of turpentine, and rectified ſpirit of wine, of each four ounces; white-wine vinegar, ſix ounces; oil of vitriol and Ægyptiacum, of each two ounces.

When the cavities are truly fiſtulous, the calloſities muſt be cut out, where it can be done, with a knife; and the remainder deſtroyed by corroſives, as red precipitate, &c.

3. *Warbles* are ſmall hard tumours under the ſaddle-part of the horſe's back, occaſioned by the heat of the ſaddle in travelling, or its uneaſy ſituation. As ſoon as the ſaddle is taken off after a ſevere chaſe or hard journey, a good groom or hoſtler will be very minute in his examinations to diſcover whether an injury has been ſuſtained in this part or any other. He will inſtantly perceive, by the horſe's wincing, whether there is any bruiſe from which a warble may ſpeedily enſue; if ſo, upon the firſt appearance, or earlieſt diſcovery, bathe three or four times a-day with the following repellent:

Extract of Saturn, half an ounce; camphorated ſpirit of wine, two ounces; ſoft water, a quarter of a pint: the extract and ſpirit ſhould be well mixed by ſhaking, before adding the water.

4. A *ſit-faſt* proceeds generally from a warble, and is the horſe's hide turned horny or callous. In ſome little time the hair comes off, and it exhibits the appearance of a foreign ſolid ſubſtance, fixed in the centre of what ſeems to be a ſuperficial wound. For this ſimple and very trifling complaint there is but one certain and expeditious cure, namely, *extirpation*; which may be performed with a common penknife. But the moſt ready and leaſt painful method of taking it off is by juſt raiſing either edge till it can be taken hold of with a pair of common pincers; when, by leaning them to any ſide, you have an immediate fulcrum, or lever, and ſeparate it with a knife, with little pain or inconvenience. After the extirpation, it may be treated as a ſimple ſuperficial wound, and may in general be healed by a ſlight application of Friar's balſam, tincture of myrrh, or even with a little common brandy. Due care, however, ſhould always be taken to guard the cicatrix in its infancy, and prevent the buckle of the girth from coming into direct contact with the injured part, not only till the ſurface is ſufficiently hardened to render a repetition unlikely, but upon all future occaſions.

The foregoing treatment of tumours, however, has been condemned, and a more ſimple method by means of ſetons recom-

mended, by that judicious practitioner Mr. Clark of Edinburgh. "The common method (fays he) of treating thofe large tumours which are feated on the upper part of the neck, immediately behind the ears, generally known by the name of the *poll-evil*, and thofe which are feated on the withers or the upper parts of the fhoulders, is exceedingly improper. They are either allowed to break of themfelves, or are opened the whole length of the tumour on the upper part. In this fituation, efpecially in the poll-evil, when the head is always kept in an erect pofition, the matter contained in the tumour cannot be difcharged from it, but is retained in the bottom of the wound, and expofed to the external air, &c. it foon acquires a moft ichorous corroding quality, and produces one of the largeft and the moft fordid fiftulous ulcers that horfes are infefted with: a great quantity of fungous or proud flefh is foon produced; this requires to be repeatedly extirpated with the knife, the lofs of which cannot be again fupplied; hence the horfe is greatly disfigured, the cure becomes both tedious and uncertain, and is feldom radical. In fome cafes, I have known the vertebræ of the neck affected by the fharpnefs of the confined matter, forming lodgments there, and, after great trouble and expence, the horfes were put to death.

"All thefe kinds of tumours, &c. are eafily and fpeedily difcuffed by the ufe of fetons, without any lofs of fubftance, or disfiguring of the parts, and cured with the greateft certainty when the operation is properly performed. Of a number of cafes, in my practice, where this operation has fucceeded with great expedition in curing thefe tumours, I fhall only mention the following:

"About fix years ago, an Arabian horfe, belonging to a gentleman in this place, had a large tumour feated a little on one fide of the withers, or upper part of the fhoulder; it was forwarded by applying emollient poultices; and as foon as the matter was perceived to fluctuate in the tumour, a large feton needle, armed with a cord at the other end, was introduced at the upper part of the fwelling, and brought out at the under or lowermoft part of it; the matter was difcharged at the lower orifice in a very fhort time, the tumour was by that means foon difcuffed, and, in a few weeks, it was entirely healed up, without any fcar or blemifh remaining, farther than a little baldnefs about the lower orifice, occafioned by the fharpnefs of the matter, which likewife foon difappeared, and not the leaft trace of the diforder remained.

"The other cafe happened about feven years ago: A coach-horfe (belonging to a nobleman in the neighbourhood) had a large tumour a little behind the ears, on the neck, which I have formerly obferved is called the *poll-evil*; the tumour extended to both fides of the neck, and was divided in the middle by the mane; the tumour had been opened on one fide, in a very fuperficial manner, by a farrier in the country, before the matter in it was fufficiently digefted; after applying a few emollient poultices, in order to ripen it, a ftrong feton needle was introduced at the upper part of it, almoft clofe to the mane, and after paffing it through the bottom of the tumour, which was very deep, the needle was brought out through the found mufcular parts below the tumour, in order to procure a floping or depending orifice for the matter to run freely off. The fame operation was likewife performed on the oppofite fide, beginning near the mane, and finifhed in the fame manner. In a few weeks the cure was completed. The horfe ran for feveral years in the fame nobleman's carriage, without the fmalleft veftige of his former diforder.

"From this method of treating thefe tumours, together with the ufe of alterative medicines, &c. which in cafes of this nature ought never to be omitted, they were entirely difcuffed, and the perforations made by the needle foon healed up, without the leaft deformity of the parts. I have therefore given the hiftory of thefe cafes, to fhow with what facility and expedition fuch tumours may be carried off by the ufe of fetons, in preference to the common methods ufed, and even recommended by different authors; fuch as, after opening thefe tumours by deep incifions, and pouring into them the moft corrofive mixtures, made fcalding hot, together with a long tedious courfe of hot irritating applications, by which the poor animals are kept in the utmoft torture for a confiderable time, and in the end are fo disfigured by the lofs of fubftance, occafioned by the cutting away fo much of the flefh from the parts, that fuch horfes are generally rendered unfit for any thing but the meaneft drudgery.

"Deep-feated abfceffes are cured in the fame manner by the ufe of fetons; after tracing the finufes or cavities of the abfcefs with a long flender blunt lead probe (which yields eafily without forcing its way through the cellular membrane, or taking a direction between the interftices of the mufcles), the needle, armed with a cord, fhould follow the direction of the *finews* or *pipes*, as they are commonly called, to the moft depending part; and in cafe there fhould be two or more finufes, which fometimes happens, each of them fhould be treated in the fame manner, in order to obtain a depending orifice for a free difcharge of the matter, and which being once procured, feldom fails of completing a cure."

Sect. XXV. *Of* Wind-galls, *and of* Blood *and* Bog-Spavins.

1. A Wind-gall is a flatulent fwelling, which yields to the preffure of the finger, and recovers its fhape on the removal thereof; the tumour is vifible to the eye, and often feated on both fides of the back finew, above the fetlocks, on the fore-legs, but moft frequently on the hind-legs; though they are met with in various parts of the body, wherever membranes can be fo feparated, that a quantity of fluid may be included within their duplicatures.

When they appear near the joints and tendons, they are generally caufed by ftrains or bruifes on the finews, or the fheath that covers them; which, by being overftretched, have fome of their fibres ruptured; whence probably may ooze out that fluid which is commonly found in them: though, where thefe fwellings fhow themfelves in the interftices of large mufcles, which appear blown up like bladders, air alone is the chief fluid; and thefe may fafely be opened, and treated as a common wound.

On the firft appearance of wind-galls, their cure fhould be attempted by reftringents and bandage; for which purpofe, let the fwelling be bathed twice a-day with vinegar, or verjuice alone; or let the part be fomented with a decoction of oak-bark, pomegranate, and alum, boiled in verjuice, binding over it, with a roller, a woollen cloth foaked in the fame. Some, for this purpofe, ufe red-wine lees; others curriers' fhavings, wetted with the fame, or vinegar, bracing the part up with a firm bandage.

If this method, after a proper trial, fhould not be found to fucceed, authors have advifed the fwelling to be pierced with an awl, or opened with a knife; but mild bliftering has in general the preference given to thefe methods; the included fluids being thereby abforbed, and the tumour gradually diminifhed.

2. A *blood-fpavin* is a fwelling and dilatation of the vein that runs along the infide of the hock, forming a little foft fwelling in the hollow part, and is often attended with a weaknefs and lamenefs of the hock.

The cure fhould be firft attempted with the reftringents and bandage above recommended, which will contribute greatly to ftrengthen all weakneffes of the joints, and frequently will remove this diforder if early applied; but if by thefe means the vein is not reduced to its ufual dimenfions, the fkin fhould be

opened, and the vein tied with a crooked needle and wax thread paſſed underneath it, both above and below the ſwelling, and the turgid part ſuffered to digeſt away with the ligatures: for this purpoſe, the wound may be daily dreſſed with turpentine, honey, and ſuet, incorporated together.

3. A *bog-ſpavin* is an encyſted tumour on the inſide of the hough; or, according to Bracken, a collection of browniſh gelatinous matter, contained in a bag or cyſt, which he takes to be the lubricating matter of the joint altered, the common membrane that incloſes it forming the cyſt. This caſe he has taken the pains to illuſtrate in a young colt of his own, where he ſays, when the ſpavin was preſſed hard on the inſide the hough, there was a ſmall tumour on the outſide, which convinced him the fluid was within ſide the joint: he accordingly cut into it; diſcharged a large quantity of this gelatinous matter; dreſſed the ſore with doſſils dipped in oil of turpentine; putting into it, once in three or four days, a powder made of calcined vitriol, alum, and bole: by this method of dreſſing, the bag ſloughed off, and came away, and the cure was ſucceſsfully completed without any viſible ſcar.

This diſorder, according to the above deſcription, will ſcarcely ſubmit to any other method, except firing, when the cyſt ought to be penetrated to make it effectual; but in all obſtinate caſes that have reſiſted the above methods, both the cure of this and of the ſwellings called *wind-galls*, ſhould be attempted in this manner. If, through the pain attending the operation or dreſſings, the joint ſhould ſwell and inflame, foment it twice a day, and apply a poultice over the dreſſings till it is reduced.

Sect. XXVI. *Of* Mallenders *and* Sallenders.

Mallenders are cracks in the bend of the horſe's knee, that diſcharge a ſharp irritating matter: they are often the occaſion of lameneſs, ſtiffneſs, and the horſe's tumbling. *Sallenders* are the ſame diſtemper, ſituated on the bending of the hough, and occaſion a lameneſs behind.

They are both cured by waſhing the parts with a lather of ſoap warmed, or old chamber-lye; and then applying over the cracks a ſtrong mercurial ointment ſpread on tow, with which they ſhould be dreſſed night and morning, till all the ſcabs fall off. If this ſhould not ſucceed, anoint them night and morning with a little of the following, and apply the above ointment over it.

Take hog's lard, two ounces; ſublimate, two drams.

Or, Take hog's lard, two ounces; oil of vitriol, one dram.

The next, from Gibſon, may be depended on:

Æthiops mineral, half an ounce; white vitriol, one dram; ſoft green ſoap, ſix ounces.

Anoint with this often; but firſt clip away the hair, and clear the ſcabs. On their drying up, it may be proper to give a gentle purge or two; or the nitre-balls may be taken advantageouſly for a fortnight or three weeks.

Sect. XXVII. *Of* Lampas, Barbs, *and* Wolves-Teeth.

1. The *lampas* is an excreſcence in the roof of the horſe's mouth, which is ſometimes ſo luxuriant, that it grows above the teeth, and hinders his feeding. The cure is in lightly cauteriſing the fleſh with a hot iron, taking care that it does not penetrate too deep ſo as to ſcale off the thin bone that lies under the upper bars; the part may be anointed with burnt alum and honey, which is proper for moſt ſores in the mouth.

This operation is by ſome thought to be entirely unneceſſary; it being a general obſervation with them, that all young horſes have their mouths more or leſs full of what are called *lampas*; and that ſometimes they riſe higher than the fore-teeth; but they further obſerve, in proportion as a horſe grows older, the roof flattens of itſelf, and the teeth then appear to riſe. We are obliged to the ingenious M. La Foſſe for this remark, and hope it will be the means of aboliſhing this cruel and unneceſſary operation.

2. *Barbs* are ſmall excreſcences under the tongue, which may be diſcovered by drawing it aſide, and are cured by cutting cloſe off, and waſhing with brandy or ſalt and water.

3. A horſe is ſaid to have *wolves-teeth*, when the teeth grow in ſuch a manner, that their points prick or wound either the tongue or gums in eating. Old horſes are moſt liable to this infirmity, and thoſe horſes whoſe upper overſhoot the under teeth in a great degree.

To remedy this evil, you may either chop off the ſuperfluous parts of the teeth with a chiſſel and mallet, or file them down, which is the better way, till you have ſufficiently ſhortened them.

Sect. XXVIII. *Of the* Grease.

The *greaſe* is a diſeaſe, of the nature and cauſe of which authors have given a very imperfect account. They have uſually conſidered it as ariſing from two different cauſes: 1ſt, a fault or relaxation in the veſſels; or 2dly, a bad diſpoſition in the blood and juices. They obſerve, that the blood is brought to the extreme parts by the arteries, and returned by the veins; in which latter, the blood is to riſe in perpendicular columns, to return the circulating fluids from the extremities: hence ſwellings in the legs of horſes may eaſily be accounted for, from an inadequate motion of the venous blood in the finer veſſels, where the circulation is moſt languid; and eſpecially when there is want of due exerciſe, and a proper muſcular compreſſion on the veſſels: in ſhort, they repreſent, that the blood in ſuch caſes cannot ſo readily aſcend as deſcend, or a greater quantity is brought by the arteries than can be returned by the veins.

The greaſe then, conſidered in this light, muſt be treated as a local complaint, where the parts affected are alone concerned, and the conſtitution actually takes no part; or as a diſorder where they are both complicated: but when it is an attendant on ſome other diſtemper, as the farcy, jaundice, dropſy, &c. ſuch diſeaſes muſt firſt be cured before the greaſe can be removed. In the former caſe, moderate exerciſe, proper dreſſing, cleanlineſs, and external application, will anſwer the purpoſe: in the latter, internal medicines muſt be called in to our aſſiſtance.

When a horſe's heels are firſt obſerved to ſwell in the ſtable, and ſubſide or go down on exerciſe, let care be taken to waſh them very clean every time he comes in, with ſoap-ſuds, chamber-lye, or vinegar and water; which, with proper rubbing, will frequently prevent or remove this complaint: or let them be well bathed twice a-day with old verjuice, or the following mixture, which will brace up the relaxed veſſels; and if rags dipped in the ſame are rolled on, with a proper bandage, for a few days, it is moſt likely the ſwellings will ſoon be removed by this method only, as the bandage will ſupport the veſſels till they have recovered their tone. To anſwer this end alſo, a laced ſtocking made of ſtrong canvas or coarſe cloth, neatly fitted to the part, would be found extremely ſerviceable, and might eaſily be contrived.

Take rectified ſpirit of wine, four ounces; diſſolve in it half an ounce of camphor: to which add wine-vinegar, or old verjuice, ſix ounces; white vitriol, diſſolved in a gill of water, one ounce; mix together, and ſhake the phial when uſed.

But if cracks or ſcratches are obſerved, which ooze and run, let the hair be clipped away, as well to prevent a lodgement which may become offenſive, as to give room for waſhing out dirt or gravel, which, if ſuffered to remain there, would greatly aggravate the diſorder.

When this is the caſe, or the heels are full of hard ſcabs, it is neceſſary to begin the cure with poultices, made either of boiled turnips, with a handful of linſeed powdered; or oatmeal and rye-flour, with a little common turpentine, boiled up with ſtrong-beer grounds or red-wine lees. The digeſtive ointment being applied to the ſores for two or three days, with either of theſe poultices over it, will by ſoftening them promote a diſcharge, unload the veſſels, and take down the ſwelling; when they may be dreſſed with the following:

Take white vitriol and burnt alum, of each two ounces; Ægyptiacum, one ounce; lime-water, a quart or three pints: waſh the ſores with a ſponge, dipped in this, three times a-day; and apply the common white ointment ſpread on tow, to an ounce of which may be added two drams of ſugar of lead.

This method is generally very ſucceſsful, when the diſtemper is only local, and requires no internal medicines; but if the horſe be full and groſs, his legs greatly gorged, ſo that the hair ſtares up, and is what ſome term pen-feathered, and has a large ſtinking diſcharge from deep foul ſores, you may expect to meet with great trouble, as theſe diſorders are very obſtinate to remove, being often occaſioned by a poor dropſical ſtate of blood, or a general bad habit of body.

The cure in this caſe, if the horſe is full and fleſhy, muſt be begun by bleeding, rowels, and a few purges; after which diuretic medicines are frequently given with ſucceſs. Thus,

Take four ounces of yellow roſin; one of nitre; grind them together with an oiled peſtle; add a dram of oil of amber; and give a quart of forge-water every morning, faſting two hours before and after taking, and ride moderately.

As this drink is found very diſagreeable to ſome horſes, we would recommend the nitre balls in its ſtead, given to the quantity of two ounces a-day for a month or ſix weeks, mixed up with honey or in his feeds. Take the following alſo for that purpoſe, or the diuretic balls directed under *Diſorders of the Eyes*.

Yellow roſin, four ounces; ſalt of tartar, and ſal prunel, of each two ounces; Venice ſoap, half a pound; oil of juniper, half an ounce; make into balls of two ounces each, and give one every morning.

The legs in this caſe ſhould be bathed or fomented twice a-day with the diſcutient fomentation already preſcribed, in which a handful or two of wood-aſhes has been boiled: apply then the above poultices, or the following, till the ſwelling has ſubſided, when the ſores may be dreſſed with the green ointment till they are properly digeſted, and then dried up with the water and ointment above recommended.

Take honey, one pound; turpentine, ſix ounces; incorporate with a ſpoon; and add of the meal of fenugreek and linſeed, each four ounces; boil in three quarts of red-wine lees, to the conſiſtence of a poultice; to which add, when taken from the fire, two ounces of camphor in powder; ſpread it on thick cloths, and apply warm to the legs, ſecuring it on with a roller.

If the ſores are very foul, dreſs them with two parts of the wound-ointment, and one of Ægyptiacum; and apply the following, ſpread on thick cloths, and rolled on.

Take of black ſoap, one pound; honey, half a pound; burnt alum, four ounces; verdigreaſe powdered, two ounces; wheat-flour, a ſufficient quantity.

If the diuretic balls ſhould not ſucceed, they muſt be changed for the antimonial and mercurial alteratives, already mentioned; but turning a horſe out in a field, where he has a hovel or ſhed to run to at pleaſure, would greatly contribute to quicken the cure, and indeed would in general effect it alone: but if this cannot be complied with, let him be turned out in the day-time. But if the horſe is not turned out, a large and convenient ſtall is abſolutely neceſſary, with good dreſſing and care.

The laſt thing we ſhall recommend, is a method to oblige a horſe to lie down in the ſtable. This undoubtedly is of the utmoſt conſequence, as it will not a little contribute to the removal and cure of this diſorder: for by only changing the poſition of his legs, a freer circulation would be obtained, and the ſwelling taken down; whereas in general it is greatly aggravated by the obſtinacy of the horſe, who refuſes to lie down at all (probably from the pain it gives him to bend his legs for that purpoſe), by which means the ſtiffneſs and ſwelling increaſe, till the over-gorged and diſtended veſſels are obliged to give way, and, by burſting, diſcharge the fluids which ſhould circulate through them.

To theſe remarks we ſhall only add that the theory of the diſeaſe as delivered by authors is greatly to be ſuſpected; but at leaſt if we admit it to bear any reſemblance to œdema or dropſy, as ſuggeſted above, it behoves the practitioner to be ſomewhat cautious leſt he *bleed*, rowel, and carry the evacuating ſyſtem too far. It has been thought by an ingenious gentleman who has taken conſiderable pains in the inveſtigation, that the farcy, the greaſe, and the glanders are very nearly allied to each other. How far this idea is well founded, time and farther experiments muſt decide.

The name of this diſeaſe is probably derived from the nature of the diſcharge which is thrown out from the ſkin of the part affected, and which is of a greaſy or unctuous nature.

The part in which the greaſe always begins is the fetlock of one of the hind legs. It ſcarcely ever is ſeen in the fore leg; and the reaſon why it affects the hind leg excluſively, is probably its greater diſtance from the centre of the circulation, the veſſels acting more and more weakly in proportion to their greater diſtance from the heart. From this circumſtance, it ſhould ſeem to be a diſeaſe primarily ariſing from local debility, and from an inert ſtate of the circulating veſſels.

There is ſomething peculiar in the ſecretions thrown out from the ſkin of the fetlock, which yields in health a kind of perſpirable matter different from that produced from the ſkin of other parts. In this, perhaps, there exiſts the ſame difference that may be obſerved between the moiſture of the arm-pit and that of other parts of the ſkin in the human ſubject. The ſkin of the fetlock is found in ſome inſtances to yield matter from its pores inſtead of the common ſweat, and that without having undergone excoriation, ulceration, or any derangement of texture whatever.

When a horſe becomes affected with the greaſe, ſeveral tranſverſe chaps or fiſſures take place at different diſtances above the heels. When theſe exiſt they are greatly aggravated by the motions of the horſe, which are continually varying; ſo that if there exiſted in theſe fiſſures a diſpoſition to unite, it would ſtill be counteracted by the parts being repeatedly put on the ſtretch, and the union, if any had taken place, would be forcibly torn aſunder.

Sect. XXIX. *Of* Scratches, Crown Scabs, Rat-tails, *and* Capellets.

1. Scratches in the heels have ſo much affinity with the greaſe, and are ſo often concomitants of that diſtemper, that the method of treating them may be ſelected chiefly from the preceding ſection; which at firſt ſhould be by the linſeed and turnip poultice, with a little common turpentine, to ſoften them and relax the veſſels; the green ointment may then be applied for a few days to promote a diſcharge, when they may be dried up with the ointments and waſhes recommended in the above ſection. It is beſt afterwards to keep the heels ſupple, and ſoftened with currier's dubbing, which is made of oil and

tallow. This will keep the hide from cracking, and be as good a preſervative as it is to leather; and, by uſing it often before exerciſe, will prevent the ſcratches, if care is taken to waſh the heels with warm water when the horſe comes in: when they prove obſtinate, and the ſores are deep, uſe the following; but if any cavities or hollow places are formed, they ſhould firſt be laid open; for no foundation can be laid for healing till you can dreſs to the bottom.

Take Venice turpentine, four ounces; quickſilver, one ounce; incorporate well together, by rubbing ſome time; and then add honey and ſheeps' ſuet, of each two ounces.

Anoint with this once or twice a-day; and if the horſe is full or fleſhy, you muſt bleed and purge; and alteratives ſhould alſo be given.

2. The *crown ſcab* is an acrimonious diſcharge that breaks out round the coronet, and is attended with a ſcurfineſs. Sharp waters prepared with vitriol are well adapted to the cure. A doſe or two of phyſic may be very proper, with the diuretic medicines preſcribed already, and the alteratives above recommended, in obſtinate caſes. See the Section on *Alteratives*.

3. *Rat-tails* are excreſcences which creep from the paſtern to the middle of the ſhanks, and are ſo called from the reſemblance they bear to the tail of a rat. Some are moiſt, others dry; the former may be treated with the drying ointment and waſhes, already pointed out, the latter with ſtrong mercurial ointment. If the hardneſs does not ſubmit to the laſt medicine, it ſhould be pared off with a knife, and dreſſed with turpentine, tar, and honey, to which verdigreaſe or white vitriol may occaſionally be added.

4. There are particular ſwellings which horſes are ſubject to, of a wenny nature, which grow on the heel of the hock, and on the point of the elbow, and are called by the French and Italians *capellets:* they ariſe often from bruiſes and other accidents; and, when this is the caſe, ſhould be treated with vinegar and other ſedative remedies. But when they grow gradually on both heels or elbows, they are ſometimes more troubleſome. When matter is formed, the ſkin ſhould be opened with a lancet, in ſome depending part towards one ſide, to avoid a ſcar; the dreſſings may be turpentine, honey, and tincture of myrrh. The relaxed ſkin may be bathed with equal parts of ſpirit of wine and vinegar, to which an eighth part of oil of vitriol may be added. The contents of theſe tumours are various; ſometimes watery; at others ſuety, or like thick paſte; which, if care be not taken to digeſt out properly with the cyſt, will frequently collect again. Was it not for the disfigurement, the ſhorteſt method would be to extirpate them with a knife; which if well executed, and the ſkin properly preſerved, would leave very little deformity.

Sect. XXX. *Of* Ruptures, Anticor, Diseases *of the* Mouth, *and* Colt-Evil *or* Gonorrhœa.

1. In regard to *ruptures*, though they are generally divided into particular claſſes, we ſhall only obſerve, that by violent efforts of the horſe, or other accidents, the inteſtine or omentum, or a portion of each, may be forced between the muſcles of the belly at the navel, or through the rings of the muſcles into the ſcrotum. Theſe ſwellings are generally about the ſize of a man's fiſt, ſometimes much larger, deſcending to the very hock; they are frequently ſoft, and yield to the preſſure of the hand, when they will return into the cavity of the belly with a rumbling noiſe: and, in moſt, the aperture may be felt through which they paſſed.

On their firſt appearance, endeavours ſhould be made to return them by the hand; but if the ſwelling ſhould be hard and painful, in order to relieve the ſtricture, and relax the parts through which the gut or caul has paſſed, let a large quantity of blood be immediately taken away, and the part fomented twice or thrice a-day, applying over it a poultice made of oatmeal and vinegar, which ſhould be continued till the inflammation ſubſides, and the gut can be returned. In the mean time, it would be proper to throw up emollient oily clyſters twice a-day, and to let the horſe's chief diet be boiled barley, ſcalded malt, or bran.

Should the ſwelling afterwards return, the reſtringent applications, uſually recommended on theſe occaſions, will avail nothing without a ſuſpenſory bandage; ſo that an ingenious mechanic in that art is chiefly to be relied on for any future aſſiſtance. It has nevertheleſs been obſerved, that with moderate feeding, and gentle exerciſe, ſome horſes have continued to be very uſeful under this complaint.

2. The *anticor* is a diſorder not very common among our horſes, or thoſe in northern climates; but is particularly taken notice of by the French, Spaniſh, and Italian writers; who deſcribe it a malignant ſwelling in the breaſt, which extends ſometimes to the very ſheath under the belly; it is attended with a fever, great depreſſion and weakneſs, and a total loſs of appetite.

The cure ſhould be firſt attempted by large and repeated bleedings, to abate the inflammation; emollient clyſters ſhould be injected twice or thrice a-day, with an ounce of ſal prunella in each, and the cooling drink in the ſection on *Fevers* ſhould be given inwardly; the ſwelling ſhould be bathed with the marſhmallow ointment; and a ripening poultice, with onions boiled in it, ſhould be applied over it. If by this method, continued four or five days, the inflammation in the throat and gullet is removed, our attention ſhould more particularly turn to encourage the ſwelling at the breaſt, and bring it, if poſſible, to matter; to which end, continue the poultice, and give two ounces of Venice treacle diſſolved in a pint of beer every night: when the ſwelling is grown ſoft, it muſt be opened with the knife, and dreſſed with turpentine digeſtive, the danger now being over.

But ſhould it be found impracticable to bring the ſwelling to matter, and it increaſes upwards, ſo as to endanger ſuffocation; authors have adviſed to pierce the tumour with a hot pointed cautery in five or ſix places; to dreſs with the above digeſtive; and, in order to ſtimulate and promote a greater diſcharge, to add to it a ſmall quantity of Spaniſh flies and euphorbium in powder; fomenting at the ſame time, and bathing the circumjacent parts with ointment of marſhmallows. M. Gueriniere, as well as Soleyſel, have adviſed opening the ſkin, when the tumour cannot be brought to matter, in order to introduce a piece of black hellebore-root ſteeped in vinegar, and to confine it there for 24 hours: this alſo is intended as a ſtimulant; and is ſaid to anſwer the intention, by occaſioning ſometimes a ſwelling as big as a man's head.

3. Beſides the diſorders of the mouth, which we have already animadverted on, there are frequently obſerved on the inſide of the lips and palate, little ſwellings or bladders called *giggs*. Slitting them open with a knife or lancet, and waſhing them afterwards with ſalt and vinegar, is in general their cure; but when they degenerate into what are called *cankers*, which are known by little white ſpecks, that ſpread and occaſion irregular ulcers, the beſt method then is to touch them daily with a ſmall flat cautery, moderately heated till the ſpreading is ſtopped, and to rub the ſores three or four times a-day with Ægyptiacum, and tincture of myrrh ſharpened with oil of vitriol; when by this dreſſing the ſloughs are ſeparated, they may be waſhed frequently with a ſponge dipped in copperas, or ſublimate water, if they continue to ſpread; or a tincture made by diſſolving half an ounce of burnt alum, and two ounces of honey, in a pint of tincture of roſes. Either of theſe will dry them up, and are very uſeful in moſt diſorders of the mouth.

A relaxation and ſwelling of the palate ſometimes happens to horſes on catching cold. To remedy this diforder, apply with a feather every day a little of the following liniment:

Take of camphor, two drams; olive oil, one ounce. Rub down the camphor to powder, with a few drops of ſpirits of wine, and then add the oil.

4. The *colt-evil* is ſuppoſed to ariſe from ſtoned colts attempting to copulate with mâres before they are able: whence frequently enſues an excoriation or fretting on the glands and a ſwelling on the ſheath. This laſt diſorder frequently proceeds too from dirt or filth lodging there, and is often removed by waſhing the part clean with butter and beer: but when the yard itſelf is ſwelled, foment it twice a-day with a decoction of marſhmallows. Dreſs the excoriation with ſimple ointment, or waſh it with a ſponge dipped in lime water, to a pint of which may be added two drams of ſugar of lead. The penis ſhould be tied up to the belly; and if the ſwelling ſhould increaſe with the inflammation, bleed, give ſome cooling phyſic, and apply a poultice of bread and linſeed meal made with Goulard water.

If a ſimple gonorrhœa or ſeminal gleet flows from the yard (which is often the caſe in high-fed young horſes, where relaxation has been brought on by frequent emiſſions), let the horſe be plunged every day into a river or pond; give him two or three rhubarb purges, at proper intervals; and afterwards ſome balls prepared with rhubarb and turpentine; two drachms of the former to half an ounce of the latter. They ſhould be given every night till the complaint goes off.

PART IV. OF THE FORMATION AND DISEASES OF THE FOOT.

THE diſeaſes to which the foot of the horſe is liable are ſo many and important, as to entitle them to a ſhare of our conſideration, diſtinct from the general complaints to which the animal is expoſed, and which have juſt now occupied our attention. As theſe are likewiſe ſo intimately connected with the anatomical ſtructure of the horſe's foot, and the proceſs of ſhoeing, we have preferred giving a connected view of theſe ſubjects in this concluding part of our Treatiſe, rather than, as might have been expected, including the former of theſe in our deſcriptions of the anatomy of the horſe.

Sect. I. *Of the Structure of the Foot.*

The horny external part of an horſe's foot is a kind of caſe or box adapted to the ſize and ſhape of the bone and other contained parts. It conſiſts of a thick and ſtrong upright and ſomewhat oblique part called the *wall* or *cruſt*; a thinner flat part forming the baſe of the foot, called the *horny ſole*; the *bars* or *binders*, formed by a continuation and inflexion of the cruſt inwards, calculated to keep the cruſt from approaching and preſſing on the heel; and laſtly, the *frog*, a part whoſe uſe is to give the animal a firm footing, particularly in going down a declivity, &c.

In the conſtruction of the foot of a horſe, nature evidently intended that the frog ſhould come in contact with the ground. Hence it is pointed downwards and forwards like a plough-ſhare, that it may pierce the ground, and afford the animal a point of ſupport in progreſſive motion, and more particularly in deſcending a hill, &c. It has a degree of elaſticity alſo by which the force with which the foot ſometimes comes in contact with the ground, is prevented from communicating to the reſt of the connected parts any painful jarring or concuſſion.

In plate 22, we have given different views of the horſe's foot.

Fig. 1. repreſents the bottom or baſe of the foot. *a*, *a*, *a*, the horny ſole. *b*, The frog. *z*, The hoof towards its lower edge, called the cruſt or wall of the foot.

Fig. 2. ſhews the horny ſole *a*, raiſed from the fleſhy ſole *c*, *c*, *c*, round which is the enchannelled fleſh *y*, placed in the ſulcus of the inner ſurface of the hoof *x x*, the horny part of which is ſoft and white.

Fig. 3. repreſents the under part of the fleſhy ſole *c*, raiſed from the foot-bone, or what Gibſon calls the coffin-bone *d*, *d*, *d*. *g*, the covering or ſheath of the tendo Achillis. *z*, The cartilage. *y*, The edge of the fleſhy ſole confined in the furrow of the channelled horny ſubſtance.

The *cartilages of the ſole* are ſometimes oſſified, and preſs in ſuch a way, that if the veſſels did not anaſtomoſe, the blood would be obſtructed in its courſe, and bad effects ſucceed. This oſſification of what ought to be a flexible and yielding part, gives the horſe pain at every ſtep, and to avoid it he endeavours to tread only on his toe, and thus walks exceedingly lame.

Growth of the Foot.—All the veſſels ſupplying the hoof are ſmall branches of the artery ſupplying the coronary ring. The hoof is at firſt ſoft, but, from expoſure to the air, the moiſture evaporates, and the part becomes hard.

The laminated ſubſtance covering the inſide of the hoof is ſecreted by the laminated ſubſtance covering the coffin-bone.

The hoof grows by the particles which compoſe it being accumulated at its ſuperior part, and puſhing the part laſt formed downwards. It is renewed, or grows *out*, about twice or three times a-year; and as it deſcends it always brings the ſole along with it.

Sect. II. *Of the natural Defects of the Feet.*

It is very well known, that different climates and different ſoils greatly affect the feet of horſes. Thoſe that are bred in hot countries, ſtanding moſtly upon dry ground, have deep cruſted hollow hoofs with ſmall frogs; for, being but little expoſed to wet or moiſture, the fibres of the hoof contract more cloſely. And, even in Great Britain, there is a conſiderable difference, according to the dryneſs or wetneſs of the ſoil upon which horſes are bred. Horſes that are bred upon the mountainous parts of England and Wales, and in the northern parts of Scotland, have generally good ſound tough hoofs; whilſt thoſe horſes that are bred upon low marſhy grounds (which are moſtly of the huge draught kind), have flat, large, ſoft hoofs; for, being kept too moiſt, by always ſoaking in wet, the horny fibres of the hoof are too much relaxed.

Thoſe hoofs which are either too large or too ſmall, in proportion to the ſize of the body, and thickneſs of the bones of the legs, are generally, and not without foundation, looked upon as bad. Large broad hoofs, for the moſt part, have thin flat ſoles; large, ſoft, ſpongy frogs: a ſtrong cruſt, ſomething hollow upon the upper and fore part, and full of wrinkles or rings, not unlike the rough outſide of an oyſter-ſhell. Hoofs of this ſhape are liable to that diſeaſe termed *founder;* and to have high, round, or ſwelled ſoles, and low weak heels, &c.

Small hoofs are liable to the oppoſite extreme, eſpecially thoſe of that kind which generally go under the denomination of *aſſes hoofs*, as they are deep cruſted and narrow, the ſole very hollow, the frog ſmall, the heels high and ſtrong, the cruſt upon the outſide clear and ſhining: theſe are naturally diſpoſed to a contraction of the whole hoof, which is called *hoof-bound*; and likewiſe to corns, running thruſhes, or fruſhes; either of which renders a horſe lame.

Some hoofs are pretty well proportioned, and look well to the eye; but, at the ſame time, they are thin and weak cruſted,

and not able to ſtand much fatigue in travelling upon hard ſtony grounds. On the other hand, very ſtrong cruſted hoofs are by no means the beſt, but are liable to cracks, &c. In ſuch hoofs, the horny fibres appear very diſtinct, and run in a ſtraight line from the coronet or top of the hoof to its baſis, reſembling the grain of ſome kinds of wood, particularly oak. Hence they are diſpoſed to cracks or fiſſures, which cleave the hoof quite through, ſometimes from the coronet down to the bottom of the hoof. In others, theſe cracks at firſt do not penetrate through the horn, but appear like a ſeam on the ſurface of the hoof, commonly named a *ſand-crack*; which, from retaining the ſand and gravel, at laſt works its way into the quick, and occaſions lameneſs, &c. Another diſadvantage attending very ſtrong-cruſted hoofs is, that, when they ſtand long in a dry hot ſtable, they contract, and by their thickneſs and hardneſs bruiſe the internal parts of the foot. Hence the horſe will be lame, though, at the ſame time, no viſible defect will be ſeen about the hoof, excepting a great heat, pain, and tenderneſs in his feet: the true cauſe of which is ſeldom attended to or known; and hence the horſe is ſaid to be lame in ſome other part, perhaps the ſhoulders. Low thin heels are weak-cruſted, and liable to lameneſs from injudicious ſhoeing. The oppoſite extreme, *viz.* very high heels, is equally bad; as theſe are ſubject to corns, and contraction of the hoof; and the deepneſs of the cruſt cauſes a numbneſs in the foot, and unſteadineſs in the horſe's going, which make him liable to trip and ſtumble.

Much has been ſaid by authors, with reſpect to the different colours of horſes' hoofs, aſcribing different qualities and temperaments to peculiar colours, ſuch as hardneſs, dryneſs, brittleneſs, &c. But it is very well known to practitioners in ſhoeing horſes, that there are good and bad hoofs of all colours; ſome being naturally weak and diſpoſed to be brittle, whilſt others are tough and ſtrong. But a great deal depends upon the management of them in the ſtable, in keeping them properly moiſtened, in order to preſerve a due medium between theſe oppoſite extremes. It is likewiſe generally remarked by authors, as a ſure ſign of bad thin hoofs, that, when the ſhoe-nails are drove high up in the cruſt, it is, ſay they, an evidence that the cruſt is thin, and that there was not ſufficient hold, without driving the nails high up. But this can be no true criterion to judge by; for if the nails can be driven high up in the cruſt with ſafety in a thin weak foot, the ſame may as certainly be done in a ſtrong foot, with more eaſe and expedition, which indeed is frequently the caſe.

To form a right judgment of what may be called a *good hoof*, it muſt neither be too large nor too ſmall in proportion to the ſize of the leg: at the ſame time, its ſhape muſt be regular, gradually enlarging from the coronet towards its baſis; the cruſt ſmooth, even, and free from ſeams, cracks, or wrinkles; the ſole ſtrong, and a little hollow; the heels firm and open; the frog tough, ſound, and dry.

Sect. III. *Of the Methods uſed to preſerve the Feet.*

The cuſtom of keeping our fineſt horſes conſtantly ſtanding upon dry litter and hot dung in the ſtable, is exceedingly hurtful to the feet and legs, particularly the former, which are always found to agree beſt with coolneſs and moiſture. Hence we find, that horſes' hoofs, whilſt running in the fields, are always in better condition than thoſe that are kept hot and dry in the ſtable, which, beſide being liable to many diſeaſes, are hard, brittle, ſhattered, and often broken.

With reſpect to greaſy or oily applications, ſo often preſcribed for the hoofs of horſes in order to preſerve them ſound, tough, &c. Mr. Clark, in his Obſervations on the Shoeing of Horſes, and on the Diſeaſes of their Feet, very juſtly condemns them as rather pernicious than ſalutary.

When young horſes, he obſerves, are firſt taken from the fields, their hoofs are cool, ſound, and tough. Theſe are found from experience to be good qualities. But horſes are no ſooner introduced into the ſtable, than their hoofs are greaſed or oiled two or three times a-week: and if they are kept much in the houſe ſtanding upon hot dry litter, without being frequently led abroad, and without having an opportunity of getting their hoofs cooled and moiſtened in wet ground, their hoofs grow ſo brittle, dry, and hard, that pieces frequently break off, like chips from a hard ſtone; and, when driving the nails in ſhoeing, pieces will ſplit off, even although the nails are made very fine and thin. Now, if theſe ſame horſes with brittle ſhattered hoofs are turned out to graze in the fields, their hoofs in time will become, as they were originally, ſound, tough, and good.

This change muſt undoubtedly be aſcribed to the wet and moiſture which the hoofs are expoſed to in the fields, of which water is the principal ingredient; and it is a certain fact, of which we have daily proofs, that when all other means fail, horſes are turned out to graſs in order to recover their decayed brittle hoofs. It is known, that the hoofs of horſes are porous; and that inſenſible perſpiration is carried on through theſe pores, in the ſame manner, and according to the ſame laws as take place in other parts of the body. Now, every body knows, that greaſy or oily medicines applied to the ſkin of the human body prevent perſpiration, which is frequently attended with the worſt conſequences. The ſame reaſoning will hold with reſpect to the hoofs of horſes; for greaſy or oily applications cloſe or ſhut up the pores of the hoof, by being abſorbed or ſucked into its inner ſubſtance. Hence the natural moiſture which ſhould nouriſh the hoof, is thereby prevented from arriving at its ſurface; which, on that account, becomes as it were dead, and conſequently dry, brittle, and hard.

The original practice of greaſing or oiling horſes' hoofs has probably taken its riſe, from obſerving, that greaſe or oil ſoftens dead ſubſtances, ſuch as leather, &c. But this will by no means apply to the hoofs of horſes, as there is a very great difference between the living and dead parts of animals; the former having juices, &c. neceſſary for their own nouriſhment and ſupport, whilſt the latter require ſuch applications as will preſerve them only from decaying and rotting.

The dealers in horſes about London, when they get a bad-footed horſe in their hands, moiſten his hoofs frequently in water; for which purpoſe, they keep a puddle of water and dung at the watering place, that, when the horſe comes to water, his fore-feet may be ſunk in the puddle, by which means they are cooled and moiſtened twice or thrice every day; ſo that, whilſt they are making up his carcaſe for the market, his hoofs are likewiſe repaired, and ſufficient to ſtand the teſt of a trial upon ſale. But no ſooner do horſes with hoofs of this kind come into other hands, their hoofs at the ſame time being kept dry and greaſed, &c. than they degenerate into their former ſtate. Hence the cauſe of ſo many complaints that horſes turn ſoon lame after they come from dealers, when, in fact, it proceeds from greaſy applications, and neglecting to cool or moiſten the hoofs in water; for the careful groom, when airing his maſter's horſes, rather than lead them into a puddle, will go about in order to keep their legs clean and dry.

Another practice equally pernicious, is the *ſtuffing up* horſes' hoofs (as it is called) with hot reſinous and greaſy mixtures, under the notion of cooling and ſoftening them. Various are the preſcriptions recommended for this purpoſe, many of which are of a quite oppoſite nature to the purpoſe intended. There is likewiſe a great impropriety in ſtuffing up the hoofs with rotten dung and ſtale urine: this, it is true, is moiſture; but of the very worſt kind, on account of the ſalts contained in the urine, which of itſelf greatly contributes towards hardening and

drying their hoofs, in place of softening them; besides the other bad effects which may arise to the frog, &c. from the rottenness of the dung. But, without commenting upon the various compositions or pompous prescriptions recommended in books, or those handed about as receipts for the softening and stuffing horses' hoofs, we rather would recommend one which is more natural, and ought not to be despised for its simplicity, as it is only cooling and moistening the hoofs with water morning and evening: And, to those who are fond of stuffing, we would prescribe bran and water, or clay, &c. made into the consistency of a poultice; and in particular cases, where horses stand much in the stable, and the hoofs are disposed to be very hard, dry, and brittle, a poultice of this kind, or any other emollient composition in which water is a principal ingredient, may be applied all round the hoof; or, in imitation of some dealers, to keep a puddle of water at the watering place, which will answer equally well, if not better. From this manner of treatment, the hoofs will be preserved in their natural state, and a free and equal perspiration kept up, by which the nourishment natural to the hoof will have free access to its surface, as it is this only which causes that cohesion of the parts which constitutes a firm, sound, tough hoof.

Sect. IV. *Of Wounds in the Feet.*

Wounds in the feet happen frequently; and chiefly from want of proper care, or treating them injudiciously when they are first inflicted, they are liable to become serious.

1. Wounds upon the coronet, or top of the hoof, when superficial, are easily cured, if not neglected or improperly treated. But the most simple wound, by bad management or neglect, may, especially if the horse should happen at the time to be in a bad habit of body, be attended with dangerous consequences: therefore, however trifling they may at first appear, they should be treated with attention.

When large deep wounds are inflicted upon the coronet, from which may be apprehended a great inflammation, and its consequences; to prevent these evils as much as possible, it will be necessary to have recourse to bleeding, and, at the same time, to give such internal remedies as are recommended in inflammatory cases; cooling salts, clysters, &c. together with a low soft diet, keeping the hoof moist and soft with emollient poultices applied around it, which may be made of turnip, mallows, or even bran, rye meal, and water.

Deep wounds upon the coronet are generally made by long sharp caukers upon the heels of the shoes of the opposite foot, penetrating downwards between the coffin-bone and the hoof. In this case, as there is no depending orifice or passage for the matter contained in the wound to be discharged downwards, there is great danger of a fistula or sinuous ulcer being formed. To prevent this, an artificial drain or opening must be made through the hoof, first rasping or paring it very thin upon the outside where the perforation is to be made; then introduce a sharp-pointed instrument, a little bent, into the orifice of the wound, and, passing it to the bottom, force it outwards. This operation will be performed with less pain to the animal, if the instrument be concealed within a canula or hollow tube, till it reaches to the bottom of the wound; when the perforation is to be made by pushing it beyond the extremity of the canula; and, by applying a bandage pretty tight round the coronet, the sides or lips of the wound may be brought into contact and healed up, or a seton may be introduced, and continued till the inflammation, swelling, &c. are removed. If this operation be too long delayed, the matter confined in the wound forms a number of sinuses or fistulæ, which frequently run in different directions under the hoof, and require a large portion of it to be cut away before they can be healed up, leaving an ugly blemish, and a weakness or tenderness on that part of the hoof, which never admits of a thorough cure. But, by treating it in the manner now mentioned, the annular ligament may be preserved entire, and a false quarter avoided: and, although there may remain an horizontal crack or fissure in the hoof where the perforation was made, yet, as the hoof grows downward, it will likewise go along with it, and wear out, without leaving a blemish or any other bad consequence.

When the capsular ligament of the coffin joint is wounded or perforated by any instrument, so as to admit the external air into its cavity, the glands there situated inflame; and, in place of secreting a lubricating mild liquor, they discharge a sharp ichorous fluid, which destroys and corrodes the very cartilages or gristles upon the ends of the articulated bones, which at last grow together, and form what is termed an *anchylosis*, and of course lameness. There are many farriers who boast of their having cured wounds in the joints after they were affected with that symptom which they call a *joint-water*, that is, a discharge of the synovia or mucilaginous fluid contained within the cavity of the joint. But what they commonly call a *joint-water*, is only a yellow serum or lymph, which is frequently to be observed issuing in great abundance from wounds in the legs; and not the synovia or fluid contained within the cavity of the joint. Notwithstanding wounds of this kind happen frequently; yet so little are the generality of practitioners acquainted with the nature of them and their consequences, that they make no distinction betwixt them and those of a more simple nature. Hence, therefore, they find themselves frequently mistaken in prognosticating the cure of a wound, to appearance of a very simple nature.

It is a certain fact, confirmed by experience, that when the capsular ligament of any joint is perforated or cut through, there is but little chance of effecting a complete cure, so as the horse may be useful for the saddle or carriage; although, in other respects, to those who are willing to be at the expence, he may, if a strong horse, be useful in some kinds of drudgery.

As to the mode of dressing wounds of this kind, all that art can do, is to prevent, as much as possible, a violent inflammation and its consequences to the affected limb, by blooding, clysters, cooling salts, together with a low soft diet, applying digestive poultices to the wound; but injecting into the cavity of the joint any strong tincture is hurtful.

2. Wounds upon the coronet towards the back part of the foot or heel, which are commonly called an *over-reach*, are occasioned by the toe of the hind-shoe on the same side cutting the fore-heel. Some horses are much addicted to this, owing entirely to their manner of going, *viz.* the hind-foot moving in the same line of direction with the fore-foot; in riding fast, the fore-foot not giving place in time, the hind-foot strikes against the fore-heel: hence some horses, in trotting, make a clattering noise with the hind-shoes striking against the heel of the fore ones; hence, likewise, many horses are thrown down by the same cause.

Although an over-reach is a wound of the complicated kind, being at the same time a contusion or bruise together with a wound; yet they are nowise dangerous, and are easily cured by treating them in the manner hereafter mentioned; for, in two or three days, when the wound comes to suppurate properly, the bruised or dead parts fall off, and only leave a larger surface of a wound than was at first apprehended.

With respect to the dressing proper for recent wounds, farriers are too much prejudiced in favour of certain balsams, ointments, and tinctures; and too sanguine in the belief of their supposed specific virtues, the healing qualities of which they flatter themselves are irresistible. But the truth is, all that art can do in the healing of wounds, is to remove every impediment which may obstruct the uniting of the divided parts, and to forward the formation of laudable pus or matter: that be-

ing once effected, the reſt is performed by nature, which is all-ſufficient. Thoſe balſams and remedies which are ſaid to generate new fleſh, in fact only aſſiſt nature by excluding the external air, keeping the wounded parts warm, and confining the ſecreted humours, which, by remaining there a due time, are converted into laudable matter, which is the balſam of nature's preparing. Therefore, the moſt approved and rational method of treating recent wounds is, by poultices which abate inflammation.

Many people are indeed prejudiced againſt the uſe of poultices, from a wrong notion, that they (as the phraſe is) *draw* humours to the wounded part; but the abſurdity of this way of reaſoning will be evident to thoſe who are in the leaſt acquainted with the healing art.

" Poultices (ſays Mr. Bartlett) are of ſuch real and extenſive uſe in farriery, that we thought the compoſition of them could not be too general. How ſimple ſoever the ingredients may appear to ſome (which are generally at hand), yet they will be found to anſwer moſt intentions, where preſent eaſe is to be obtained by warmth, ſoftening, and relaxing the injured part. Many are the caſes which demand ſuch aſſiſtance, as recent ſwellings, inflammations, treads, bruiſes, cracked and ſwelled heels and feet, burns, ſcalds, bruiſed and lacerated wounds from ſtumps, thorns, glaſs, nails, &c. which laſt are much better treated with ſuch ſimple emollient applications, than by hot oils or ſcalding plaſters dropt into the wounds; which, under the abſurd notion of *drawing*, but too often increaſe inflammation and produce ſerious miſchief."

Poultices may be continued till ſuch time as the wound appears healthy, and looks ſmooth and equal; in that caſe, the uſe of poultices may be left off, and the ſurface of the wound may be dreſſed ſuperficially with a little lint, alone, or dipped in lime water.

3. There is another ſpecies of wounds to which the feet are much expoſed, called *punctures*, on account of their ſmall orifice, as the parts immediately after the wound is inflicted readily cloſe up, whereby it becomes difficult to know the depth of the wound. They are generally occaſioned from treading upon ſharp ſtones, broken glaſs, ſharp bones, and nails, and likewiſe from nails in ſhoeing; either of theſe perforating the ſole or frog, and wounding the internal parts of the foot; which, from their ſituation and confinement within the hoof, are attended with the moſt violent pain and inflammation, which are frequently increaſed by the injudicious method generally obſerved in treating theſe wounds when firſt inflicted, by the application of hot corroſive oils poured into the recent wound, in order to *deaden* it (as the phraſe is), which is productive of the worſt of conſequences.

Punctures or pricks from nails in ſhoeing, are, when diſcovered in time, eaſily cured by dreſſing with a lead water poultice. But when it is overlooked, or a fragment of the nail remains in the wound, the inflammation increaſing, it at laſt ſuppurates. In this caſe, if a proper depending opening be omitted, the matter accumulating, and not finding a paſſage downwards, from the natural formation of the hoof will run upwards, to the coronet or top of the hoof, and form a round tumour, which afterwards may degenerate into a moſt malignant ulcer, commonly termed,

4. A *Quittor*. This tumour is uſually attended with great pain and inflammation, and a conſiderable ſwelling round its baſis. The method of cure commonly practiſed, and indeed recommended by authors, is the actual cautery, or elſe ſome very active cauſtic. The knife, however, ſeems far preferable: firſt, tie a ligature round the fetlock, in order to ſtop the bleeding; and, with a crooked ſharp knife, cut out the tumour to the bottom; afterwards dreſs it like a freſh wound till it is healed up.

In ulcers of this kind, as there are a number of ſinuſes or fiſtulæ which run in different directions underneath the hoof, it is hardly poſſible to avoid deſtroying the annular ligament which lies below the coronet, and cutting away a large portion of the hoof; yet, in many caſes (eſpecially when there is an opening in the tumour), the method propoſed, at the beginning of this ſection, for curing the deep wounds upon the coronet with a ſeton, may be firſt tried; and, if that does not ſucceed, the operation above mentioned may be performed.

Punctures differ little or nothing, in the manner of treating them, from wounds; only the ſole or frog ſhould be ſcraped thin all round the orifice of the wound, which, at the ſame time, if too ſmall, ſhould be enlarged, and an emollient poultice applied, taking care that no fragment or extraneous ſubſtance remain in the wound, and keeping the whole hoof moiſt and ſoft with ſimilar poultices around it; and, in caſes attended with violent pain, recourſe muſt be had to ſuch internal remedies as are proper in inflammatory caſes, ſuch as the following mixture by way of a drink, in order to leſſen, as much as poſſible, the inflammation: bleeding being firſt premiſed, together with a low diet.

Take ſalt of nitre, one ounce; common treacle, two ounces. Diſſolve in a quart of water.

It will be neceſſary to repeat this draught morning and evening: if the horſe ſhould ſhow any uneaſineſs, or appear griped, the quantity of water may be increaſed, or the ſame quantity of nitre may be given the horſe in a maſh of bran twice a-day, if it does not cauſe him to loath his food. If the coffin-bone ſhould be wounded and turn carious, it will be tedious to wait for an exfoliation, as, from the ſpongy texture of this bone, it exfoliates but ſlowly: therefore, if it can conveniently be done, the carious parts may be ſcraped off with a knife, and afterwards dreſſed with pledgets of tow dipped in tincture of myrrh; and let the poultice be applied above it.

In punctures, as above deſcribed, common farriers are in the practice of pouring into the wound hot corroſive oils, and ſome even run into the wound an iron nail made red-hot, in order, as the phraſe is, to *deaden* the part. But common ſenſe ſhews that either of theſe cruel methods is extremely hurtful. When miſchief ariſes, as muſt be the conſequence of ſuch vile practice, theſe unfeeling ſavages excuſe themſelves by ſaying, that the wound is of an inveterate or deſperate kind; when, in fact, their injudicious applications are alone to blame.

5. *Contuſions* or *bruiſes* happen frequently on the coronet or top of the hoof, from the treading of other horſes' feet, which will occaſion lameneſs; although, at the ſame time, no external mark of violence will appear on the coronet farther than a little ſwelling, or the horſe will ſhow a ſenſe of pain when the affected part is touched or preſſed upon. The following poultice in this caſe may be applied with ſucceſs, if continued for ſome time:

Take thick lees of wine or vinegar, one pint; crude ſal ammoniac, two ounces; oat-meal or bran, ſufficient to make it of a due conſiſtence. Diſſolve the ſal ammoniac in the lees firſt.

Before concluding this ſection, it may not be improper to mention the following rules, which ought carefully to be attended to by every practitioner. 1. The firſt thing to be obſerved in dreſſing of wounds is, to remove all foreign bodies (if it can be done with ſafety), all lacerated or torn parts, whether of the fleſh or of the hoof, &c. which, if left in the wound, might poſſibly impede the cure. 2. All wounds ſhould be carefully inſpected at every dreſſing, obſerving attentively whether any alteration has been made on their ſurface, whether they be clean at the bottom, and free from any extraneous ſubſtance that may hinder or retard the cure. 3. Cramming wounds with hard tents, or ſyringing them frequently with ſpirituous

tinctures, are extremely hurtful. The former increaſes the pain and inflammation, &c.; the latter produces a callus upon the internal ſurface of the wounds, which prevents their healing. 4. The dreſſings of wounds ſhould lie ſmooth and eaſy upon the parts. 5. Over-tight ligatures or bandages ſhould be carefully avoided. 6. As wounds in the feet or legs, for obvious reaſons, are more difficult to heal than on any other part of the body; therefore, reſt and a wide ſtall are abſolutely neceſſary, together with a low regimen, in order to keep the body cool and open.

Sect. V. *Of the Diſeaſe called the* Founder.

The diſeaſe called the founder in horſes, ariſes from three different cauſes, all very probably to be attributed to bad ſhoeing. The firſt cauſe that we ſhall notice is the contraction of the heels, produced by imprudently cutting away the inſenſible frog, and the bars of the hoof, together with the gradual miſchief produced by the fixed points, which the nails driven into the quarters of the ſhoe occaſion; and from which there exiſts a continual tendency to narrow the heel, in conſequence of the cruſt overgrowing the ſhoe. The cure of this can only conſiſt in a removal of the cauſe, and in the practice of a more rational mode of ſhoeing.

The ſecond cauſe of the founder is an oſſification of thoſe large and ſtrong cartilages which embrace the coffin-bone at its lateral parts. In conſequence of the inconvenience which a horſe's foot undergoes from irregular preſſure, whether from bad ſhoeing, or any other cauſe, a conſiderable, and indeed a continual degree of heat and inflammation is excited, and a larger quantity of blood is derived to the part than is natural. To this cauſe is owing that alteration which takes place in the texture of the lateral cartilages; for theſe, after a long exiſtence of the original cauſe, become bony, and are attached to the coffin-bone itſelf, which partakes of the diſeaſe, and in ſome inſtances throws out a conſiderable portion of oſſeous matter. It is evident, that the elaſticity of thoſe parts which were once cartilaginous being now loſt, and a number of ſharp bony points brought into contact with the ſoft and ſenſible parts, the horſe can no longer put his foot forcibly to the ground without ſuffering great pain, or without exhibiting the moſt palpable ſigns of lameneſs.

The third cauſe of the founder is exceedingly ſimilar to the former, and conſiſts in the ſame ſort of change, taking place in the ſenſible laminæ covering the forepart of the coffin-bone, as we have deſcribed to take place in the lateral ligaments. Theſe, perhaps for reaſons ſimilar to the foregoing, become oſſified and attached to the coffin-bone; and the animal being deprived of the functions of the part, as well as tortured by motion, becomes lame.

The treatment of this diſeaſe, when diſcovered at a pretty early period, ſhould be attempted by all the means which are likely to abate local inflammation, but particularly by local bleeding; for as the blood is derived to the affected parts in too great quantity, nothing can be more rational than to unload the blood veſſels; by opening ſome of them, and ſuffering a conſiderable quantity of blood to be evacuated. This deſign cannot be better effected than by what the farriers term *bleeding in the toe*, which conſiſts in paring away with a knife ſo much of the horny ſole as ſhall divide a ſufficient number of blood veſſels; the part fixed on for this purpoſe being that moſt immediately within, and adjoining, that projecting part of the cruſt called the *toe* of the hoof.

Beſides the uſe of theſe means, and particularly where the diſeaſe has been of long ſtanding, it is of conſiderable advantage to apply repeated bliſters to the part. Indeed the application of ſome ſubſtance that will excite nearly an equal degree of action on the ſurface, and yet may be repeated with greater frequency, will probably anſwer better; at leaſt the two remedies may be applied alternately, according to circumſtances. For bliſtering the part, employ the following:

Take cantharides, in powder, two drams; oil of turpentine, and powdered euphorbium, of each one dram; corroſive ſublimate, finely powdered, a ſcruple; common oil, four ounces. Mix theſe well together; and after rubbing it extenſively and thoroughly into the part, cover the whole with a flannel roller.

For the other and leſs active kind of application, ſpirit of turpentine alone is the moſt ſuitable; as it occaſions the horſe great pain, and conſequently cauſes the blood to flow from the deep-ſeated parts to the ſurface.

The manner in which a horſe walks or ſtands upon his fore parts, when affected with this diſorder, has induced many farriers to conclude, that the ſhoulders are affected: hence they ſay a horſe is foundered in the body; and that drains, ſuch as rowels, are the only proper remedies. But the fact is, that the appellation of *foundered* is given to many complaints which have no connection whatever with the real diſeaſe.

Sect. VI. *Of the Diſeaſe called* Hoof-Bound.

This complaint affects the hoofs differently, according to their natural ſhape, and the treatment they are expoſed to, whether it be injudicious ſhoeing, keeping the hoofs too hot and dry, or paring the ſole and binders at every time they are ſhoed. Some are affected with a circular contraction of the cruſt, compreſſing the whole foot. In others, the cruſt is contracted at the coronet only, compreſſing the annular ligament, &c. A third kind is, when either one or both heels are contracted: hence, therefore, in proportion to the degree of contraction, the internal parts of the foot are compreſſed, and the horſe becomes more or leſs lame.

It has been already obſerved, that deep-cruſted narrow hoofs, or what are commonly called *aſſes hoofs*, are naturally diſpoſed to this malady: when they become diſeaſed, they are eaſily known from their appearance, as they are ſmaller in proportion than the legs, and frequently ſmaller at their baſis than at the coronet; the cruſt of the heels is high, thick, and ſtrong; the frog waſted and rotten; the hoofs are almoſt perpendicular; the horſe moves in pain, ſteps ſhort and quick, and trips and ſtumbles frequently; it is not uncommon that one foot only is affected, which then appears conſiderably ſmaller than the other.

This diſeaſe is haſtened and brought on by paring and hollowing out the ſole and binders at every time the ſhoes are renewed, from a miſtaken notion of widening the heels; hence they are thereby made ſo very thin, that the cruſt at the extremity of the heels may be forced almoſt cloſe together even with one's fingers alone: and what greatly forwards the complaint, is the form of the ſhoes commonly uſed, which are made hollow; for this practice of hollowing the ſhoes ſo univerſally prevails, that, without any regard to the ſhape of the ſole, whether it be flat or otherwiſe, the ſhoe is made concave or hollow upon that ſide which is placed next the foot. Hence the outer edges of the concave ſhoes force the cruſts at the heels nearer to one another; which being there retained, the contraction of the hoof becomes general, and confirmed beyond the power of art or remedy.

In the ſecond ſpecies of this complaint, the hoof acquires a particular ſhape, which Mr. Gibſon, in his Treatiſe, compares to that of a bell; that is, the hoof appears contracted and tight round the coronet and inſtep, but ſpreads wider downwards to its baſis; the hoof, in other reſpects, looking well and ſound. This is generally occaſioned by keeping the horſe ſtanding for a long time together in the ſtable upon hot dry litter, without moiſtening and cooling the hoofs, allowing them at the ſame

time to grow to a preternatural ſize both in length and breadth: hence, from the great ſtrength, and the rigid and dry ſtate of the under part of the hoof, a preternatural ſtricture or preſſure is made by the hardened cruſt at the coronet, which compreſſes the annular ligament and parts near it.

The third ſpecies of this malady is, when either one or both heels are contracted. This frequently happens even in all kinds of hoofs, but more eſpecially in thoſe that are flat, from the uſe of concave or hollow ſhoes, together with cutting out the ſole and binders at every time the horſe is ſhoed. But it more frequently happens, that the inſide heel only is contracted, from the natural weakneſs of that part of the hoof: hence the weight of the limb, &c. preſſing upon the inſide cruſt at the heel, it is inflected or bended inwards; by which, together with the concave form of the ſhoe, and loſs of ſubſtance from paring, &c. the diſorder is increaſed, the cruſt of the heels becomes contracted, and compreſſes that quarter of the foot, and of courſe occaſions lameneſs.

With reſpect to any particular method of cure to be obſerved in removing this diſeaſe, all that can be ſaid is, that, as it is one of that kind which comes on gradually yet perceptibly, it may by proper care and management, when properly attended to, be prevented. But when once it becomes confirmed, it never will admit of a thorough cure. Nevertheleſs, it may be ſo far palliated as to render a horſe in ſome degree ſounder, by keeping the hoofs cool and moiſt: as, in this caſe, they are naturally diſpoſed to be very hot, dry, and hard, his ſhoes ſhould be flat, narrow, and open-heeled, the hoofs never greaſed nor oiled, the ſoles never pared. But as the cruſts of the heels in theſe hoofs are preternaturally high and ſtrong, they ſhould always be pared down till they are lower than the frog, that if poſſible it may reſt upon the ground. This operation will ſo far remove that ſtricture from the heels and frog, as will greatly relieve them. But many people, adhering too ſtrictly to that general rule, which from inattention has crept into practice, *viz.* of paring down the toes, and keeping the heels entire, without reflecting upon the ſhape or natural formation of ſome particular hoofs, continue the ſame practice upon deep-cruſted, high-heeled hoofs, which is only neceſſary to be obſerved in long-toed hoofs with low heels, and thereby this diſorder is greatly increaſed. The weight of the body is likewiſe thrown forwards, by which the horſe ſtands too much upon his toes; and hence the leg-bones, from the awkward habit of the horſe's ſtanding, become bent at the joints, and occaſion what is called *knuckleing* or *nuckeling.*

For the ſecond ſpecies of this complaint, when the cruſt at the coronet becomes contracted, and compreſſing the annular ligament, &c. occaſions lameneſs, the hoof acquiring the ſhape formerly compared to that of a bell, different methods have been tried and recommended by practitioners. Mr. Gibſon propoſes to make ſeveral lines or raſes on the fore-part of the hoof with a drawing knife, almoſt to the quick, from the coronet down to its baſis, and turning the horſe out to graſs: others, after this operation is performed, ſcrew the heels wide, by means of a ſcrewed ſhoe: a third method practiſed is, to draw the ſole, and divide the fleſhy ſubſtance of the frog with a knife, keeping it ſeparated by the ſcrewed ſhoe above mentioned: a fourth method in uſe, is to make the inner rim of the ſhoe-heel very thick on the under ſide (its upper ſurface being quite flat); and by making it reſt upon the binders and ſole at the extremity of the heels, by preſſure from the weight of the body, the heels are forced to recede to a greater diſtance from one another. Either of theſe methods may indeed in a ſmall degree widen or expand the horny ſubſtance of the cruſt, and may be of uſe in recent contractions. But when once it has become confirmed, and is of ſome ſtanding, no means whatever can then reſtore the internal parts to their primitive ſtate; for, as the contraction takes place, the tender parts within the hoof, being compreſſed, loſe their tone, and diminiſh in their ſize. The blood veſſels become impervious; hence a decay or waſting of the whole foot, and not unfrequently a concretion of the parts, and of courſe the impoſſibility of the horſe ever becoming ſound. But it has juſt been obſerved, that the cauſe of this ſpecies of the complaint now under conſideration proceeds from allowing the hoofs to grow to an extraordinary ſize, and keeping them too hot and dry, by which they acquire a rigidity and dryneſs, occaſioning a preternatural compreſſion upon the coronet. To remove this (as the caſe will only admit of palliation), the ſurface of the hoof at its baſis muſt be pared down till the blood appears, the thick ſtrong cruſt upon the outſide towards the toe raſped in the ſame manner, and the horſe turned out to graſs in ſoft meadow-ground till the feet recover. But it muſt be obſerved, that if both hoofs are alike affected, one of them at one time only ſhould be treated in the manner directed, as a tenderneſs will remain for ſome days, which might prevent the horſe from walking about in ſearch of food.

In the third ſpecies, or a contraction of one, or ſometimes of both heels, in flat feet, from the uſe of concave ſhoes, &c. where it has not been of very long ſtanding, it may, by proper management, be greatly relieved, by laying aſide the uſe of concave ſhoes, and refraining from paring the ſole, &c. But to remove the ſtricture of the hoof more immediately, the whole contracted quarter of the cruſt near the heel muſt be raſped or pared to the quick, from the coronet to its baſis, cloſe to the frog, taking care to avoid drawing blood, putting on a barred ſhoe, cauſing the ſhoe-bar to preſs upon the frog, keeping the hoof cool and moiſt, or turning the horſe out to graſs. Hence the preſſure from the contracted hoof being removed, and the frog at the ſame time reſting upon the bar of the ſhoe, the contracted quarter is thereby dilated or expanded: the new hoof growing from the coronet downwards acquires a round, full ſhape, and becomes of its original form.

From what has been ſaid concerning this diſorder in the feet of horſes, it is evident, what little proſpect there is of effecting a thorough cure by art, as the complaint is of ſuch a nature as only to admit of ſome palliation, and even then in ſome very favourable caſes only. Nevertheleſs, it is practicable to prevent contractions in the hoofs from taking place, even in thoſe hoofs which are ſeemingly diſpoſed that way from their ſhape, &c. by obſerving the rules already laid down, viz. by keeping the hoofs moiſt and cool, which is their natural ſtate; uſing flat ſhoes, from which the hoofs can acquire no bad ſhape; allowing the ſole and frog to continue in their full ſtrength, the latter eſpecially to reſt upon the ground; and keeping the cruſt within due bounds, not ſuffering it to grow too long towards the toe, nor too high at the heels.

Sect. VII. *Of* Corns.

In the human body, corns in the feet are termed ſo with ſome propriety, from their horny ſubſtance; but what are called *corns* in the feet of horſes are not very properly named, as they are not of a ſimilar nature, but rather reſemble contuſions or bruiſes, and not unlike thoſe hardneſſes which happen in the palms of the hands and fingers to working people, ariſing from violent pinching, bruiſing, &c. where the ſkin is thick. They appear of a blackiſh red colour, and exceedingly painful at firſt, containing blood; but in the end, the ſerum or thinner parts being abſorbed, the red particles appear when the dead ſkin is removed, like red powder. In like manner, corns in a horſe's foot appear red and *foxy*, as the phraſe is. They are ſituated in the corner or ſharp angle of the ſole at the extremity of the heels, where the cruſt reflects inward and forward, forming the binders. But they are more frequently to be met with in the inſide heel, from the manner of the horſe's ſtanding, toge-

ther with the preſſure or weight of the body, which is greater upon the inſide of the hoof than the outſide. Bruiſes of this kind are exceedingly painful, inſomuch that the horſe ſhrinks and ſtumbles when any thing touches or preſſes upon that quarter of the hoof; hence proceeds lameneſs.

This complaint ariſes from different cauſes, according to the ſhape or natural formation of the hoof, together with the treatment it has been expoſed to. But the following cauſes are the moſt frequent:

1. In flat low heels, from too great a preſſure of the ſhoe-heel upon the ſole, whether from caukers, a too great thickneſs of iron upon the heels of the ſhoe, or its being bended downwards upon the ſole, or the ſhoe made too concave; either of theſe cauſes will produce the ſame effect: for, from the too great preſſure upon the horny ſole, the fleſhy ſole, which lies immediately underneath it, is compreſſed and bruiſed between the ſhoe-heel, the ſole, and the extremities or outward points of the coffin-bone; and hence a contuſion or bruiſe, attended with an extravaſation of the blood, which afterwards gives that part of the ſole a red appearance, and is the reaſon why the ſole on that place never grows up ſo firm and ſolid as it was before, but remains ſoft and ſpongy, forming a lodgement for ſand or gravel, which frequently inſinuates itſelf into the quick, cauſing an inflammation, attended with a ſuppuration or diſcharge of matter, which, if not finding a paſſage below, will break out at the coronet.

2. This complaint is produced in wide open heels, when the hoofs are very thick and ſtrong, from too great a luxuriancy of the binder, which, being inflected or bended downwards between the ſhoe and the ſole, compreſſes the fleſhy ſole, as already mentioned; and hence lameneſs is produced.

3. This malady, in deep narrow hoofs, proceeds from a contraction of the cruſt compreſſing the heels, &c. Hence, it not unfrequently happens in hoofs of this ſhape, that both heels are alike affected, from the ſtricture and preſſure of the hardened cruſt upon the tendinous aponeuroſis, &c. on the outſide of the coffin-bone, which in this caſe is bruiſed between the bone and the cruſt; hence the redneſs may ſometimes be traced upwards almoſt to the coronet. In this caſe no radical cure can take place, as the cauſe which produces theſe bruiſes, &c. will exiſt while the horſe lives, and at the ſame time the horſe will be lame from the contraction of the hoof; but the remedy propoſed in the preceding ſection, by way of palliation for hoof-bound feet, may be of uſe to render the horſe in ſome meaſure more ſerviceable.

With reſpect to the two firſt cauſes, when the bruiſe proceeds from too great a preſſure from the ſhoe-heels, &c. upon the ſole, the ſhoe muſt be made ſo as to bear off the tender part, and likewiſe to ſome diſtance on both ſides of it; for which purpoſe, a round or a barred ſhoe will be neceſſary. The red and bruiſed parts muſt be cut out to the quick, and the hoof kept ſoft with emollient poultices for ſome time. But the texture of the blood-veſſels, and likewiſe that of the hoof at the bruiſed part, being deſtroyed, a ſpongineſs remains afterwards, and upon the leaſt unequal preſſure from the ſhoe, &c. they are liable to a relapſe, never admitting of a thorough cure, and of conſequence ſubject to frequent lameneſs.

Corns or bruiſes in the feet of horſes might, by taking proper care of them, be eaſily avoided: for in thoſe countries where horſes go moſtly barefooted, this malady is not ſo much as known; neither are thoſe horſes that go conſtantly at cart and plough ſubject to them: hence, therefore, this complaint is moſt frequently to be met with in great towns, where horſes go much upon hard pavement, having their ſhoes turned up with high caukers on the heels, and frequently renewed, at the ſame time their hoofs being kept too dry and hard, from ſtanding too much upon hot dry litter: hence will appear the neceſſity of complying with what is moſt natural to the hoofs of horſes, namely, coolneſs and moiſture, together with uſing ſuch a form of ſhoe as will preſs equally upon the circumference of the cruſt, and without giving it any bad unnatural ſhape. See ſect. X.

Sect. VIII. *Of* Running Thrush *and* Canker.

1. A *Running Thruſh* (or *Fruſh*) is a diſcharge of a fetid, and ſometimes ichorous, matter from the cleft in the middle of the frog, affecting one, frequently both, and in ſome caſes all the four feet: but, generally, the fore-feet are moſt ſubject to this diſeaſe. In moſt caſes, it ſeldom admits of a radical cure; but is ſubject to frequent relapſes, occaſioning lameneſs, from the rawneſs and tenderneſs of the parts affected, on being expoſed to ſand, gravel, &c. or in rough ground, from the heels treading on ſharp ſtones, &c. and when the horſe happens to be of a bad habit of body, the complaint may degenerate into what is commonly called a *canker*.

Running thruſhes, according to Mr. Gibſon, "are ſometimes profitable to horſes of fleſhy and foul conſtitutions; becauſe (ſays he) they drain off a great many bad humours." But however ſalutary or beneficial they may be in ſome particular conſtitutions, yet, upon the whole, they prove extremely troubleſome, on account of the lameneſs and tenderneſs of the feet affected with them; and, where there occurs one caſe in which they may properly be ſaid to become beneficial to the conſtitution, there are a far greater number in which they are hurtful, as they are brought on by the treatment the hoofs are expoſed to, together with the injudicious method generally obſerved in ſhoeing them, particularly in thoſe hoofs that are narrow-heeled, or diſpoſed to be hoof-bound, the running thruſh being moſtly an attendant upon that complaint. But, to explain this more particularly: there is, in the middle of the frog, a cleft or opening, by which the heels in a natural ſtate have a ſmall degree of contraction and expanſion, eſpecially when the horſe treads or preſſes his heel upon the ground, the frog then expands; when, therefore, a horſe is ſhoed with concave or hollow ſhoes, the heels are deprived of that power of expanſion, being conſtantly confined in a contracted ſtate by the reſiſtance from the outer edges of the concave ſhoe, by which the frog is preſſed or ſqueezed on both ſides, by the cruſt of the heels being brought nearer to or almoſt into contact with one another. Hence pain, inflammation, an obſtruction of the blood, &c. in the fleſhy ſubſtance of the frog, and of courſe that waſting and rottenneſs of its external covering, which, falling off in pieces, leaves the quick almoſt bare. The new frog, growing in detached pieces, never acquires the ſolidity of the former; and hence that rawneſs and tenderneſs which ever afterwards remain, and that extreme ſenſibility of pain when any hard ſubſtance touches that part of the foot, which of courſe ſubjects the horſe to frequent lameneſs. There are, no doubt, other cauſes which may be ſaid to occaſion this malady, even in thoſe hoofs that are ſufficiently wide and open, and where there is not the leaſt appearance of a contraction at the heels: but theſe are generally owing to the treatment the hoofs are expoſed to in the ſtable, by keeping them too hot and dry for a long ſpace of time together, during which the natural perſpiration is greatly obſtructed, by the conſtant application of greaſe or oil to the hardened hoofs, and ſtuffing them up with hot, reſinous, and greaſy mixtures, as tar, turpentine, &c. the horſe being all the while kept at full feeding, and not having proper and neceſſary exerciſe to promote the circulation of the fluids, and to forward the ordinary ſecretions, &c. The legs firſt ſwell and inflame; at laſt a running in the frog appears; and hence this diſcharge is ſaid to be beneficial to the conſtitution, when in fact it is but too frequently brought on by a ſlothful neglect, and kept up by bad management. Freſh air and regular exerciſe are eſſentially neceſſary

towards preserving horses in an active healthy state; for running thrushes, like other diseases to which pampered horses are subject, are not known in those countries where horses run at large in the fields; neither are they so frequently to be met with in the country amongst labouring horses, whose exercise is regular, and whose hoofs are much exposed to coolness and moisture, the natural state of the feet of horses.

With respect to the cure of a running thrush, it has been hinted, that in most cases, especially where it has been of long standing, affecting all the feet more or less, it is impracticable to eradicate it by any assistance from art. For instance, when it proceeds from contracted narrow heels in those feet which are said to be hoof-bound, it is then an attendant only on that disease; and therefore cannot be cured without removing the first cause, though then it will only admit of some small degree of palliation: see sect. vi. But in those hoofs which are wide and open at the heels, where the complaint is recent, one or both the fore-feet only being affected, and where there is reason to suspect that it proceeds from the use of concave or hollow shoes, or keeping the hoofs too hot, dry, and hard, the cure then may be completed without difficulty, by laying aside the use of concave shoes, washing the frogs clean after exercise, and dressing them with mel Egyptiacum, made as follows:

Mel Egyptiacum. Verdegris, in fine powder, two ounces; honey, six ounces; vinegar, four ounces; boil them over a gentle fire till they have acquired a reddish colour.

Or a solution of blue vitriol.

Solution of vitriol. Blue vitriol, powdered, one ounce; water, one quart:

keeping the hoofs cool and moist. But, at the same time, recourse must be had to purging or diuretic medicines, bleeding being first premised: if the former is made choice of, twice or thrice will be sufficient, repeated at proper intervals; but if the latter, which seems preferable, they may be continued for some time with great safety, without losing one day's work of the horse.

In some cases, there is frequently not only a discharge of fetid matter from the clefts of the frogs; but, at the same time, a discharge of grease-like matter from the round protuberances of the heels, and the hollow of the pastern joints. It will be necessary, therefore, to make a distinction between the matter discharged in this case, which appears of a thick, white, clammy, or soapy consistence, and that running in the legs commonly termed a *grease*, which is of a quite opposite quality; the latter by good management will admit of a thorough cure, whilst the former baffles all the power of medicine.

2. In horses of a gross habit of body, especially the heavy draught-kind, the running thrush sometimes degenerates into an incurable disease called a *canker*. In this case, the horny substance of the frog is soon thrown off; the fleshy parts grow to an immoderate size, the luxuriant substance or spongy flesh having a great number of papillæ or tubercles, which Mr. Gibson compares not improperly to cauliflower, the colour only excepted, which is of a pale red, and sometimes variegated and tinged with blood; attended with a copious discharge of a thin ichorous fetid humour, having a most offensive smell. If its progress be not speedily stopped, the fleshy sole, from its vicinity, becomes likewise affected; the horny sole rots, decays, and falls off: the whole foot turns into a kind of quag or bog (in warm weather full of maggots, which it is almost impossible to prevent, even with the most corrosive dressings); the tendons become likewise affected, the bones carious, the hoof falls off, and the horse is rendered useless. To prevent these and the like consequences, as soon as a running thrush begins to show the least malignant disposition, proper means must be used to correct the habit of body, and to divert this discharge to some other outlet, either by purging or diuretic remedies, continued for some time, bleeding being first premised. As to external applications, the first thing that is necessary to be done, is to pare down the crust till it is lower than the fungus, or growth of the canker, and to remove any hard pieces of the hoof or sole wherever it presses upon the tender parts; the circular part of the crust should be surrounded and kept soft with an emollient poultice. For dressings, the milder escharotic powders may be first tried, as the following:

Take burnt alum powdered, two ounces; blue vitriol powdered, one ounce.

But when it degenerates into the last species mentioned above, affecting the fleshy sole, &c. the strongest corrosive applications will then be necessary, and sometimes hardly sufficient to keep down the luxuriancy of the fungus. The caustic oils are found preferable, as oil of vitriol, aquafortis, butter of antimony: either of these may be applied once every day; otherwise, if neglected dressing too long, or to every other day, which is the common practice, the great humidity and moisture issuing from the fungus so weakens the force of the strongest oils, that they have little or no effect: when these sharp dressings seem to gain upon the canker, it may be dressed with equal parts of red precipitate and burnt alum pounded and mixed together, till such time as the new sole begins to grow; the purging or diuretic medicines being given at proper intervals till the cure is completed.

Sect. IX. *Of* False-quarter, *and* Sand-cracks.

1. What is commonly called a *false-quarter* in the foot of a horse is a cleft or chink in the side or quarter of the hoof, running in a slanting direction with the horny fibres of the hoof, from the coronet to its basis, by which the horny substance of the crust is divided; one part of the hoof being in a manner detached from the other, and rendered unable to sustain its portion or share of the weight of the limb, &c. and hence the name of *false-quarter*: for, when the horse sets his foot on the ground, the chink widens; but, when it is lifted up, the hardened edges of the divided hoof take in between them the tender and soft parts, and squeeze them so as to occasion frequent bleeding at the chink. This is frequently attended with inflammation, a discharge of matter, and of course lameness.

This complaint, notwithstanding the different accounts commonly given as to the cause of it, is in fact the effect of a deep wound or bruise upon the coronet, by which the continuity of the parts has been entirely broken off; for we always find, that when the horny fibres are divided at their roots, they never unite or grow up as before, but leave a blemish, more or less, in proportion to the size and deepness of such wounds, &c. We have many instances of this, even in the human body; for when a wound happens at the root of the nail, whether in the fingers or toes, it occasions a blemish, which continues to grow in the same manner afterwards. Hence it will be evident, that no radical cure can possibly take place; but we may so far palliate the complaint as to render the horse something useful, by using a shoe of such a construction as will support the weight of the limb, &c. without resting or pressing too much upon the weakened quarter; for which purpose, a round, or what is called a *barred shoe*, will be most proper. The surface of the hoof on and near the diseased part may be cut down lower than the surface of the crust upon which the shoe is to rest; or, if the hoof will not admit of being cut down, the shoe may be raised up from the weak quarter. Either of these means will remove the weight of the body from the diseased part, and the horse will of course be relieved.

But as sand or gravel is easily admitted into the chink or crack, where, being accumulated and pent up, it irritates and inflames the parts, whereby matter is formed underneath the hoof, which causes lameness, and which not unfrequently breaks out at the coronet, producing the most inveterate ul-

cers, which become extremely difficult to heal, on account of the ſinus or fiſtula branching out in different directions underneath the hoof: therefore, horſes with this defect ſhould be carefully obſerved; and, when the thick-hardened edges of the chink or crack grow too high, by which it is ſo much the deeper, and, of courſe, lodges the greater quantity of ſand, &c. theſe edges ſhould be raſped, or pared with a crooked knife, till the ſeam diſappears. But wherever there remains a blackneſs, or appearance of gravel, that part muſt be traced farther; always obſerving, if poſſible, to avoid drawing blood. The chink or crack thus made ſmooth and equal, no ſand or gravel can lodge in it; and as the parts will be tender, it will be neceſſary to apply an emollient poultice for ſome days, till the tenderneſs wears off. If the inflammation has been great, and matter formed in the crack, or the parts wounded by the knife in cutting its hardened edges, granulations of fleſh may riſe and jet out; but theſe may be reſtrained by dry lint and preſſure, without the uſe of eſcharotics, which are abſurd, as well as cruel, applications, where the fleſh produced is of a natural and healthy kind.

2. A *ſand-crack* is a perpendicular fiſſure extending more or leſs from above downwards, or from below upwards, but in all inſtances penetrating to the ſenſible parts, and thus cauſing lameneſs when the animal puts himſelf in motion. Where this happens there is a preternatural brittleneſs and dryneſs of the hoof, which ſhould be counteracted, either by turning the horſe out upon wet ground, or by applying moiſt poultices to his feet when in the ſtable.

Where a ſand-crack extends to the coronet, the veſſels whoſe office it is to ſecrete that matter which regenerates the hoof, are prevented from throwing out their contents in ſuch a way, as to produce a continuity of ſurface; the cauſe of this is principally the interruption occaſioned by the motions of the horſe, which continually produce motion between the two ſides of the fiſſure.

When a ſand-crack is firſt perceived, there is a mode by which the extent of the miſchief may be in ſome degree limited, and which ought in all caſes to be put in practice. This conſiſts in making a tranſverſe inciſion of ſome depth, about a ſtraw's breadth above (or below, if the crack proceeds downwards) the extreme portion of the fiſſure. To effect a cure of this diſeaſe, the ſides of the crack muſt be pared through its whole length, and the tranſverſe inciſion alſo made, after which the re-production of the hoof from the coronet muſt be watched, and when favourable, it muſt be ſecured from ſplitting in conſequence of motion communicated from the old crack, by another tranſverſe cut or inciſion in the cruſt.

By this kind of management, this diſeaſe ſo exceedingly detrimental to horſes may be got the better of. But in order to prevent its return, or the formation of cracks in other parts of the hoof, every method ſhould be taken to counteract the brittleneſs of the latter, as on that alone depends the healthineſs of the animal in this particular.

Sect. X. *Of* Cutting *in Travelling.*

It frequently happens that horſes cut their legs both before and behind, by ſtriking or knocking the ſhoe, when trotting, againſt the oppoſite leg, whereby a wound is made, which is attended with an inflammation, ſwelling, &c. and of courſe lameneſs. The parts commonly wounded, from cutting in the fore-legs, are the prominent and back part of the fetlock joint; and under the knee joint on the inſide of the leg. The former is moſt common: the latter only happens to thoſe horſes that raiſe their feet high in trotting; and, as ſuch horſes generally go faſt, this laſt ſpecies of cutting is diſtinguiſhed by the name of the *ſwift* or *ſpeedy cut*. In the hind-legs, horſes cut themſelves upon the prominent part of the fetlock-joint; and ſometimes, eſpecially thoſe who move their legs too low, cut upon the coronet. But whether they cut before or behind, it commonly proceeds from ſome of the following cauſes:

1. Injudicious ſhoeing; under which may be included, the hoofs being ſuffered to grow too large and broad, the ſhoe projecting over the inſide edge of the hoof, the clenches or rivets of the nails riſing above the ſurface of the cruſt.

There are a great variety of ſhoes recommended for preventing this complaint, of different conſtructions; but the moſt common are thoſe that are made thick upon the inſide heel. Others have a border or margin turned up upon the inſide of the ſhoe's rim, commonly called a *feather*, which raiſes the inſide of the hoof conſiderably higher from the ground than the outſide. Either of theſe ſhoes may be of uſe to a dealer, in order to make a wry-footed horſe appear to ſtand ſtraight upon his limbs; but can have no effect upon a horſe's manner of moving his legs, eſpecially at the time when the foot is raiſed from the ground, and paſſing by the other leg, ſo as to prevent him from cutting. The reaſon why this method of ſhoeing ſeems to ſucceed, eſpecially in the hind-feet, is this: When the ſhoe is made thick upon the inſide heel, which part commonly ſtrikes the oppoſite leg, the ſhoe-nails are removed to a conſiderable diſtance forward from the thick part of the ſhoe, which, at the ſame time, is kept much within the circle of the hoof; and, on that account, it becomes impoſſible that the ſhoe ſhould touch the oppoſite leg. But, to ſhow that this raiſing of the inſide quarter or heel, by a thickneſs of iron in the ſhoe, is not neceſſary to prevent horſes from cutting, the author has frequently cauſed the heel of the ſhoe to be made thinner than common; and, by keeping it within the hoof, it anſwered equally well with the former: he has likewiſe cauſed the ſhoe to be cut in the middle of the quarter, whereby the hoof at the heel was left quite bare; which anſwered the purpoſe ſo much the better, as the foot was the leſs loaded with the additional weight of ſuperfluous iron.

2. The great weight of the concave ſhoes commonly uſed, is likewiſe another cauſe why horſes, that in other reſpects move well upon their legs, do frequently cut and wound themſelves; and to this we may add, the great length of the hoof at the toe, eſpecially in the fore-feet, which is allowed frequently to grow to an unnatural ſize. It has been already obſerved, that a great load of iron is by no means neceſſary in a horſe's ſhoe: on the contrary, it becomes a great diſadvantage; for a flat one that is properly conſtructed, and well wrought, that is, well hammered, will wear as long as a concave or hollow ſhoe that is almoſt double the weight of the former. This, at firſt view, will perhaps appear a paradox; but, nevertheleſs, it is a fact: for as the round or outward ſurface of a concave ſhoe is the only part that touches the ground, and is liable to be worn, it ſoon grows thin, and yields to the preſſure from the weight of the body; and therefore muſt be renewed before the other parts of it are hardly touched, and but little reduced in its original weight. But the ſurface of a flat ſhoe, reſting equally upon the ground, will remain firm upon the hoof, and be ſufficiently ſtrong to ſupport the weight of the body till it wears very thin.

When horſes cut or wound themſelves immediately under the knee-joint, this is called the *ſwift* or *ſpeedy cut*; and is occaſioned by raiſing the feet high in trotting, whereby the inſide toe or quarter of the hoof ſtrikes againſt the oppoſite leg. This is eaſily prevented by making the ſhoe ſtraight, and placing it conſiderably within the hoof at the part where the hoof ſtrikes the other leg, obſerving that no nails are to be put in that part of the ſhoe which is kept ſo much within the hoof, otherwiſe they muſt immediately plunge into the quick.

3. When cutting proceeds from a natural defect, that is, a wrong poſition of the foot upon the leg-bones, whereby the toes are turned too much outward or too much inward; at the ſame

time, if the horfe croffes his legs much in trotting; in this cafe there is no preventing his cutting altogether, though it may be palliated. Such horfes are by no means fit for travelling, being generally addicted both to cutting and ftumbling.

4. This accident may proceed from fatigue or weaknefs, which happens frequently, even to thofe horfes that deal their legs well (as the phrafe is), efpecially in young horfes; but they foon leave it off when they acquire more ftrength, and are accuftomed to their work. Moft people muft have experienced this in themfelves when boys, as they at that age are very ready to knock their ancles with the heel of the oppofite fhoe, which cuftom wears off as they grow ftrong. Upon the whole, the beft general rule that can be laid down for preventing horfes from cutting their legs, is to keep their hoofs round and fhort at the toe, and from growing too large and broad; to obferve that the fhoe does not project over the infide edge of the hoof; that the clenches or rivets of the nails on the outer furface of the cruft are fmooth; and, above all, that the fhoe be made light, well worked, and properly proportioned to the fize of the foot. See the following fection:

Sect. XI. *Of* Shoeing.

Horses are fhod with iron in order to defend and preferve their hoofs. As feet differ, fo fhould fhoes accordingly. In a judicious treatife on this fubject by Mr. Clark of Edinburgh, the common form of fhoes and the method of fhoeing are, with great reafon, totally condemned, and a new method recommended, which feems founded on rational principles, and to have been confirmed by experience.

" In preparing the foot for the fhoe according to the common method, our author obferves, the frog, the fole, and the bars or binders, are pared fo much, that the blood frequently appears. The fhoe by its form (being thick on the infide of the rim, and thin upon the outfide, fee plate 22.) muft of confequence be made concave or hollow on that fide which is placed immediately next the foot, in order to prevent its refting upon the fole. The fhoes are generally of an immoderate weight and length, and every means is ufed to prevent the frog from refting upon the ground, by making the fhoe heels thick, broad, and ftrong, or raifing cramps or caukers on them.

" From this form of the fhoe, and from this method of treating the hoof, the frog is raifed to a confiderable height above the ground, the heels are deprived of that fubftance which was provided by nature to keep the cruft extended at a proper widenefs, and the foot is fixed as it were in a vice.

" By the preffure from the weight of the body, and refiftance from the outer edges of the fhoe, the heels are forced together, and retain that fhape impreffed upon them, which it is impoffible ever afterwards to remove; hence a contraction of the heels, and of courfe lamenefs. But farther—

" The heels, as has been obferved, being forced together, the cruft preffes upon the proceffes of the coffin and extremities of the nut-bone: the frog is confined, and raifed fo far from the ground, that it cannot have that fupport upon it which it ought to have: the circulation of the blood is impeded, and a wafting of the frog, and frequently of the whole foot, enfues. Hence proceed all thofe difeafes of the feet, known by the names of *founder, hoof-bound, narrow-heels, thrufhes, corns, high foles*, &c.

" I have likewife frequently obferved, from this compreffion of the internal parts of the foot, a fwelling of the legs immediately above the hoof, attended with great pain and inflammation, with a difcharge of thin, ichorous, fetid matter: from which fymptoms, it is often concluded, that the horfe is in a bad habit of body (or what is termed a *greafe falling down)*, and muft therefore undergo a courfe of medicine, &c.

" The bad effects of this practice are ftill more obvious upon the external parts of the hoof. The cruft toward the toe, being the only part of the hoof free from compreffion, enjoys a free circulation of that fluid neceffary for its nourifhment, and grows broader and longer; from which extraordinary length of toe, the horfe ftumbles in his going, and cuts his legs. The fmaller particles of fand infinuate themfelves between the fhoe and the heels, which grind them away, and thereby produce lamenefs. All this is entirely owing to the great fpring the heels of the horfe muft unavoidably have upon the heels of a fhoe made in this form.

" This concave fhoe in time wears thin at the toe, and, yielding to the preffure made upon it, is forced wider, and of confequence breaks off all that part of the cruft on the outfide of the nails. Inftances of this kind daily occur, infomuch that there hardly remains cruft fufficient to fix a fhoe upon.

" It is generally thought, that the broader a fhoe is, and the more it covers the fole and frog, a horfe will travel the better. But, as has been formerly remarked, the broader a fhoe is of this form, it muft be made the more concave; and, of confequence, the contracting power upon the heels muft be the greater. It is likewife to be obferved, that, by ufing ftrong broad-rimmed concave fhoes in the fummer-feafon, when the weather is hot and the roads very dry and hard, if a horfe is obliged to ride faft, the fhoes, by repeated ftrokes (or friction) againft the ground, acquire a great degree of heat, which is communicated to the internal parts of the foot; and, together with the contraction upon the heels occafioned by the form of the fhoe, muft certainly caufe exquifite pain. This is frequently fucceeded by a violent inflammation in the internal parts of the hoof, and is the caufe of that difeafe in the feet fo fatal to the very beft of our horfes, commonly termed a *founder*. This is alfo the reafon why horfes, after a journey or a hard ride, are obferved to fhift their feet fo frequently, and to lie down much.

" If we attend further to the convex furface of this fhoe, and the convexity of the pavement upon which horfes walk, it will then be evident that it is impoffible for them to keep their feet from flipping in this form of fhoe, efpecially upon declivities of ftreets.

" It is alfo a common practice, efpecially in this place, to turn up the heels of the fhoes into what is called *cramps* or *caukers*, by which means the weight of the horfe is confined to a very narrow furface, viz. the inner round edge of the fhoe-rim and the points or caukers of each heel, which foon wear round and blunt; befides, they for the moft part are made by far too thick and long. The confequence is, that it throws the horfe forward upon the toes, and is apt to make him flip and ftumble. To this caufe we muft likewife afcribe the frequent and fudden lamenefs horfes are fubject to in the legs, by twifting the ligaments of the joints, tendons, &c.

" I do not affirm that caukers are always hurtful, and ought to be laid afide: on the contrary, I grant, that they, or fome fuch-like contrivance, are extremely neceffary, and may be ufed with advantage upon flat fhoes where the ground is flippery; but they fhould be made thinner and fharper than thofe commonly ufed, fo as to fink into the ground, otherwife they will rather be hurtful than of any advantage.

" The Chinefe are faid to account a fmall foot an ornament in their women, and for that purpofe, when young, their feet are confined in fmall fhoes. This no doubt produces the defired effect; but muft neceffarily be very prejudicial to them in walking, and apt to render them entirely lame.

" This practice, however, very much refembles our manner of fhoeing horfes: for, if we looked upon it as an advantage to them to have long feet, with narrow low heels, and fuppofing we obferved no inconvenience to attend it, or bad confequence to follow it, we could not poffibly ufe a more effectual means to bring it about, than by following the method already defcribed.

" In fhoeing a horfe, therefore, we fhould in this, as in

every other cafe, ftudy to follow nature: and certainly that fhoe which is made of fuch a form as to refemble as near as poffible the natural tread and fhape of the foot, muft be preferable to any other.

"But it is extremely difficult to lay down fixed rules with refpect to the proper method to be obferved in treating the hoofs of different horfes: it is equally difficult to lay down any certain rule for determining the precife form to be given their fhoes. This will be obvious to every judicious practitioner, from the various conftructions of their feet, from difeafe, and from other caufes that may occur; fo that a great deal muft depend upon the difcretion and judgment of the operator, in proportioning the fhoe to the foot, by imitating the natural tread, to prevent the hoof from contracting a bad fhape.

"In order, therefore, to give fome general idea of what may be thought moft neceffary in this matter, I fhall endeavour to defcribe that form of fhoe and method of treating the hoofs of horfes, which from experience I have found moft beneficial.

The following Mr. Clark recommends as the *proper* method. "It is to be remembered (fays he) that a horfe's fhoe ought by no means to reft upon the fole, otherwife it will occafion lamenefs; therefore it muft reft entirely on the cruft: and, in order that we may imitate the natural tread of the foot, the fhoe muft be made flat (if the height of the fole does not forbid it); it muft be of an equal thicknefs all around the outfide of the rim; and on that part of it which is to be placed immediately next the foot, a narrow rim or margin is to be formed, not exceeding the breadth of the cruft upon which it is to reft, with the nail-holes placed exactly in the middle; and from this narrow rim the fhoe is to be made gradually thinner towards its inner edge. See fig. 1. and 2.

"The breadth of the fhoe is to be regulated by the fize of the foot, and the work to which the horfe is accuftomed: but, in general, it fhould be made rather broad at the toe, and narrow towards the extremity of each heel, in order to let the frog reft with freedom upon the ground. The neceffity of this has been already fhown.

"The fhoe being thus formed and fhaped like the foot, the furface of the cruft is to be made fmooth, and the fhoe fixed on with eight or at moft ten nails, the heads of which fhould be funk into the holes, fo as to be equal with the furface of the fhoe. The fole, frog, and bars, as I have already obferved, fhould never be pared, farther than taking off what is ragged from the frog, and any excrefcences or inequalities from the fole. And it is very properly remarked by Mr. Ofmer, 'That the fhoe fhould be made fo as to ftand a little wider at the extremity of each heel than the foot itfelf: otherwife, as the foot grows in length, the heel of the fhoe in a fhort time gets within the heel of the horfe; which preffure often breaks the cruft, and produces a temporary lamenefs, perhaps a corn.'

"This method of fhoeing horfes I have followed long before Mr. Ofmer's treatife on that fubject was publifhed; and for thefe feveral years paft I have endeavoured to introduce it into practice.

"But fo much are farriers, grooms, &c. prejudiced in favour of the common method of fhoeing and paring out the feet, that it is with difficulty they can even be prevailed upon to make a proper trial of it.

"They cannot be fatisfied unlefs the frog be finely fhaped, the fole pared, and the bars cut out, in order to make the heels appear wide. This practice gives them a fhow of widenefs for the time; yet that, together with the concave form of the fhoe, forwards the contraction of the heels, which, when confirmed, renders the animal lame for life.

"In this flat form of fhoe, its thickeft part is upon the outfide of the rim, where it is moft expofed to be worn; and being made gradually thinner towards its inner edge, it is therefore much lighter than the common concave fhoe: yet it will laft equally as long, and with more advantage to the hoof; and as the frog or heel is allowed to reft upon the ground, the foot enjoys the fame points of fupport as in its natural ftate. It muft therefore be much eafier for the horfe in his way of going, and be a means of making him furer-footed. It is likewife evident, that, from this fhoe, the hoof cannot acquire any bad form; when, at the fame time, it receives every advantage that poffibly could be expected from fhoeing. In this refpect it may very properly be faid, that we make the fhoe to the foot, and not the foot to the fhoe, as is but too much the cafe in the concave fhoes, where the foot very much refembles that of a cat's fixed into a walnut-fhell.

"It is to be obferved, that the hoofs of young horfes, before they are fhoed, for the moft part are wide and open at the heels, and that the cruft is fufficiently thick and ftrong to admit of the nails being fixed very near the extremities of each. But, as I have formerly remarked, from the conftant ufe of concave fhoes, the cruft of this part of the foot grows thinner and weaker; and when the nails are fixed too far back, efpecially upon the infide, the horfe becomes lame: to avoid this, they are placed more towards the fore-part of the hoof. This caufes the heels of the horfe to have the greater fpring upon the heels of the fhoe, which is fo very detrimental as to occafion lamenefs; whereas, by ufing this flat form of fhoe, all thefe inconveniences are avoided; and if the hoofs of young horfes, from the firft time that they were fhoed, were continued to be conftantly treated according to the method here recommended, the heels would always retain their natural ftrength and fhape.

"By following this flat method of fhoeing, and manner of treating the hoofs, feveral horfes now under my care, that were formerly tender-footed, and frequently lame, while fhoed with broad concave fhoes, are now quite found, and their hoofs in as good condition as when the firft fhoes were put upon them: In particular, the horfe that wore the broad concave fhoes, from which the drawings of fig. 3. and 4. were taken, now goes perfectly found in the open narrow kind of fhoes, as reprefented fig. 1. 2.

"If farriers confidered attentively the defign of fhoeing horfes, and would take pains to make themfelves acquainted with the anatomical ftructure of the foot, they would then be convinced, that this method of treating the hoofs, and this form of fhoe, is preferable to that which is fo generally practifed.

"It has been alleged, that in this form of fhoe horfes do not go fo well as in that commonly ufed. This objection will eafily be laid afide, by attending to the following particulars. There are but few practitioners that can or will endeavour to make this fort of fhoe as it ought to be. The iron, in forming it, does not fo eafily turn into the circular fhape neceffary as in the common fhoe; and perhaps this is the principal reafon why farriers object to it, efpecially where they work much by the piece. And as many horfes that are commonly fhoed with concave fhoes have their foles confiderably higher than the cruft, if the fhoe is not properly formed, or if it is made too flat, it muft unavoidably reft upon the fole, and occafion lamenefs.

"The practice of paring the fole and frog is alfo fo prevalent, and thought fo abfolutely neceffary, that it is indifcriminately practifed, even to excefs, on all kinds of feet: And while this method continues to be followed, it cannot be expected that horfes can go upon hard ground (on this open fhoe) with that freedom they would do if their foles and frogs were allowed to remain in their full natural ftrength.

"Experience teaches us, that, in very thin-foled fhoes, we feel an acute pain from every fharp-pointed ftone we happen to tread upon. Horfes are fenfible of the fame thing in their feet,

when their soles, &c. are pared too thin. Hence they who are prejudiced against this method, without ever reflecting upon the thin state of the sole, &c. are apt to condemn it, and draw their conclusions more from outward appearances than from any reasoning or knowledge of the structure of the parts. From a due attention likewise to the structure of a horse's foot in a natural state, it will be obvious, that paring away the sole, frog, &c. must be hurtful, and in reality is destroying that substance provided by nature for the defence of the internal parts of the foot: From such practice it must be more liable to accidents from hard bodies, such as sharp stones, nails, glass, &c. From this consideration we shall likewise find, that a narrow piece of iron adapted to the shape and size of the foot, is the only thing necessary to protect the crust from breaking or wearing away; the sole, &c. requiring no defence if never pared.

"There is one observation I would farther make, which is, that the shoe should be made of good iron, well worked, or what smiths call *hammer-hardened*, that is, beat all over lightly with a hammer when almost cold. The Spaniards and Portuguese farriers use this practice greatly, insomuch that many people, who have seen them at work, have reported that they form their horses' shoes without heating them in the fire as we do. It is well known, that heating of iron till it is red softens it greatly; and when shoes thus softened are put upon horses' feet, they wear away like lead. But when the shoes are well hammered, the iron becomes more compact, firm, and hard; so that a well-hammered shoe, though made considerably lighter, yet will last as long as one that is made heavier; the advantage of which is obvious, as the horse will move his feet with more activity, and be in less danger of cutting his legs.

"The common concave shoes are very faulty in this respect; for, in fitting or shaping them to the foot, they require to be frequently heated, in order to make them bend to the unequal surface which the hoof acquires from the constant use of these shoes: they thereby become soft; and to attempt to harden them by beating or hammering when they are shaped to the foot would undo the whole. But flat shoes, by making them, when heated, a little narrower than the foot, will, by means of hammering, become wider, and acquire a degree of elasticity and firmness which it is necessary they should have, but impossible to be given them by any other means whatever; so that any farrier, from practice, will soon be able to judge, from the quality of the iron, how much a shoe, in fitting it to the circumference of the hoof, will stretch by hammering when it is almost cold: this operation, in fitting flat shoes, will be the less difficult, especially when it is considered, that as there are no inequalities on the surface of the hoof (or at least ought not to be) which require to be bended thereto, shoes of this kind only require to be made smooth and flat; hence they will press equally upon the circumference or crust of the hoof, which is the natural tread of a horse."

There can be no doubt but the foregoing observations of Mr. Clark are extremely judicious; yet it should not pass unnoticed, that this subject has also occupied the attention of two or three later writers, who have each brought forward some remarks on the subject of shoeing, and particularly on the most advantageous construction of the *shoe*; of these we shall here take some little notice.

Mr. St. Bel, the first professor that was appointed at the VETERINARY COLLEGE, constructed a shoe differing from the common one, in being somewhat convex even on that side which was placed in contact with the horse's foot, but considerably so on that surface which was presented to the ground. On this plan the horses sent for shoeing to the college were for some time shod; and it cannot be denied, that if every horse so sent had had the advantage of a perfectly natural hoof, Mr. St. Bel's shoe might have been found worthy the name of an improvement, since its formation was certainly adapted to what the shape of the horse's foot naturally is, and ought to be, if the farriers would permit. As the case was otherwise, however, in a great majority of instances, many who had sanguine expectations from the invention were disappointed. Nevertheless this shoe has its advantages, which are set forth at large by the author in a quarto volume on the subject, and to which we refer the reader.

From Mr. Taplin we have a form of a shoe recommended, which, as far as can be judged from the delineation, (pl. 22.) differs little from that of Mr. St. Bel; and that gentleman's language is so little remarkable for perspicuity, that we feel no disposition to give a place here to his copious descriptions on the subject.

By Mr. Coleman, the present ingenious professor at the Veterinary College, we are presented with what appears to be a material improvement. In his public lectures that gentleman has observed, that, for a good natural foot (see the plate), all that is required by way of a shoe, is to guard the crust by a small and narrow piece of iron, which should be attached principally towards the toe, and should not be extended so far back as the heel.

The sole itself, he asserts, should not be covered by the shoe; for dirt and stones will get between, and will form a permanent and partial pressure on the sole, which will produce disease. According to the present mode of shoeing, it is observable, that those diseases which affect the horse's foot constantly take place on that portion of it which is covered by the extended breadth of the shoe, while the exposed parts escape and remain uninjured. The reason is, that the covered parts, besides being exposed to permanent pressure from the cause already related, become tender by being covered. If these parts therefore are exposed, they get hardened and thick; and if the horse happens to tread on a hard and rough body, the inconvenience is but momentary, and the pain occasioned will make him remove his foot, so as to prevent mischief.

Common shoeing is very liable to produce corns by the hoofs spreading out, and leaving the shoe in close contact with the sole, where it acts as a fixed point, and will not allow the elasticity of the insensible sole to act.

The nails of the shoe should not be placed near the heels, for it disposes the heel to contract, especially when the bars are cut away. The narrow shoe has another advantage. The horse is less likely to slip than with the broad one on any ground on which the foot makes an impression. But it would not perhaps be quite so proper for horses always treading on a pavement, such as the streets of London, nor for horses that are calculated for heavy draught, such as dray or cart horses, which require not only a stouter shoe, but also to be turned up behind, in order to resist the descent of heavy loads in passing down a hill, &c.

In plate 22. we have given a sketch of Mr. Coleman's shoe, the principle of which rests not only on the advantages attending the exposure of the horny sole, but likewise on an objection to which all shoes are liable that require to be nailed *all round*, as in common instances. The nails at the quarters form so many fixed points, and prevent that expansion which is natural to the hoof in consequence of its growth; and the effect of this confinement is that of contracting the whole foot, and particularly the heel; to which circumstance, as has already been said, many of the diseases of that part of the animal may be attributed. In Mr. Coleman's shoe this material objection seems to be removed, for it requires to be fixed to the wall of the foot only by a few nails at the toe, which leaves the growth of the quarters to take entirely their natural direction.

Whenever the roads are covered with ice, it becomes necessary to have the heels of a horse's shoes turned up, and fre-

quently ſharpened, in order to prevent him from ſlipping and falling: but this cannot be done without the frequent moving of the ſhoes, which breaks and deſtroys the cruſt of the hoof where the nails enter. To prevent this, it is recommended to thoſe who are willing to be at the expence, to have ſteel points ſcrewed into the heels or quarters of each ſhoe, which might be taken out and put in occaſionally.

The method of doing this properly, as directed by Mr. Clark, is firſt to have the ſhoes fitted to the ſhape of the hoof, then to make a ſmall round hole in the extremity of each heel, or in the quarters, about three-eighths of an inch in diameter, or more, in proportion to the breadth and ſize of the ſhoe; in each of theſe holes a ſcrew is to be made: the ſteel points are likewiſe to have a ſcrew on them, exactly fitted to that in the ſhoes. Care muſt be taken that the ſcrew on the points is no longer, when they are ſcrewed into the ſhoe, than the thickneſs of the latter. The ſteel points are to be made ſharp; they may either be made ſquare, triangular, or chiſſel pointed, as may be moſt agreeable; the height of the point above the ſhoe ſhould not exceed half an inch for a ſaddle horſe; they may be made higher for a draught horſe. The key or handle that is neceſſary to ſcrew them in and out occaſionally, is made in the ſhape of the capital letter T, and of a ſufficient ſize and ſtrength; at the bottom of the handle, a ſocket or cavity muſt be made, properly adapted to the ſhape of the ſteel point, and ſo deep as to receive the whole head of the point that is above the ſhoe. In order to prevent the ſcrew from breaking at the neck, it will be neceſſary to make it of a gradual taper; the ſame is likewiſe to be obſerved of the female ſcrew that receives it, that is, the hole muſt be wider on the upper part of the ſhoe than the under part; the ſharp points may be tempered or hardened, in order to prevent them from growing too ſoon blunt; but when they become blunt, they may be ſharpened as at firſt. Theſe points ſhould be unſcrewed when the horſe is put into the ſtable, as the ſtones will do them more injury in a few minutes than a day's riding on ice. A draught horſe ſhould have one on the point of each ſhoe, as that gives him a firmer footing in drawing on ice; but for a ſaddle horſe, when points are put there, they are apt to make him trip and ſtumble. See fig. 5. in the plate.

When the ſhoes are provided with theſe points, a horſe will travel on ice with the greateſt ſecurity and ſteadineſs, much more ſo than on cauſeway or turnpike roads, as the weight of the horſe preſſes them into the ice at every ſtep he takes. For the operation called Nicking, ſee that article.

FARTHING, a ſmall Engliſh copper coin, amounting to one-fourth of a penny. It was anciently called *fourthing*, as being the fourth of the integer or penny.

Farthing *of Gold*, a coin uſed in ancient times, containing in value the fourth part of a noble, or 20d. ſilver. It is mentioned in the ſtat. 9 Hen. V. cap. 7. where it is enacted, that there ſhall be good and juſt weight of the noble, half-noble, and farthing of gold.

Farthing *of Land* ſeems to differ from farding-*deal*; for in a ſurvey-book of the manor of Weſt-Hapton in Devonſhire, there is an entry thus: A. B. holds ſix farthings of land at 126l. *per ann.* So that the farthing of land muſt have been a conſiderable quantity, far more than a rood.

FASCES, in Roman antiquity, axes tied up together with rods or ſtaves, and borne before the Roman magiſtrates as a badge of their office and authority. According to Florus, the uſe of the faſces was introduced by the elder Tarquin, the fifth king of Rome; and were then the mark of the ſovereign dignity. In after-times they were borne before the conſuls, but by turns only, each his day. They had each of them 12, borne by as many lictors. Theſe faſces conſiſted of branches of elm; having in the middle a ſecuris or axe, the head of which ſtood out beyond the reſt. Publicola took the axe out of the faſces, as Plutarch aſſures us, to remove from the people all occaſion of terror. After the conſuls, the pretors aſſumed the faſces. In the government of the decemvirs, it was the practice at firſt for only one of them to have the faſces. Afterwards each of them had twelve, after the manner of the kings. When the magiſtrates, who by right had the axes carried before them, had a mind to ſhow ſome deference to the people, or ſome perſon of ſingular merit, they either ſent away the lictors, or commanded them to lower the faſces before them, which was called *ſubmittere faſces*. Many inſtances of this occur in the Roman hiſtory.

FASCETS, in the art of making glaſs, are the irons thruſt into the mouths of bottles, in order to convey them to the annealing tower.

FASCIA, in antiquity, a thin ſaſh which the Roman women wrapped round their bodies, next to the ſkin, in order to make them ſlender. Something of this ſort ſeems alſo to have been in uſe amongſt the Grecian ladies, if we can depend upon the repreſentation given by Terence, Eun. act. 2. ſc. 4.

> Haud ſimilis eſt virginum noſtrarum, quas matres ſtudent
> Demiſſis humeris eſſe—vincto corpore, ut graciles fiant.

Fascia, in architecture, ſignifies any flat member having a conſiderable breadth and but a ſmall projecture, as the band of an architrave, larmier, &c. In brick-buildings, the juttings out of the bricks beyond the windows in the ſeveral ſtories except the higheſt are called *faſcias*, or *faſciæ*.

Fascia *Lata*, in anatomy, a tendinous expanſion, covering and, as it were, keeping together, the muſcles of the leg, thigh, &c. It is called alſo *ſemi-membranoſus*. See Anatomy, *Table of the Muſcles*.

Fasciæ, in aſtronomy, the belts ſeen on the diſk of the ſuperior planets Mars, Jupiter, and Saturn. See Astronomy *paſſim*.

FASCIALIS, in anatomy, one of the muſcles of the thigh, called *ſartorius*. See Anatomy, *Table of the Muſcles*.

FASCINATION, from the Greek βασκαινειν, to *faſcinate* or *bewitch*, a ſort of witchcraft ſuppoſed to operate either by the eye or the tongue. Ancient writers diſtinguiſh two ſorts of faſcination, one performed by looking, or the efficacy of the eye. Such is that ſpoken of by Virgil in his third eclogue:

> Neſcio quis teneros oculus mihi *faſcinat* agnos.

The ſecond by words, and eſpecially malignant praiſes. Such is that mentioned by the ſame poet in his ſeventh eclogue:

> Aut, ſi ultra placitum laudârit, baccare frontem
> Cingite, ne vati noceat mala lingua futuro.

Horace touches on both kinds in his firſt book of epiſtles:

> Non iſtic obliquo oculo mea commoda quiſquam
> Limat, non odio obſcuro, morſuque venenat.

FASCINES, in fortification, faggots of ſmall wood, of about a foot diameter, and ſix feet long, bound in the middle, and at both ends. They are uſed in raiſing batteries, making chandeliers, in filling up the moat to facilitate the paſſage to the wall, in binding the ramparts where the earth is bad, and in making parapets of trenches to ſcreen the men. Some of them are dipped in melted pitch or tar; and, being ſet on fire, ſerve to burn the enemy's lodgments or other works. In the corrupt Latin they uſe *faſcenina*, *faſcennia*, and *faſcinata*, &c. to

ſignify the pales, faſcines, &c. uſed to incloſe the ancient caſtles, &c.

FASCIOLA, in zoology, the FLUKE or GOURD WORM: a genus of inſects of the order of vermes inteſtina; of which the characters are theſe: The body is flattiſh, and has a vent hole at the extremity and on the belly. See plate 18. There are ſeveral ſpecies. 1. The *hepatica*, or liver-fluke, grows to two thirds of an inch in length, though it is more uſually met with not half that ſize; and its breadth is nearly equal to two thirds of its length: it is flattiſh, but ſomewhat rounded on the back, and has about eight deep longitudinal furrows in two ſeries; its ſkin is ſoft and whitiſh, with a tinge of brown. The hinder part is rounded, the fore part is furniſhed with a large mouth. It bears ſome reſemblance to the ſeed of the common gourd, whence it has acquired the name of the *gourd worm*. It is found in freſh waters, in ditches, at the roots of ſtones, ſometimes in the inteſtines, and often in the ſubſtance of the other viſcera in quadrupeds. It often infeſts the liver of ſheep, and on that account is called *hepatica*. Bags with ſalt in them ſhould be placed in the fold that the ſheep might lick them, which is a good remedy. 2. The *inteſtinalis*, or inteſtinal fluke, is of a long ſlender form, if extended; when contracted, of a ſuboval form; inhabits the inteſtines of freſh-water fiſh, eſpecially in the bream. 3. The *barbata* is white, with tranſverſe papillæ in the mouth. It is of an oblong ſhape, and about the ſize of a cucumber-ſeed. It is found in the inteſtines of the ſepia lotigo.

FASHION-PIECES, in the ſea-language, the aftmoſt or hindmoſt timbers of a ſhip, which terminate the breadth, and form the ſhape of the ſtern. They are united to the ſtern-poſt, and to the extremity of the wing-tranſom, by a rabbit, and a number of ſtrong nails or ſpikes driven from without.

FAST, in general, denotes an abſtinence from food (ſee FASTING); but is more particularly uſed for ſuch abſtinence on a religious account.

Religious faſting has been practiſed by moſt nations from the remoteſt antiquity. Some divines even aſſign its origin to the earthly paradiſe, where our firſt parents were forbidden to eat of the tree of knowledge. But though this ſeems carrying the matter too far, it is certain that the Jewiſh church has obſerved faſts ever ſince its firſt inſtitution. Nor were the neighbouring heathens, viz. the Egyptians, Phœnicians, and Aſſyrians, without their faſts. The Egyptians, according to Herodotus, ſacrificed a cow to Iſis, after having prepared themſelves by faſting and prayer: a cuſtom which he likewiſe aſcribes to the women of Cyrene. Porphyry affirms, that the Egyptians, before their ſtated ſacrifices, always faſted a great many days, ſometimes for ſix weeks; and that the leaſt behoved to be for ſeven days; during all which time the prieſts and devotees not only abſtained from fleſh, fiſh, wine, and oil, but even from bread, and ſome kinds of pulſe. Theſe auſterities were communicated by them to the Greeks, who obſerved their faſts much in the ſame manner. The Athenians had the Eleuſinian and Theſmophorian faſts, the obſervation of which was very rigorous, eſpecially among the women, who ſpent one whole day ſitting on the ground in a mournful dreſs, without taking any nouriſhment. In the iſland of Crete, the prieſts of Jupiter were obliged to abſtain all their lives from fiſh, fleſh, and baked meats. Apuleius informs us, that whoever had a mind to be initiated in the myſteries of Cybele were obliged to prepare themſelves by faſting ten days; and, in ſhort, all the pagan deities, whether male or female, required this duty of thoſe that deſired to be initiated into their myſteries, of their prieſts and prieſteſſes that gave the oracles, and of thoſe that came to conſult them.

Among the heathens faſting was alſo practiſed before ſome of their military enterpriſes. Ariſtotle informs us, that the Lacedemonians, having reſolved to ſuccour a city of the allies, ordained a faſt throughout the whole extent of their dominions, without excepting even the domeſtic animals: and this they did for two ends; one to ſpare proviſions in favour of the beſieged; the other to draw down the bleſſing of heaven upon their enterpriſe. The inhabitants of Tarentum, when beſieged by the Romans, demanded ſuccours from their neighbours of Rhegium, who immediately commanded a faſt throughout their whole territories. Their enterpriſe having had good ſucceſs by their throwing a ſupply of proviſions into the town, the Romans were obliged to raiſe the ſiege; and the Tarentines, in memory of this deliverance, inſtituted a periodical faſt.

Faſting has always been reckoned a particular duty among philoſophers and religious people, ſome of whom have carried their abſtinence to an incredible length. At Rome it was practiſed by kings and emperors themſelves. Numa Pompilius, Julius Cæſar, Auguſtus, Veſpaſian, and others, we are told, had their ſtated faſt-days: and Julian the apoſtate was ſo exact in this obſervance as to outdo the prieſts themſelves, and even the moſt rigid philoſophers. The Pythagoreans kept a continual lent; but with this difference, that they believed the uſe of fiſh to be equally unlawful with that of fleſh. Beſides their conſtant temperance, they alſo frequently faſted rigidly for a very long time. In this reſpect, however, they were all outdone by their maſter Pythagoras, who continued his faſts for no leſs than 40 days together. Even Apollonius Tyaneus, one of his moſt famous diſciples, could never come up to him in the length of his faſts, though they greatly exceeded thoſe of the ordinary Pythagoreans. The gymnoſophiſts, or brachmans of the eaſt, are alſo very remarkable for their ſevere faſtings; and the Chineſe, according to father Le Comte, have alſo their ſtated faſts, with forms of prayer for preſerving them from barrenneſs, inundations, earthquakes, &c. The Mahometans too, who poſſeſs ſo large a part of Aſia, are very remarkable for the ſtrict obſervance of their faſts; and the exactneſs of their derviſes in this reſpect is extraordinary.

Faſting was often uſed by the heathens for ſuperſtitious purpoſes; ſometimes to procure the interpretation of dreams; at others, to be an antidote againſt their pernicious conſequences. A piece of ſuperſtition prevails to this day among the Jews; who, though expreſsly forbidden to faſt on Sabbath-days, think themſelves at liberty to diſpenſe with this duty when they happen to have frightful and unlucky dreams, the night preceding, that threatened them with great misfortunes. On theſe occaſions they obſerve a formal faſt the whole day; and at night the patient, having invited three of his friends, addreſſes himſelf to them ſeven times in a very ſolemn manner, ſaying, "May the dream I have had prove a lucky one!" And his friends anſwer as many times, "Amen, may it be lucky, and God make it ſo!" After which, in order to encourage him, they conclude the ceremony with theſe words of Eccleſiaſtes, "Go eat thy bread with joy;" and then ſeat themſelves down at table. They have alſo added ſeveral faſts not commanded in the law of Moſes, particularly three, in memory of ſore diſtreſſes their nation has ſuffered at different times. The abſtinence of the ancient Jews commonly laſted 27 or 28 hours at a time; beginning before ſun-ſet, and not ending till ſome hours after ſun-ſet next day. On theſe days they were obliged to wear white robes in token of grief and repentance; to cover themſelves with ſackcloth, or their worſt clothes: to lie on aſhes, to ſprinkle them on their heads, &c. Some ſpent the whole night and day following in the temple or ſynagogue, in prayers and other devotions, barefooted, with a ſcourge in their hands, of which they ſometimes made a good uſe in order to raiſe their zeal. Laſtly, in order to complete their abſtinence, at night they were to eat nothing but a little bread dipped in water, with ſome ſalt for ſeaſoning;

except they chose to add to their repast some bitter herbs and pulse.

The ancients, both Jews and Pagans, had also their fasts for purifying the body, particularly the priests and such as were any way employed at the altars; for when nocturnal disorders happened to these, it was unlawful for them to approach all the next day, which they were bound to employ in purifying themselves. On this account, at great festivals, where their ministry could not be dispensed with, it was usual for them, on the eve thereof, not only to fast, but also to abstain from sleep, for the greater certainty. For this purpose the high-priest had under-officers to wake him, if overtaken with sleep; against which other preservatives were also made use of.

FASTERMANS, or Fasting-men, q. d. *homines habentes*, was used in our ancient customs for men in repute and substance; or rather for pledges, sureties, or bondsmen, who, according to the Saxon polity, were fast bound to answer for one another's peaceable behaviour.

FASTI, in Roman antiquity, the kalendar wherein were expressed the several days of the year, with their feasts, games, and other ceremonies. There were two sorts of fasti, the greater and less; the former being distinguished by the appellation *fasti magistrales*, and the latter by that of *fasti kalendares*.

1. The *Fasti Kalendares*, which were what was properly and primarily called *fasti*, are defined by Festus Pompeius to be books containing a description of the whole year: *i. e.* Ephemerides, or diaries, distinguishing the several kinds of days, *festi*, *profesti*; *fasti*, *nefasti*, &c. The author hereof was Numa, who committed the care and direction of the fasti to the pontifex maximus, whom the people used to go and consult on every occasion. This custom held till the year of Rome 450, when C. Flavius, secretary to the pontifices, exposed in the forum a list of all the days whereon it was lawful to work; which was so acceptable to the people, that they made him curule ædile.

These lesser fasti, or fasti calendares, were of two kinds, *urbani* and *rustici*.—The *fasti urbani*, or fasti of the city, were those which obtained or were observed in the city. Some will have them thus called because they were exposed publicly in many parts of the city; though, by the various inscriptions or gravings thereof on antique stones, one would imagine that private persons had them likewise in their houses. Ovid undertook to illustrate these fasti urbani, and comment on them, in his Libri Fastorum, whereof we have the six first books still remaining; the six last, if ever they were written, being lost. In the *fasti rustici*, or country fasti, were expressed the several days, feasts, &c. to be observed by the country people: for as these were taken up in tilling the ground, fewer feasts, sacrifices, ceremonies, and holidays, were enjoined them than the inhabitants of cities; and they had also some peculiar ones not observed at Rome. These rustic fasti contained little more than the ceremonies of the calends, nones, and ides; the fairs, signs of the zodiac, increase and decrease of the days, the tutelary gods of each month, and certain directions for rural works to be performed each month.

2. In the greater fasti, or *Fasti Magistrales*, were expressed the several feasts, with every thing relating to the gods, religion, and the magistrates; the emperors, their birth-days, offices, days consecrated to them, and feasts and ceremonies established in their honour, or for their prosperity, &c. With a number of such circumstances did flattery at length swell the fasti; when they became denominated *Magni*, to distinguish them from the bare kalendar, or fasti kalendares.

Fasti was also a chronicle or register of time, wherein the several years were denoted by the respective consuls, with the principal events that happened during their consulates. These were called also *fasti consulares*, or *consular fasti*.

Fasti, or *Dies Fasti*, also denoted court-days. The word *fasti fastorum* is formed of the verb *fari* "to speak," because during those days the courts were opened, causes might be heard, and the prætor was allowed *fari*, to pronounce the three words, *do*, *dico*, *addico*: The other days wherein this was prohibited were called *nefasti*: thus Ovid,

> Ille nefastus erit, per quem tria verba silentur:
> Fastus erit, per quem lege licebit agi.

These *dies fasti* were noted in the kalendar by the letter *F*: but observe, that there were some days *ex parte fasti*, partly *fasti*, partly *nefasti*; i. e. justice might be distributed at certain times of the day, and not at others. These days were called *intercisi*, and were marked in the kalendar thus: *F. P. fastos primo*, where justice might be demanded during the first part of that day.

FASTING, the abstaining from food. Many wonderful stories have been told of long continued fasting; a great many of which undoubtedly must be false. Others, however, we have on very good authority; particularly an account of a *Fasting Woman*, given in the Phil. Trans. vol. 67, part I.

The following remarkable instances of animals being able to live long without food, are related by Sir William Hamilton, in his account of the late earthquakes in Italy (*Phil. Trans.* vol. 73): "At Soriano (says he), two fattened hogs that had remained buried under a heap of ruins, were taken out alive the 42d day; they were lean and weak, but soon recovered." Again, "At Messina two mules belonging to the duke of Belviso remained under a heap of ruins, one of them 22 days, and the other 23 days: they would not eat for some days, but drank water plentifully, and are now recovered. There are numberless instances of dogs remaining many days in the same situation; and a hen belonging to the British vice-consul at Messina, that had been closely shut up under the ruins of his house, was taken out the 22d day, and is now recovered; it did not eat for some days, but drank freely; it was emaciated, and showed little signs of life at first. From these instances, and those related before of the hogs at Soriano, and several others of the same kind that have been related to me, but which being less remarkable I omit, one may conclude, that long fasting is always attended with great thirst and total loss of appetite." See the article Abstinence.

FASTOLF (Sir John), a valiant and renowned English officer, a knight-banneret and of the garter, who served in France under Henry IV, V, and VI, was descended from an ancient family in Norfolk, and was born about the year 1377. He was as much distinguished for his virtue at home as for his valour abroad; and became no less amiable in his private than he had been admirable in his public character. He died in 1459, upwards of 80 years of age, as we learn from his noted cotemporary William Caxton, the first English printer. By an unaccountable mistake it has been asserted, that Shakespear's Falstaff was drawn to ridicule this great man; and this has made judicious biographers more studious to preserve his reputation.

FAT, an oily concrete substance deposited in different parts of animal bodies. See Anatomy, p. 186.

Labours of the mind prevent the accumulation of fat, as well as bodily labour, and intemperance. Hence, rest and plentiful food are sufficient to fatten brutes; but with men it is often otherwise. It is surprising how soon some birds grow fat; ortolans in 24 hours, and larks still sooner.

Fats may be divided, from their consistence, into three kinds: 1. The soft and thin, which grow perfectly liquid in a very

ſmall heat. 2. The thick and conſiſtent, which liquefy leſs readily: and, 3. The hard and firm, which require a ſtill ſtronger heat to melt them. The firſt is called *Pinguedo*; the ſecond, *Axungia*; and the third, *Adeps*, as taken from the animal; and *Sevum* or *Sebum*, when freed from the ſkins, &c. This uſe of the names, however, is not conſtant, ſome employing them promiſcuouſly.

To obtain fat pure, it muſt be cut into pieces, and melted with a gentle heat in a proper veſſel with an equal quantity of water. It is afterwards to be put into an earthen pot, where the fat riſes to the top, and becomes ſolid when cold. In this ſtate it is exceedingly white, and ſufficiently pure for the purpoſes of pharmacy or chemical examination. See Chemistry, p. 464.

The uſes of fat in the animal economy have not been clearly aſcertained. It is known however, that animals which are caſtrated, not much exerciſed, or which are come to an age when the loſs and production of the ſeminal fluid is leſs, and which at the ſame time conſume much ſucculent aliment, generally become fatter, and ſometimes exceedingly ſo. Animals certainly become lean, and ſeem to ſubſiſt upon their fat, when they have too little food, and when they have diſeaſes which prevent digeſtion, and the production of the nutritive juices; and in theſe caſes the fatter animals hold out longer than the leaner. The fat appears to be then abſorbed, and to be transformed into nouriſhment.

Fat, in the ſea-language, ſignifies the ſame with broad. Thus a ſhip is ſaid to have a fat quarter, if the truſſing-in or tuck of her quarter be deep.

Fat likewiſe denotes an uncertain meaſure of capacity. Thus a fat of iſinglaſs contains from $3\frac{1}{2}$ hundred weight to 4 hundred weight; a fat of unbound books, half a maund or four bales; of wire, from 20 to 25 hundred weight; and of yarn, from 220 to 221 bundles.

Fat, or Vat, is uſed alſo for ſeveral utenſils: as, 1. A great wooden veſſel, employed for the meaſuring of malt, and containing a quarter or eight buſhels. 2. A large brewing veſſel, uſed by brewers to run their wort in. 3. A leaden pan or veſſel for the making of ſalt at Droitwich.

FATA morgana, a very remarkable aerial phenomenon, which is ſometimes obſerved from the harbour of Meſſina and adjacent places, at a certain height in the atmoſphere. The name, which ſignifies the *Fairy Morgana*, is derived from an opinion of the ſuperſtitious Sicilians, that the whole ſpectacle is produced by fairies, or ſuch like viſionary inviſible beings. The populace are delighted whenever it appears; and run about the ſtreets ſhouting for joy, calling every body out to partake of the glorious ſight.

This ſingular meteor has been deſcribed by various authors; but the firſt who mentioned it with any degree of preciſion was father Angelucci, whoſe account is thus quoted by Mr. Swinburne in his *Tour through Sicily*: "On the 15th of Auguſt 1643, as I ſtood at my window, I was ſurpriſed with a moſt wonderful delectable viſion. The ſea that waſhes the Sicilian ſhore ſwelled up, and became, for ten miles in length, like a chain of dark mountains; while the waters near our Calabrian coaſt grew quite ſmooth, and in an inſtant appeared as one clear poliſhed mirror, reclining againſt the aforeſaid ridge. On this glaſs was depicted, in *chiaro ſcuro*, a ſtring of ſeveral thouſands of pilaſtres, all equal in altitude, diſtance, and degree of light and ſhade. In a moment they loſt half their height, and bent into arcades, like Roman aqueducts. A long cornice was next formed on the top, and above it roſe caſtles innumerable, all perfectly alike. Theſe ſoon ſplit into towers, which were ſhortly after loſt in colonnades, then windows, and at laſt ended in pines, cypreſſes, and other trees, even and ſimilar. This is the Fata Morgana, which for 26 years I had thought a mere fable."

To produce this pleaſing deception, many circumſtances muſt concur, which are not known to exiſt in any other ſituation. The ſpectator muſt ſtand with his back to the eaſt, in ſome elevated place behind the city, that he may command a view of the whole bay; beyond which the mountains of Meſſina riſe like a wall, and darken the back ground of the picture. The winds muſt be huſhed, the ſurface quite ſmoothed, the tide at its height, and the waters preſſed up by currents to a great elevation in the middle of the channel. All theſe events coinciding, as ſoon as the ſun ſurmounts the eaſtern hills behind Reggio, and riſes high enough to form an angle of 45 degrees on the water before the city, every object exiſting or moving at Reggio will be repeated 1000 fold upon this marine looking glaſs; which, by its tremulous motion, is as it were cut into facets. Each image will paſs rapidly off in ſucceſſion as the day advances, and the ſtream carries down the wave on which it appeared. Thus the parts of this moving picture will vaniſh in the twinkling of an eye. Sometimes the air is at that moment ſo impregnated with vapours, and undiſturbed by winds, as to reflect objects in a kind of aerial ſcreen, riſing about 30 feet above the level of the ſea. In cloudy heavy weather, they are drawn on the ſurface of the water, bordered with fine priſmatical colours.

To the above account we ſhall add the following, given by M. Houel, whoſe judgment and veracity render his authority highly reſpectable. "In fine ſummer days, when the weather is calm, there riſes above the great current a vapour, which acquires a certain denſity, ſo as to form in the atmoſphere horizontal priſms, whoſe ſides are diſpoſed in ſuch a manner, that when they come to their proper degree of perfection, they reflect and repreſent ſucceſſively, for ſome time (like a moveable mirror), the objects on the coaſt or in the adjacent country. They exhibit by turns the city and ſuburbs of Meſſina, trees, animals, men, and mountains. They are certainly beautiful aerial moving pictures. There are ſometimes two or three priſms, equally perfect; and they continue in this ſtate eight or ten minutes. After this, ſome ſhining inequalities are obſerved upon the ſurface of the priſm, which render confuſed to the eye the objects which had been before ſo accurately delineated, and the picture vaniſhes. The vapour forms other combinations, and is diſperſed in air. Different accounts have been given of this ſingular appearance; which for my part I attribute to a bitumen that iſſues from certain rocks at the bottom of the ſea, and which is often ſeen to cover a part of its ſurface in the canal of Meſſina. The ſubtle parts of this bitumen being attenuated, combined, and exhaled with the aqueous globules that are raiſed by the air, and formed into bodies of vapour, give to this condenſed vapour more conſiſtence; and contribute, by their ſmooth and poliſhed particles, to the formation of a kind of aerial cryſtal, which receives the light, reflects it to the eye, and tranſmits to it all the luminous points which colour the objects exhibited in this phenomenon, and render them viſible."

FATE, fatum, denotes an inevitable neceſſity depending upon a ſuperior cauſe. The word is formed *a fando*, "from ſpeaking:" and primarily implies the ſame with *effatum*, viz. a word or decree pronounced by God; or a fixed ſentence whereby the Deity has preſcribed the order of things, and allotted to every perſon what ſhall befall him. The Greeks called it εἱμαρμένη, as it were a chain or neceſſary ſeries of things indiſſolubly linked together. It is alſo uſed to expreſs a certain unavoidable deſignation of things, by which all agents, both neceſſary and voluntary, are ſwayed and directed to their ends. See Necessity. In this laſt ſenſe, fate is diſtinguiſhed into, 1. Aſtrological fate, ariſing from the influence and poſition of the heavenly bodies; which (it is ſuppoſed) gave laws both to

the elements and mixed bodies, and to the will of men. 2. Stoical fate, defined by Cicero an order or series of causes, wherein, cause being linked to cause, each produces another, and thus all things flow from one prime cause. To this fate the Stoics subject even the gods. Fate is divided by later authors into physical and divine. 1. Physical fate is an order and series of natural causes appropriated to their effects. By this fate it is that fire warms, bodies communicate motion to each other, &c. and the effects of it are all the events and phenomena of nature. 2. Divine fate is what is more usually called *Providence*. See PROVIDENCE.

FATES, in mythology. See PARCÆ.

FATHEMITES, FATEMITES, or FATHIMITES, the descendants of Mahomet by Fathema, or Fatima, his daughter. They never enjoyed the khalifat of Mecca or Bagdad, but reigned in Barbary and Egypt, as we learn from the history of those countries.

FATHER, a term of relation denoting a person who hath begot a child. See PARENT and CHILD. By the laws of Romulus, a father had an unlimited power over his children. Amongst the Lacedemonians, as we learn from Aristotle's politics, the father of three children was excused from the duty of mounting guard for the security of the city; and a father of four children was exempted from every public burden. The Poppæan law, amongst the Romans, granted many valuable privileges to the fathers of three children; amongst which one was, that he should be excused from civil offices, and that the mother should have liberty, in her father's life-time, to make a will, and manage her estate without the authority of tutors.

Natural FATHER, is he who has illegitimate children. See the articles BASTARD and LAW.

Adoptive FATHER, is he who takes the children of some other, and acknowledges them as his own. See ADOPTION.

Putative FATHER, is he who is only the reputed or supposed father. Joseph was the putative father of our Saviour.

FATHER-*in-law*, is a person married to a woman who has children by a former husband, &c. to which children he is said to be a father-in-law.

FATHER is also used in theology for the first Person in the Trinity.

FATHER is also used in a figurative sense on various moral and spiritual occasions. Thus, it is applied to the patriarchs; as we say Adam was the father of all mankind, Abraham the father of the faithful, &c.

FATHER, in church-history, is applied to ancient authors who have preserved in their writings the traditions of the church. Thus St. Chrysostom, St. Basil, &c. are called *Greek fathers*, and St. Augustine and St. Ambrose *Latin fathers*. No author who wrote later than the 12th century is dignified with the title of *Father*.

FATHER is also a title of honour given to prelates and dignitaries of the church, to the superiors of convents, to congregations of ecclesiastics, and to persons venerable for their age or quality. Thus we say, the right reverend father in God, the father general of the Benedictines, the fathers of the council of Nice, father of his country, &c.

FATHERLASHER, in ichthyology. See COTTUS.

FATHOM, a long measure containing six feet, used chiefly at sea for measuring the length of cables and cordage.

FATNESS. See CORPULENCY. It is observed, that for one fat person in France or Spain, there are an hundred in England and Holland. This is supposed to be from the use of new malt liquors, more than from the difference of climate. Indolence may cause fatness in some few constitutions; but, in general, those who are disposed to this habit will be fat in spite of every endeavour to the contrary, but that of destroying health.

FATUARII, in antiquity, were persons who, appearing inspired, foretold things to come. The word is formed of *Fatua*, wife of the god Faunus, who was supposed to inspire women with the knowledge of futurity, as Faunus himself did men.—Fatua had her name from *fari*, q. d. *vaticinari*, "to prophesy."

FAVISSÆ, in antiquity, were, according to Festus and Gellius, cisterns to keep water in: but the favissæ in the Capitol at Rome were dry cisterns or subterraneous cellars, where they laid up the old statues, broken vessels, and other things used in the temple. These were much the same with what, in some of the modern churches, are called the *archives* and *treasury*.

FAUNA, a deity among the Romans. She was daughter of Picus, and was originally called *Marica*. Her marriage with Faunus procured her the name of *Fauna*, and her knowledge of futurity that of *Fatua* and *Fatidica*. It is said that she never saw a man after her marriage with Faunus, and that her uncommon chastity occasioned her being ranked among the gods after death. She is the same, according to some, as *Bona Mater*.

FAUNALIA, in antiquity, Roman feasts celebrated in honour of the god Faunus, who was the same among the Romans with the *Pan* of the Greeks. The Faunalia were held on the day of the nones of December; i. e. on the fifth day of that month. The principal sacrifice was a roe-buck; or rather, according to Horace, a kid, attended with libations of wine and burning of incense. It was properly a country festival, being performed in the fields and villages with peculiar joy and devotion. Horace gives us a very gay description of it in the 18th ode of his third book:

> ——*Tener pleno cadit hœdus anno:*
> *Larga nec desunt Veneris sodali*
> *Vina cratera: vetus ara multo*
> *Fumat odore.*

Struvius in his Roman kalendar marks the feast of Faunus on the day of the ides of February, which is the 30th day of that month; and the Faunalia he places on the fifth of the ides of December, or the 9th of that month: and in chap. ix. he shows, that there really were two Faunalia; the one in February, mentioned by Ovid, Fast. lib. vi. ver. 246; the other on the 9th of December, mentioned by Horace in the place just cited.

FAUNS, FAUNI, among the ancients, were a species of demi-gods inhabiting the forests; called also *Sylvans (Sylvani)*, and little differing from the Satyrs. They delighted more particularly in vineyards; and they generally appear as attendants of Bacchus, in the representations of Bacchanal feasts and processions. They were represented as half men, half goats, having the horns, ears, feet, and tail of a goat, a very flat nose, and the rest human. Though the Fauns were held as demi-gods, yet they were supposed to die after a long life. Arnobius shows that their father or chief, Faunus himself, only lived 120 years.

FAUNUS, in fabulous history, a son of Picus, who reigned in Italy about 1300 years before the Augustan age. His bravery, as well as wisdom, have given rise to the tradition that he was the son of Mars. His great popularity, and his fondness for agriculture, made his subjects revere him as one of their country deities after death. He was represented with all the equipage of the satyrs, and was consulted to give oracles.

FAVONIUS, among the Romans, the wind which blew directly from the west.

FAVORINUS, an ancient orator and philosopher of Gaul, who flourished under the emperor Adrian, and taught with high reputation both at Athens and Rome. Many works are attri-

buted to him; among the reſt, a Greek miſcellaneous hiſtory often quoted by Diogenes Laertius.

FAUSTUS. See Fust.

FAWKES (Francis), an ingenious poet, had his ſchool-education at Leeds; from whence he was tranſplanted to Jeſus-college, Cambridge, where he took the degrees in arts. Entering early into holy orders, he ſettled firſt at Bramham in Yorkſhire, near the elegant ſeat of that name (Mr. Lane's), which he celebrated in verſe in 1745, in a 4to pamphlet anonymous. His firſt poetical publications were, Gawen Douglas's Deſcription of May and Winter moderniſed. Removing afterwards to the curacy of Croydon in Surry, he recommended himſelf to the notice of Archbiſhop Herring, then reſident there on account of his health, to whom beſides other pieces he addreſſed an Ode on his recovery in 1754, printed in Mr. Dodſley's Collection. In conſequence, his Grace collated him in 1755 to the vicarage of Orpington with St. Mary Gray in Kent; and Mr. Fawkes lamented his patron's death in 1757 in a pathetic Elegy ſtyled *Aurelius*, firſt printed with his Grace's Seven Sermons, in 1763. He married about the ſame time Miſs Purrier of Leeds. In April 1774, by the late Dr. Plumtree's favour, he exchanged his vicarage for the rectory of Hayes. He was alſo one of the chaplains to the princeſs dowager of Wales. He publiſhed a volume of Poems by ſubſcription in 8vo. 1761; the Poetical Kalendar, 1763; and Poetical Magazine, 1764, in conjunction with Mr. Woty; Partridge-ſhooting, an Eclogue, to the honourable Charles York, 1767, 4to.; and a Family Bible, with notes, in 4to. a compilation. But his great ſtrength lay in tranſlation, in which, ſince Pope, few have equalled him. Witneſs his fragments of Menander (in his Poems); his Works of Anacreon, Sappho, Bion, Moſchus, and Muſæus, 12mo. 1760; his Idylliums of Theocritus, by ſubſcription, 8vo. 1767; and his Argonautics of Apollonius Rhodius, by ſubſcription alſo (a poſthumous publication, completed by the Rev. Mr. Meen of Emanuel college, Cambridge), 8vo. 1780. He died Auguſt 26, 1777.

FAWN, among ſportſmen, a buck or doe of the firſt year; or the young one of the buck's breed in its firſt year.

FE, fo, or *Fohi*, the name of the chief god of the Chineſe, whom they adore as the ſovereign of heaven. They repreſent him ſhining all in light, with his hands hid under his robes, to ſhow that his power does all things inviſibly. He has at his right hand the famous Confucius, and at his left Lanza or Lanca, chief of the ſecond ſect of their religion.

FEAL, a provincial term for ſod or turf.

Feal-*Dikes*, a cheap ſort of fence common in Scotland; built with feal or ſod dug up by the ſpade from the ſurface of graſs-ground, conſiſting of the upper mould rendered tough and coherent by the matted roots of the graſs thickly interwoven with it. If only a very thin bit of the upper ſurface is pared off with a paring ſpade, the pieces are called *divots*. Theſe being of a firmer conſiſtence are more durable when built into dikes than feal, but much more expenſive alſo.

FEALTY, in law, an oath taken on the admittance of any tenant, to be true to the lord of whom he holds his land: by this oath the tenant holds in the freeſt manner, on account that all who have fee hold *per fidem et fiduciam*, that is, by fealty at the leaſt. This fealty, at the firſt creation of it, bound the tenant to fidelity, the breach of which was the loſs of his fee. It has been divided into general and ſpecial: general, that which is to be performed by every ſubject to his prince; and ſpecial, required only of ſuch as, in reſpect of their fee, are tied by oath to their lords. To all manner of tenures, except tenancy at will, and frank-almoign, fealty is incident, though it chiefly belongs to copyhold eſtates held in fee and for life. The form of this oath, by ſtat. 17 Edw. II. is to run as follows: "I, A. B. will be to you my lord D. true and faithful, and bear to you faith for the lands and tenements which I hold of you; and I will truly do and perform the cuſtoms and ſervices that I ought to do to you. So help me God."

FEAR, one of the paſſions of the human mind. See Passion. It is defined, an apprehenſion of impending evil, attended with a deſire of avoiding it. Fear in the extreme is called *fright* or *terror*. See Fright.

Fear, in ſcripture, is uſed in various ſenſes. The *fear of God* is either filial or ſervile. The filial fear is a holy affection or gracious habit in the ſoul, whereby it is inclined to obey all God's commandments, and to hate and avoid evil. Slaviſh or ſervile fear is the conſequence of guilt; it is a judicial impreſſion from the ſad thoughts of the provoked majeſty of heaven; it is an alarm within that diſturbs the reſt of a ſinner. Though this fear be in wicked men, yet it often proves preparative to faith and repentance. *Fear* is likewiſe uſed for the *object* of fear. Thus it is ſaid, "the *fear* of Iſaac," to deſcribe the God whom Iſaac feared (Gen. xxxi. 42.), and in Prov. i. 26. "I will mock you when your *fear* cometh;" that is, the calamity you feared. God ſays, that he will ſend his *fear* before his people; that is, a dread wrought by him, in order to terrify and deſtroy the inhabitants of Canaan.

Fear, *Metus*, *Pavor*, or *Timor*, was deified by the Pagans. Tullus Hoſtilius brought the worſhip of this deity to Rome. The Ephori of Sparta erected a temple to Fear, near their tribunal, to ſtrike an awe into thoſe who approached it. Fear was likewiſe worſhipped at Corinth. The poets did not forget this imaginary deity. Virgil places her in the entrance of hell, in company with diſeaſes, old age, &c. *Æn.* vi. 273. Ovid places her in the retinue of Tiſiphone, one of the furies, *Met.* iv. 483.

FEAST, or Festival, in a religious ſenſe, is a ceremony of feaſting and thankſgiving. The word is formed of the Latin *feſtum*, which ſome derive *a feriari* "to keep holiday;" others from the Greek ἑστιάω "I feaſt or entertain," of ἑστία "hearth, fire." Feaſts, and the ceremonies thereof, have made great part of the religion of almoſt all nations and ſects; witneſs thoſe of the Greeks, Romans, Hebrews, Chriſtians, and Mahometans. The firſt feaſts among the Greeks were celebrated in ſolemn aſſemblies of the whole nation, on occaſion of their games, as the Olympic, the Pythian, the Iſthmian, and Nemæan: in proceſs of time they had many others, the principal of which are enumerated in the courſe of this work. The Romans alſo had abundance of ſtated feaſts in honour of their deities and heroes; ſuch were the Saturnalia, Cerealia, Lupercalia, Liberalia, Neptunalia, Conſualia, Portumnalia, Vulcanalia, Palilia, Divalia, &c. See Saturnalia, &c. They had alſo feaſts inſtituted occaſionally; as Carmentalia, Quirinalia, Terminalia, Floralia, Compitalia, Lemuria, Vernalia, beſide other moveable and occaſional ones: as to give thanks to the gods for benefits received; to implore their aſſiſtance, or to appeaſe their wrath, &c. as the Paganalia, Feralia, Bacchanalia, Ambarvalia, Amburbalia, Suovetaurilia, and divers others, particularly denominated *feriæ*; as Sementinæ, Latinæ, &c. See each of theſe feaſts, and Feriæ in its proper place. The feaſts were divided into days of ſacrifice, and days of banqueting and feaſting; days of games, and days of reſt or *feriæ*. There being but little hiſtory written, or at leaſt publiſhed, in thoſe days, one end of feaſts was to keep up the remembrance of paſt occurrences.

The principal feaſts of the Jews were the feaſts of trumpets, that of the expiation, of tabernacles, of the dedication, of the paſſover, of pentecoſt, and that of purification. See Expiation, &c. The modern Jews have other feaſts marked in their kalendar of modern inſtitution. The Mahometans, beſides their weekly feaſt or ſabbath, which is kept on Friday, have two ſolemn feaſts, the firſt of which is called the *Feaſt of Victims*,

and celebrated on the tenth day of the laſt month of their year; and the ſecond called *Bairam*. The Chineſe have two ſolemn feaſts in the year, in memory of Confucius, beſides others of leſs note on other days of the year.

Feaſts among us are either *immoveable* or *moveable*. *Immoveable Feaſts* are thoſe conſtantly celebrated on the ſame day of the year; the principal of theſe are Chriſtmas-day or the Nativity, the Circumciſion, Epiphany, Candlemas, or the Purification; Lady-day, or the Annunciation, called alſo the *Incarnation* and *Conception*; All Saints, and All Souls; beſides the days of the ſeveral apoſtles, St. Thomas, St. Paul, &c. which with us are feaſts, though not *feriæ*. See each feaſt under its proper article. *Moveable Feaſts* are thoſe which are not confined to the ſame day of the year. Of theſe the principal is Eaſter, which gives law to all the reſt, all of them following, and keeping their proper diſtances from it; ſuch are Palm-Sunday, Good-Friday, Aſh-Wedneſday, Sexageſima, Aſcenſion-day, Pentecoſt, and Trinity-Sunday. See EASTER, SEXAGESIMA, PENTECOST, TRINITY, &c. The four feaſts which the Engliſh laws take eſpecial notice of are, the Annunciation of the bleſſed Virgin Mary, or Lady-day, the 25th of March; the nativity of St. John the Baptiſt, held on the 24th of June; the Feaſt of St. Michael the Archangel, on the 29th of September; and that of St. Thomas the Apoſtle, on the 21ſt of December: on which quarterly days rent on leaſes is uſually reſerved to be paid (5 and 6 Edw. VI. cap. 3. 3 Jac. I. cap. 1. 12 Car. II. cap. 30.).

Beſide theſe feaſts which are *general*, and enjoined by the church, there are others *local* and *occaſional*, enjoined by the magiſtrate, or voluntarily ſet on foot by the people; ſuch are the days of thankſgiving for delivery from wars, plagues, &c. Such alſo are the vigils or wakes in commemoration of the dedications of particular churches. See VIGIL, &c. The prodigious increaſe of feaſt-days in the Chriſtian church commenced towards the cloſe of the fourth century, and was occaſioned by the diſcovery that was then made of the remains of martyrs and other holy men, for the commemoration of whom they were eſtabliſhed. Theſe, inſtead of being ſet apart for pious exerciſes, were abuſed in indolence, voluptuouſneſs, and criminal practices. Many of them were inſtituted on a pagan model, and perverted to ſimilar purpoſes.

FEAST *of Death*, or *Feaſt of Souls*, a ſolemn religious ceremony in uſe among the ſavages of America; ſome of whom thus teſtify their reſpect for the deceaſed every eight years; and others, as the Hurons and Iroquois, every ten years.

The day of this ceremony is appointed by public order; and nothing is omitted, that it may be celebrated with the utmoſt pomp and magnificence. The neighbouring tribes are invited to be preſent, and to join in the ſolemnity. At this time all who have died ſince the laſt ſolemn occaſion are taken out of their graves: thoſe who have been interred at the greateſt diſtance from the villages are diligently ſought for, and brought to this great rendezvous of carcaſes.

It is not difficult to conceive the horror of this general diſinterment; but it cannot be deſcribed in a more lively manner than it is done by Lafitau, to whom we are indebted for the moſt authentic account of thoſe nations.

"Without queſtion (ſays he), the opening of theſe tombs diſplays one of the moſt ſtriking ſcenes that can be conceived; this humbling portrait of human miſery, in ſo many images of death, wherein ſhe ſeems to take a pleaſure to paint herſelf in a thouſand various ſhapes of horror, in the ſeveral carcaſes, according to the degree in which corruption has prevailed over them, or the manner in which it has attacked them. Some appear dry and withered; others have a ſort of parchment upon their bones; ſome look as if they were baked and ſmoked, without any appearance of rottenneſs; ſome are juſt turning towards the point of putrefaction; whilſt others are all ſwarming with worms, and drowned in corruption. I know not which ought to ſtrike us moſt, the horror of ſo ſhocking a ſight, or the tender piety and affection of theſe poor people toward their departed friends; for nothing deſerves our admiration more than that eager diligence and attention with which they diſcharge this melancholy duty of their tenderneſs; gathering up carefully even the ſmalleſt bones, handling the carcaſes, diſguſtful as they are, with every thing loathſome, cleanſing them from the worms, and carrying them upon their ſhoulders through tireſome journeys of ſeveral days, without being diſcouraged from the offenſiveneſs of the ſmell, and without ſuffering any other emotions to ariſe than thoſe of regret, for having loſt perſons who were ſo dear to them in their lives, and ſo lamented in their death.

"They bring them into their cottages, where they prepare a feaſt in honour of the dead; during which their great actions are celebrated, and all the tender intercourſes which took place between them and their friends are piouſly called to mind. The ſtrangers, who have come ſometimes many hundred miles to be preſent on the occaſion, join in the tender condolence; and the women, by frightful ſhrieks, demonſtrate that they are pierced with the ſharpeſt ſorrow. Then the dead bodies are carried from the cabins for the general re-interment. A great pit is dug in the ground, and thither, at a certain time, each perſon, attended by his family and friends, marches in ſolemn ſilence, bearing the dead body of a ſon, a father, or a brother. When they are all convened, the dead bodies, or the duſt of thoſe which were quite corrupted, are depoſited in a pit: then the torrent of grief breaks out anew. Whatever they poſſeſs moſt valuable is interred with the dead. The ſtrangers are not wanting in their generoſity, and confer thoſe preſents which they have brought along with them for the purpoſe. Then all preſent go down into the pit, and every one takes a little of the earth, which they afterwards preſerve with the moſt religious care. The bodies, ranged in order, are covered with entire new furs, and over theſe with bark, on which they throw ſtones, wood, and earth. Then taking their laſt farewel, they return each to his own cabin.

"We have mentioned, that in this ceremony the ſavages offer, as preſents to the dead, whatever they value moſt highly. This cuſtom, which is univerſal among them, ariſes from a rude notion of the immortality of the ſoul. They believe this doctrine moſt firmly, and it is the principal tenet of their religion. When the ſoul is ſeparated from the body of their friends, they conceive that it ſtill continues to hover around it, and to require and take delight in the ſame things with which it formerly was pleaſed. After a certain time, however, it forſakes this dreary manſion, and departs far weſtward into the land of ſpirits. They have even gone ſo far as to make a diſtinction between the inhabitants of the other world; ſome, they imagine, particularly thoſe who in their lifetime have been fortunate in war, poſſeſs a high degree of happineſs, have a place for hunting and fiſhing, which never fails, and enjoy all ſenſual delights, without labouring hard in order to procure them. The ſouls of thoſe, on the contrary, who happen to be conquered or ſlain in war, are extremely miſerable after death."

FEAST is alſo uſed for a banquet, or a ſumptuous meal, without any immediate view to religion. The uſe of the word, in this ſenſe, ariſes hence; that a part of the ceremony of many of the ancient feſtivals, both thoſe of the heathens and agapæ of the Chriſtians, was good eating; though Mr. Huet chooſes to derive the word from *feſtinare*, which, in an ancient Latin verſion of Origen's Comment on Matthew, ſignifies "to feaſt:" *Ut veniens illuc Jeſus feſtinet cum diſcipulis ſuis.*

Social or civil feaſts were alſo expreſſed by the words *convivium* and *compotatio*, or *concœnatio*. Cicero ſays, that in the

Roman tongue, the word *convivium*, which means "people aſſembled at table," is more ſignificant than the Greek word *compotatio* or *concœnatio:* the Roman, ſays he, expreſſes the conjunction of body and mind which ought to take place at an entertainment; the Greek denotes what relates to the body alone.

Among the Romans, the place where they ſupped was generally the veſtibule, that a more retired part of the houſe might not encourage licentiouſneſs and diſorder. There were ſeveral laws that reſtricted their meals to theſe veſtibules.

When luxury reigned in Rome, they had ſuperb halls for their entertainments. Lucullus had many, each of which bore the name of ſome deity; and this name was a mark which indicated to the ſervants the expence of the entertainment. The expence of a ſupper in Lucullus's hall of Apollo amounted to 50,000 drachmas.

The Romans did not, as we do, uſe but one table at their feaſts; they had generally two; the firſt was for the ſervices of animal food, which was afterwards removed, and another introduced with fruits: at this laſt they ſung, and poured out their libations. The Greeks and eaſtern nations had the ſame cuſtom, and even the Jews in their ſolemn feaſts and at ſacrifices.

We learn from Herodotus, that the ancients had neither cups nor bowls, but that they drank out of little horns tipt with ſilver or gold.

Under the reign of Charles V. of France, the cuſtom of placing the lights upon the table was not yet introduced. A number of domeſtics held the candles in their hands during the whole time of the repaſt.

The Greeks and Romans kept a domeſtic for the purpoſe of reading during their meals and feaſts. Sometimes the chief of the family himſelf performed the office of reader; and hiſtory informs us, that the Emperor Severus often read while his family ate. The time of reading was generally at ſupper; and gueſts were invited to a reading as they are now a-days to play cards. The Greeks, in their flouriſhing times, did not profane, according to their own expreſſion, the *holineſs* of the table; but rather adorned it with ingenious and elegant converſation: they propoſed moral topics, of which Plutarch has preſerved a collection.

When Rome was corrupted with luxury; ſingers, dancers, muſicians, ſtage-players, and people that told pleaſant tales, were brought into the hall to amuſe the gueſts. Plutarch informs us, that Cæſar, after his triumphs, treated the Roman people at 22,000 tables; and by calculation it would ſeem that there were at theſe tables upwards of 200,000 perſons. At the end of the feaſt the Romans drank out of a large cup as often as there were letters in the name of their miſtreſſes.

Feaſting ſeems to have been the chief delight of the Germans, Gauls, Britons, and all the other Celtic nations; in which they indulged themſelves to the utmoſt, as often as they had an opportunity. "Among theſe nations (ſays an author who had carefully ſtudied their manners) there is no public aſſembly, either for civil or religious purpoſes, duly held; no birthday, marriage, or funeral properly celebrated; no treaty of peace or alliance rightly cemented, without a great feaſt." It was by frequent entertainments of this kind that the great men or chieftains gained the affections and rewarded the ſervices of their followers; and thoſe who made the greateſt feaſts were ſure to be moſt popular, and to have the greateſt retinue. Theſe feaſts (in which plenty was more regarded than elegance) laſted commonly ſeveral days, and the gueſts ſeldom retired until they had conſumed all the proviſions and exhauſted all the liquors.

As to the drink uſed at thoſe feaſts, particularly in Britain, it ſeems probable, that before the introduction of agriculture into the iſland, mead or honey diluted with water was the only ſtrong liquor known to its inhabitants, as it was to many other ancient nations in the ſame circumſtances. This continued to be a favourite beverage among the ancient Britons and their poſterity, long after they had become acquainted with other liquors. The mead-maker was the eleventh perſon in dignity in the courts of the ancient princes of Wales, and took place of the phyſician. After the introduction of agriculture, ALE or beer became the moſt general drink of all the Britiſh nations who practiſed that art, as it had long been of all the Celtic people on the continent.

The diſhes in which the meat was ſerved up were either of wood or earthen-ware, or a kind of baſkets made of oſiers. Theſe laſt were moſt uſed by the Britons, as they very much excelled in the art of making them both for their own uſe and for exportation. The gueſts ſat in a circle upon the ground, with a little hay, graſs, or the ſkin of ſome animal under them. A low table or ſtool was ſet before each perſon, with the portion of meat allotted to him upon it. In this diſtribution, they never neglected to ſet the largeſt and beſt pieces before thoſe who were moſt diſtinguiſhed for their rank, their exploits, or their riches. Every gueſt took the meat ſet before him in his hands, and, tearing it with his teeth, fed upon it in the beſt manner he could. If any one found difficulty in ſeparating any part of his meat with his hands and teeth, he made uſe of a large knife, that lay in a particular place for the benefit of the whole company. Servants, or young boys and girls, the children of the family, ſtood behind the gueſts ready to help them to drink, or any thing they wanted. As the ancient Britons greatly excelled and very much delighted in muſic, all their feaſts were accompanied with the joys of ſong, and the muſic of harps.

It has been often obſerved by authors, that there is no nation in the world comes near the Engliſh in the magnificence of their feaſts. Thoſe made at our coronations, inſtalments, conſecrations, &c. tranſcend the belief of all foreigners; and yet it is doubted whether thoſe now in uſe are comparable to thoſe of our forefathers.

FEATHER, in phyſiology, a general name for the covering of birds; it being common to all the animals of this claſs to have the whole body, or at leaſt the greateſt part of it, covered with feathers or plumage. See ORNITHOLOGY. Feathers make a conſiderable article of commerce, particularly thoſe of the oſtrich, heron, ſwan, peacock, gooſe, &c. for plumes, ornaments of the head, filling of beds, writing-pens, &c. Geeſe are plucked in ſome parts of Great Britain five times in the year; and in cold ſeaſons many of them die by this barbarous cuſtom. See ANAS. Thoſe feathers that are brought from Somerſetſhire are eſteemed the beſt, and thoſe from Ireland the worſt.

Eider down (ſee the article DOWN) is imported from Denmark; the ducks that ſupply it being inhabitants of Hudſon's Bay, Greenland, Iceland, and Norway. All the iſlands weſt of Scotland breed numbers of theſe birds, which turn out a profitable branch of trade to the poor inhabitants. Hudſon's Bay alſo furniſhes very fine feathers, ſuppoſed to be of the gooſe kind. The down of the ſwan is brought from Dantzic. The ſame place alſo ſends us great quantities of the feathers of the cock and hen. The London poulterers ſell a great quantity of the feathers of thoſe birds, and of ducks and turkies: thoſe of ducks being a weaker feather, are inferior to thoſe of the gooſe; and turkeys' feathers are the worſt of any. The beſt method of curing feathers is to lay them in a room, expoſed to the air and ſun; and when dried, to put them in bags, and beat them well with poles to get the dirt off.

FEBRIFUGE, an appellation given to ſuch medicines as mitigate or remove a fever.

FEBRUARY, in chronology, the ſecond month of Numa's year, and under the protection of the god Neptune. This month is not found in the kalendar of Romulus, but was added

to the year by Numa. It had its name from *Februa, Februaca*, or *Februalis*, all names of Juno, who presided over the purifications of women; and in this month the Lupercalia were held in honour of Juno, and women were purified by the priests of Pan Lyceus at that festival. See LUPERCALIA. February, in a common year, consists only of 28 days; but in the bissextile it has 29, on account of the intercalary day added in that year.

FECIALES, or FOECIALES, an order of priests or officers, consisting of 20 persons, among the ancient Romans, appointed to proclaim war, negotiate peace, &c.

The feciales were a sort of heralds, who, when the Romans had any dispute with their neighbours, were sent first to demand the thing pretended to be usurped, or require satisfaction for the injury alleged to be done. If an answer was not returned by them that was satisfactory to the people and the senate, they were dispatched again to declare war; and the same in treating of peace; the feciales being the only persons appointed to negotiate between the senate, &c. and the enemy.

Plutarch, in the life of Numa, and Halicarnasseus (lib. ii.), observe, that they were first instituted by that prince. The latter adds, that they were chosen out of the best families in Rome; that their office, which was reputed a sort of sacerdotium, or priesthood, only ended with their life; that their persons were sacred and inviolable, as those of other priests; that they were even charged to see the republic did not declare war unjustly; that they were to receive the complaints and remonstrances of nations who pretended to have been any way injured by the Romans; that if those complaints were found just, they were to seize the criminals, and deliver them up to those they had offended; that they were invested with the rights and privileges of ambassadors; that they concluded treaties of peace and alliance, and took care they were executed; and, lastly, abolished them, if they were found not to be equitable. Livy, lib. i. cap. 24. ascribes their institution to Ancus Martius, in the year of Rome 114. Varro assures us, that in his time most of these functions of the feciales were set aside; though Plutarch observes, that they had still some authority in his time.

The feciales were crowned with *verbena*, "vervain," when they went to declare war. The head was covered with a veil over which the crown was applied. In this equipage they proceeded to the frontiers of the new enemy's country, and threw a bloody dart or javelin into the ground within the same. In Livy and other ancient authors, we have the formula used in such declarations.

FECUNDITY, the same with FERTILITY.

FEE, in law, signifies a complete feudal property. Hence, where the bare liferent of any feudal subject is meant to be conveyed to A, and the absolute property to B, that meaning is expressed thus; "to A in liferent, and to B in fee." See LAW. Fees are commonly divided into *absolute*, otherwise called fees-simple; and *limited*, one species of which we usually call fee-tail.

I. According to Judge Blackstone, a tenant in fee-simple (or, as he is frequently styled, *tenant in fee)* is he that hath lands, tenements, or hereditaments, to hold to him and his heirs for ever; generally, absolutely, and simply; without mentioning what heirs, but referring that to his own pleasure, or to the disposition of the law. The true meaning of the word *fee (feodum)* is the same with that of *feud* or *fief*, and in its original sense it is taken in contradistinction to *allodium*; which latter the writers on this subject define to be every man's own land, which he possesseth merely in his own right, without owing any rent or service to any superior. This is property in its highest degree; and the owner thereof hath *absolutum et directum dominium*, and therefore is said to be seised thereof absolutely *in dominio suo*, in his own demesne. But *feodum*, or *fee*, is that which is held of some superior, on condition of rendering him service; in which superior the ultimate property of the land resides: and therefore Sir Henry Spelman defines a feud or fee to be, the right which the vassal or tenant hath in lands to use the same, and take the profits thereof to him and his heirs, rendering to the lord his due services; the mere allodial property of the soil always remaining in the lord. This allodial property no subject in Britain has; it being a received and now undeniable principle in the law, that all the lands are holden mediately or immediately of the king. The king therefore only hath *absolutum et directum dominium*; but all subjects' lands are in the nature of *feodum* or *fee*, whether derived to them by descent from their ancestors, or purchased for a valuable consideration: for they cannot come to any man by either of those ways, unless accompanied with those feodal clogs which were laid upon the first feudatory when it was originally granted. A subject therefore hath only the usufruct, and not the absolute property, of the soil; or, as Sir Edward Coke expresses it, he hath *dominium utile*, but not *dominium directum*. And hence it is, that, in the most solemn acts of law, we express the strongest and highest estate that any subject can have, by these words, "he is seised thereof *in his demesne*, as of fee." It is a man's demesne, *dominium*, or property, since it belongs to him and his heirs for ever: yet this *dominium*, property, or demesne, is strictly not absolute or allodial, but qualified or feodal: it is in his demesne, *as of fee*; that is, it is not purely and simply his own, since it is held of a superior lord, in whom the ultimate property resides.

This is the primary sense and acceptation of the word *fee*. But (as Sir Martin Wright very justly observes) the doctrine, "that all lands are *holden*," having been for so many ages a fixed and undeniable axiom, the English lawyers do very rarely (of late years especially) use the word *fee* in this its primary original sense, in contradistinction to *allodium* or absolute property, with which they have no concern; but generally use it to express the continuance or quantity of estate. A *fee* therefore, in general, signifies an estate of inheritance; being the highest and most extensive interest that a man can have in a feud: and when the term is used simply, without any other adjunct, or has the adjunct of *simple* annexed to it (as, a fee, or a fee-simple), it is used in contradistinction to a fee-conditional at the common law, or a fee-tail by the statute; importing an absolute inheritance, clear of any condition, limitation, or restrictions to particular heirs, but descendible to the heirs-general, whether male or female, lineal or collateral. And in no other sense than this is the king said to be seised in fee, he being the feudatory of no man.

Taking therefore *fee* in this its secondary sense, as a state of inheritance, it is applicable to, and may be had in, any kind of hereditaments either corporeal or incorporeal. But there is this distinction between the two species of hereditaments; that of a corporeal inheritance a man shall be said to be seised *in his demesne, as of fee*; of an incorporeal one he shall only be said to be seised *as of fee*, and not *in his demesne*. For as incorporeal hereditaments are in their nature collateral to, and issue out of, lands and houses, their owner hath no property, *dominium*, or demesne, in the *thing* itself, but hath only something derived out of it; resembling the *servitutes*, or services, of the civil law. The *dominium*, or property, is frequently in one man, while the appendage or service is in another. Thus Caius may be seised *as of fee*, of a way going over the land, of which Titius is seised *in his demesne as of fee*.

The fee-simple or inheritance of lands and tenements is generally vested and resides in some person or other; though divers inferior estates may be carved out of it. As if one grants a lease for 21 years, or for one or two lives, the fee-simple remains vested in him and his heirs; and after the determination of those years or lives, the land reverts to the granter or his heirs, who shall hold it again in fee-simple. Yet sometimes the fee may be in *abeyance*, that is (as the word signifies) in expectation, remembrance, and contemplation in law; there

being no perſon *in eſſe*, in whom it can veſt and abide, though the law conſiders it as always potentially exiſting, and ready to veſt whenever a proper owner appears. Thus, in a grant to John for life, and afterwards to the heirs of Richard, the inheritance is plainly neither granted to John nor Richard, nor can it veſt in the heirs of Richard till his death, *nam nemo eſt hæres viventis:* it remains therefore in waiting, or abeyance, during the life of Richard. This is likewiſe always the caſe of a parſon of a church, who hath only an eſtate therein for the term of his life; and the inheritance remains in abeyance. And not only the fee, but the freehold alſo, may be in abeyance; as, when a parſon dies, the freehold of his glebe is in abeyance until a ſucceſſor be named, and then it veſts in the ſucceſſor.

The word *heirs* is neceſſary in the grant or donation, in order to make a fee or inheritance. For if land be given to a man for ever, or to him and his aſſigns for ever, this veſts in him but an eſtate for life. This very great nicety about the inſertion of the word *heirs* in all feoffments and grants, in order to veſt a fee, is plainly a relic of the feodal ſtrictneſs: by which it was required, that the form of the donation ſhould be punctually purſued; or that, as Craig expreſſes it, in the words of Baldus, *donationes ſint ſtricti juris, ne quis plus donaſſe præſumatur quam in donatione expreſſerit.* And therefore, as the perſonal abilities of the donee were originally ſuppoſed to be the only inducements to the gift, the donee's eſtate in the land extended only to his own perſon, and ſubſiſted no longer than his life; unleſs the donor, by an expreſs proviſion in the grant, gave it a longer continuance, and extended it alſo to his heirs. But this rule is now ſoftened by many exceptions.

For, 1. It does not tend to deviſes by will; in which, as they were introduced at the time when the feodal rigour was apace wearing out, a more liberal conſtruction is allowed: and therefore by a deviſe to a man for ever, or to one and his aſſigns for ever, or to one in fee-ſimple, the deviſee hath an eſtate of inheritance; for the intention of the deviſor is ſufficiently plain from the words of perpetuity annexed, though he hath omitted the legal words of inheritance. But if the deviſe be to a man and his aſſigns, without annexing words of perpetuity, there the deviſee ſhall take only an eſtate for life; for it does not appear that the deviſor intended any more. 2. Neither does this rule extend to fines or recoveries, conſidered as a ſpecies of conveyance; for thereby an eſtate in fee paſſes by act and operation of law without the word *heirs:* as it does alſo, for particular reaſons, by certain other methods of conveyance, which have relation to a former grant or eſtate, wherein the word *heirs* was expreſſed. 3. In creations of nobility by writ, the peer ſo created hath an inheritance in his title, without expreſſing the word *heirs*; for they are implied in the creation, unleſs it be otherwiſe ſpecially provided: but in creations by patent, which are *ſtricti juris*, the word *heirs* muſt be inſerted, otherwiſe there is no inheritance. 4. In grants of lands to ſole corporations and their ſucceſſors, the word *ſucceſſors* ſupplies the place of *heirs*; for as heirs take from the anceſtor, ſo doth the ſucceſſor from the predeceſſor. Nay, in a grant to a biſhop, or other ſole ſpiritual corporation, in *frankalmoign*, the word *frankalmoign* ſupplies the place of *ſucceſſors* (as the word *ſucceſſors* ſupplies the place of *heirs) ex vi termini*; and in all theſe caſes a fee-ſimple veſts in ſuch ſole corporation. But, in a grant of lands to a corporation aggregate, the word *ſucceſſors* is not neceſſary, though uſually inſerted: for, albeit ſuch ſimple grant be ſtrictly only an eſtate for life, yet as that corporation never dies, ſuch eſtate for life is perpetual, or equivalent to a fee-ſimple, and therefore the law allows it to be one. Laſtly, in the caſe of the king, a fee-ſimple will veſt in him, without the word *heirs* or *ſucceſſors* in the grants; partly from prerogative royal, and partly from a reaſon ſimilar to the laſt, becauſe the king, in judgment of law, never dies. But the general rule is, that the word *heirs* is neceſſary to create an eſtate of inheritance.

II. We are next to conſider limited fees, or ſuch eſtates of inheritance as are clogged and confined with conditions or qualifications of any ſort. And theſe we may divide into two ſorts: viz. *Qualified*, or *baſe* fees; and, fees *conditional*, ſo called at the common law; and afterwards fees-*tail*, in conſequence of the ſtatute *de donis*. 1. A *baſe* or qualified fee, is ſuch a one as has a qualification ſubjoined thereto, and which muſt be determined whenever the qualification annexed to it is at an end. As, in the caſe of a grant to A and his heirs, tenants in the manor of Dale; in this inſtance, whenever the heirs of A ceaſe to be tenants of that manor, the grant is entirely defeated. So, when Henry VI. granted to John Talbot, lord of the manor of Kingſton-Liſle in Berks, that he and his heirs, lords of the ſaid manor, ſhould be peers of the realm, by the title of *barons of Liſle*; here John Talbot had a baſe or qualified fee in that dignity; and the inſtant he or his heir quitted the ſeigniory of this manor, the dignity was at an end. This eſtate is a fee, becauſe by poſſibility it may endure for ever in a man and his heirs; yet as that duration depends upon the concurrence of collateral circumſtances, which qualify and debaſe the purity of the donation, it is therefore a qualified or baſe fee. 2. As to fees-*conditional*, or fees-*tail*, ſee the article TAIL.

FEE alſo ſignifies a certain allowance to phyſicians, barriſters, attorneys, and other officers, as a reward for their opinion and advice. If a perſon refuſe to pay an officer his due fees, the court will grant an attachment againſt him, to be committed till the fees are paid; and an attorney may bring an action on the caſe for his fees againſt the client that retained him in his cauſe.

FEE alſo denotes a ſettled perquiſite of public officers, payable by thoſe who employ them. The fees due to the officers of the cuſtom-houſe are expreſsly mentioned in a ſchedule, or table, which is hung up to public view in the ſaid office, and in all other places where the ſaid fees are to be paid or received. And if any officer ſhall offend, by acting contrary to the regulations therein contained, he ſhall forfeit his office and place, and be for ever after incapable of any office in the cuſtom-houſe. The other public offices have likewiſe their ſettled fees, for the ſeveral kinds of buſineſs tranſacted in them.

FEE-*Farm*, a kind of tenure without homage, fealty, or other ſervice, except that mentioned in the feoffment; which is uſually the full rent, or at leaſt a fourth part of it. The nature of this tenure is, that if the rent be behind, and unpaid for two years, then the feoffor and his heirs may have an action for the recovery of the lands.

FEELERS, in natural hiſtory, a name uſed by ſome for the horns of INSECTS.

FEELING, one of the five external ſenſes, by which we obtain the ideas of ſolid, hard, ſoft, rough, hot, cold, wet, dry, and other tangible qualities. See ANATOMY, p. 186.

FEET-BEARER, the name of an officer in the courts of the ancient Anglo-Saxon and Welch kings. He was a young gentleman whoſe duty it was to ſit on the floor, with his back towards the fire, and hold the king's feet in his boſom all the time he ſat at table, to keep them warm and comfortable: a piece of ſtate and luxury happily unknown in modern times.

FEINT, in fencing, a ſhow of making a thruſt at one part, in order to deceive the enemy, that you may really ſtrike him in another. A ſimple feint is a mere motion of the wriſt, without ſtirring the foot.

FELAPTON, in logic, one of the ſix firſt modes of the third figure of ſyllogiſms: whereof the firſt propoſition is an univerſal negative, the ſecond an univerſal affirmative, and the third a particular negative.

FELIBIEN (Andre), was born at Chartres in 1619, and went ſecretary under the marquis de Fontenay Mareuil, ambaſſador to the court of Rome in 1647. On his return, M. Colbert procured him the places of hiſtoriographer to the king, ſuperintendant of his buildings, and of the arts and manufactures

in France. He became afterwards deputy comptroller general of the bridges and dykes in that kingdom; and died in 1695. He wrote feveral pieces relating to the fine arts; the principal of which is his "Dialogues on the lives and works of the moft eminent painters."

FELICITAS, Felicity, or *Happinefs*, was deified by the ancient Pagans. Lucullus built a temple to her. She had another erected by Lepidus. The Greeks paid divine worfhip to *Mocaria*, daughter of Hercules, the fame with *Felicitas*. This deity is often pictured upon medals, and generally with a cornucopia in one hand, and a caduceus in the other. The infcriptions are, *Felicitas Temporum*, *Felicitas Augufti*, *Felicitas Publica*, &c.

FELIS, in zoology, a genus of quadrupeds belonging to the order of feræ, the characters of which are thefe: The fore-teeth are equal; the molares or grinders have three points; the tongue is furnifhed with rough fharp prickles, and pointing backwards; and the claws are fheathed and retractile. See Plates 23. and 24. This genus comprehends twenty-one fpecies, *viz.*

I. *Leo*, the Lion. The largeft lions are from eight to nine feet in length, and from four to fix feet high: thofe of a fmaller fize are generally about $5\frac{1}{2}$ feet long, and about $3\frac{1}{2}$ high. His head is very thick, and his face is befet on all fides with long bufhy yellowifh hair; this fhaggy hair extends from the top of the head to below the fhoulders, and hangs down to his knees: the belly and breaft are likewife covered with long hair. The reft of the body is covered with very fhort hair, excepting a bufh at the point of the tail. The ears are roundifh, fhort, and almoft entirely concealed under the hair of his front. The fhagginefs of the fore-part of his body makes the hinder-part have a naked appearance. The tail is long and very ftrong; the legs are thick and flefhy; and the feet are fhort; the length of the claws is about an inch and a quarter, are of a whitifh colour, very crooked, and can be extended or retracted into the membranous fheath at pleafure: their points are feldom blunted, as they are never extended but when he feizes his prey.

The female, or lionefs, has no mane, or long hair about her head or fhoulders; in her we fee diftinctly the whole face, head, ears, neck, fhoulders, breaft, &c. all thefe parts being in fome meafure concealed under the long hair of the male, give the female a very different appearance: befides, fhe is confiderably lefs than the male. The hair of both male and female is of a yellowifh colour, and whitifh on the fides and belly.

In warm countries, quadrupeds in general are larger and ftronger than in the cold or temperate climates. They are likewife more fierce and hardy; all their natural qualities feem to correfpond with the ardour of the climate. The lions nourifhed under the fcorching fun of Africa or the Indies, are the moft ftrong, fierce, and terrible. Thofe of mount Atlas, whofe top is fometimes covered with fnow, are neither fo ftrong nor fo ferocious as thofe of Biledulgerid or Zaara, whofe plains are covered with burning fand. It is in thefe hot and barren deferts that the lion is the dread of travellers, and the fcourge of the neighbouring provinces. But it is a happy circumftance that the fpecies is not very numerous: they even appear to diminifh daily. The Romans, fays Mr. Shaw, brought many more lions out of Libya for their public fhows, than are now to be found in that country. It is likewife remarked, that the lions in Turky, Perfia, and the Indies, are lefs numerous than formerly. As this formidable and courageous animal makes a prey of moft other animals, and is himfelf a prey to none, this diminution in the number of the fpecies can be owing to nothing but an increafe in the number of mankind: for it muft be acknowledged, that the ftrength of this king of animals is not a match for the dexterity and addrefs of a negro or Hottentot, who will often dare to attack him face to face, and with very flight weapons.

The ingenuity of mankind augments with their number; that of other animals continues always the fame. All the noxious animals, as the lion, are reduced to a fmall number, not only becaufe mankind are become more numerous, but likewife becaufe they have become more ingenious, and have invented weapons which nothing can refift. This fuperiority in the numbers and induftry of mankind, at the fame time that it has broken the vigour of the lion, feems likewife to have enervated his courage. This quality, though natural, is exalted or lowered, according to the good or bad fuccefs with which any animal has been accuftomed to employ his force. In the vaft deferts of Zaara; in thofe which feem to feparate two very different races of men, the Negroes and Moors, between Senegal and the boundaries of Mauritania; in thofe uninhabited regions above the country of the Hottentots; and, in general, all the meridional parts of Africa and Afia, where mankind have difdained to dwell, lions are ftill as numerous and as ferocious as ever. Accuftomed to meafure their ftrength by that of all other animals which they encounter, the habit of conquering renders them haughty and intrepid. Having never experienced the ftrength of man, or the power of his arms, inftead of difcovering any figns of fear, they difdain and fet him at defiance. Wounds irritate, but do not terrify them: they are not even difconcerted at the fight of numbers. A fingle lion of the defert has been known to attack a whole caravan; and if, after a violent and obftinate engagement, he found himfelf weakened, he retreats fighting, always keeping his face to the enemy. On the other hand, the lions which live near the villages or huts of the Indians or Africans, being acquainted with man and the force of his arms, are fo daftardly as to fly and leave their prey at the fight of women or children.

This foftening in the temper and difpofition of the lion fhows that he is capable of culture, and fufceptible, at leaft to a certain degree, of the impreffions that he receives: accordingly, hiftory informs us of lions yoked in triumphal chariots, trained to war, or the chace; and that, faithful to their mafters, they never employed their ftrength or courage but againft their enemies. It is certain, that a lion taken young, and brought up among domeftic animals, will eafily be accuftomed to live and fport with them; that he is mild and careffing to his mafter, efpecially when he is young; and that, if his natural ferocity fometimes breaks out, it is rarely turned againft thofe who have been kind to him. But, as his paffions are impetuous and vehement, it is not to be expected that the impreffions of education will at all times be fufficient to balance them: for this reafon it is dangerous to let him fuffer hunger long, or to vex him by ill-timed teafings: bad treatment not only irritates him, but he remembers it long, and meditates revenge. On the other hand, he is exceedingly grateful, and feldom forgets benefits received. He has been often obferved to difdain weak or infignificant enemies, to defpife their infults, and to pardon their offenfive liberties. When led into captivity, he will difcover fymptoms of uneafinefs, without anger or peevifhnefs: on the contrary, his natural temper foftens, he obeys his mafter, careffes the hand that gives him food, and fometimes gives life to fuch animals as are thrown to him alive for prey: by this act of generofity he feems to confider himfelf as for ever bound to protect them; he lives peaceably with them; allows them a part, and fometimes the whole, of his food; and will rather fubmit to the pangs of hunger, than fill his ftomach with the fruit of his beneficence. We may likewife obferve, that the lion is not a cruel animal: he kills rather from neceffity than choice, never deftroying more than he eats; and whenever his appetite is fatisfied, he is mild and peaceable. For his ordinary fubfiftence, he requires about 15 pounds of raw flefh each day.

The afpect of the lion correfponds with the noble and ge-

nerous qualities of his mind. His figure is refpectable; his looks are determined; his gait is ftately, and his voice tremendous. In a word, the body of the lion appears to be the beft model of ftrength joined to agility. The force of his mufcles is expreffed by his prodigious leaps and bounds, often 20 feet at once; by the brifk motion of his tail, a fingle fweep of which is fufficient to throw a man to the ground; by the eafe with which he moves the fkin of his face, and particularly of his forehead; and, laftly, by the faculty of erecting and agitating the hair of his mane when irritated.

Lions are very ardent in their amours: when the female is in feafon, fhe is often followed by eight or ten males, who roar inceffantly, and enter into furious engagements, till one of them completely overcomes the reft, takes peaceable poffeffion of the female, and carries her off to fome fecret recefs. The lionefs brings forth her young in the fpring, and produces but once a year.

All the paffions of the lion, the foft paffion of love not excepted, are exceffive; the love of offspring is extreme: the lionefs is naturally weaker, lefs bold, and more gentle than the lion; but fhe becomes perfectly rapacious and terrible when fhe has young. Then fhe exhibits more courage than the male; fhe regards no danger; fhe attacks indifferently men and all other animals, kills them, and carries them to her young ones, whom fhe thus early inftructs to fuck their blood and tear their flefh. She generally brings forth in the moft fecret and inacceffible places; and, when afraid of a difcovery, fhe endeavours to conceal the traces of her feet, by returning frequently on her fteps, or rather by effacing them with her tail; and, when the danger is great, fhe carries off her young, and conceals them fomewhere elfe. But, when an actual attempt is made to deprive her of her young, fhe becomes perfectly furious, and defends them till fhe is torn to pieces.

The lion feldom goes abroad in the middle of the day; but fallies forth in the evening and night in queft of prey. He is afraid of fire, and feldom or never approaches the fires ufually made by the fhepherds for the protection of their flocks; he does not trace other animals by the fcent, but is obliged to truft to his eyes. Many hiftorians have even mifreprefented him as incapable of finding out his prey; but that he is obliged to the jackal, an animal of exquifite fcent, in order to provide for him, and that this animal either accompanies or goes before him for this purpofe. The jackal is a native of Arabia, Libya, &c. and, like the lion, lives upon prey: perhaps fometimes he follows the lion, but it is with a view to pick up what he leaves behind, not to provide for him; for, being a fmall and feeble animal, he ought rather to fly from than to ferve the lion.

The lion, when hungry, will attack any animal that prefents itfelf: but he is fo very formidable, that all endeavour to avoid his rencounter: this circumftance often obliges him to conceal himfelf, and lie in wait till fome animal chances to pafs. He lies fquat on his belly in a thicket; from which he fprings with fuch force and velocity, that he often feizes them at the firft bound. He endures hunger longer than thirft; he feldom paffes water without drinking, which he does by lapping like a dog. In burning deferts, where rivers and fountains are denied, they live in a perpetual fever, a fort of madnefs fatal to every animal they meet with. The author of *The Oeconomy of Nature* gives a wonderful proof of the inftinct of thefe animals in thofe unwatered tracts. There the pelican makes her neft; and in order to cool her young ones, and accuftom them to an element they muft afterwards be converfant in, brings from afar, in her great gular pouch, fufficient water to fill the neft: the lion, and other wild beafts, approach, and quench their thirft; yet never injure the unfledged birds, as if confcious that their deftruction would immediately put a ftop to thofe grateful fupplies.

The roaring of the lion, which is ftrong and loud, is his ordinary voice; but when he is irritated, his cry is fhorter, repeated more fuddenly, and is ftill more terrible than the roaring: befides, he beats his fides with his tail, ftamps with his feet, erects and agitates the hair of his head and mane, moves the fkin of his face, fhows his angry teeth, and lolls out his tongue.

The gait of the lion is ftately, grave, and flow, though always in an oblique direction. His movements are not equal or meafured, but confift of leaps and bounds; which prevents him from ftopping fuddenly, and makes him often overleap his mark. When he leaps upon his prey, he makes a bound of 12 or 15 feet, falls above it, feizes it with his fore-teeth, tears the flefh with his claws, and then devours it with his teeth. If he chance to mifs his leap, he will not, as the Hottentots unanimoufly affured Mr. Sparman, follow his prey any farther; but, as though he were afhamed, turning round towards the place where he lay in ambufh, flowly, and ftep by ftep, as it were, meafures the exact length between the two points, in order to find how much too fhort of, or beyond, the mark he had taken his leap.

The fame writer, in his account of the lion, detracts confiderably from the character of courage and generofity generally afcribed to that animal. He even relates an occurrence, which, in his idea, ferves to fhow his cowardly and infidious difpofition. For thefe and many other curious particulars, however, we muft refer the reader to Mr. Sparman's publications.

II. *Tigris*, the Tiger. The fize of this animal, according to fome authors, is larger, and, according to others, fomewhat lefs, than the lion. M. de la Landemagon affures us, that he has feen a tiger in the Eaft Indies 15 feet long, including undoubtedly the length of the tail, which, fuppofing it to be four feet, makes the body of the tiger about 11 feet in length. The fkeleton preferved in the cabinet of the French king, indicates that the animal was about feven feet long from the point of the muzzle to the origin of the tail; but then it muft be confidered, that he was caught young, and lived all his days in confinement. The head of the tiger is large and roundifh; and the ears are fhort, and at a great diftance from each other. The form of the body has a great refemblance to that of the panther. The fkin is of a darkifh yellow colour, ftriped with long black ftreaks; the hair is fhort, excepting on the fides of the head, where it is about four inches long. The point of the tail is black, and the reft of it is interfperfed with black rings. His legs and claws refemble thofe of the lion, only the legs are much fhorter in proportion to the fize of the animal.

The tiger is more ferocious, cruel, and favage than the lion. Although gorged with carnage, his thirft for blood is not appeafed; he feizes and tears in pieces a new prey with equal fury and rapacity, the very moment after devouring a former one; he lays wafte the country he inhabits; he neither dreads the afpect nor the weapons of men; puts to death whole troops of domeftic animals; and attacks young elephants, the rhinoceros, and fometimes even braves the lion himfelf. The tiger feems to have no other inftinct but a conftant thirft after blood, a blind fury which knows no bounds or diftinction, and which often ftimulates him to devour his own young, and to tear the mother in pieces for endeavouring to defend them. He lies in wait on the banks of rivers, &c. where the heat of the climate obliges other animals to repair for drink. Here he feizes his prey, or rather multiplies his maffacres; for he no fooner kills one animal, than he flies with equal fury upon the next, with no other view but to plunge his head into their bodies and drink their blood. However, when he kills a large animal, as a horfe or a buffalo, he fometimes does not tear out the entrails on the fpot; but, to prevent any interruption, he drags them off to the wood, which he performs with incredible fwift-

nefs. This is a fufficient fpecimen of the ftrength of this rapacious animal.

Neither force, reftraint, or violence, can tame the tiger. He is equally irritated with good as with bad treatment: he tears the hand which nourifhes him, with equal fury as that which adminifters blows: he roars and is enraged at the fight of every living creature. Almoft every natural hiftorian agrees in this horrible character of the tiger fpecies.

There is a fort of cruelty in their devaftations, unknown to the generous lion; as well a sa poltroonery in their fudden retreat on any difappointment. "I was informed (fays Mr. Pennant) by very good authority, that in the beginning of this century, fome gentlemen and ladies, being on a party of pleafure, under a fhade of trees, on the banks of a river in Bengal, obferved a tiger preparing for its fatal fpring: one of the ladies, with amazing prefence of mind, laid hold of an umbrella, and furled it full in the animal's face, which inftantly retired, and gave the company opportunity of removing from fo terrible a neighbour. Another party had not the fame good fortune: a tiger darted among them while they were at dinner, feized on one gentleman, and carried him off, and he never was more heard of." The tiger attacks all forts of animals, even the lion; and it has been known that both have perifhed in their combats. There is in fome parts of India a popular notion, that the rhinoceros and the tiger are in friendfhip, becaufe they are found near each other. But according to Mr. Pennant, the fact is, that the rhinoceros, like the hog, loves to wallow in the mire; and on that account frequents the banks of rivers: the tiger, to quench his raging thirft, is met with in places contiguous to them.

Pliny has been frequently taken to tafk by the moderns, for calling the tiger *animal tremendæ velocitatis:* they allow it great agility in its bounds, but deny it fwiftnefs in purfuit. Two travellers of authority, however, both eye-witneffes, confirm what Pliny fays: the one indeed only mentions in general its vaft fleetnefs; the other faw a trial between one and a fwift horfe, whofe rider efcaped merely by getting in time amidft a circle of armed men. The chafe of this animal was a favourite diverfion with the great Cam-hi, the Chinefe monarch, in whofe company Mr. Bell, a Scots traveller, and the Pere Gerbilion, faw thefe proofs of the tiger's fpeed.

The tiger, according to Mr. Pennant, is peculiar to Afia; and is found as far north as China and Chinefe Tartary, and about lake Aral and the Altaic mountains. It inhabits mount Ararat and Hyrcania, of old, famous for its wild beafts; but the greateft number, the largeft, and the moft cruel, are met with in India and its iflands. In Sumatra the natives are fo infatuated that they feldom kill them, having a notion that they are animated by the fouls of their anceftors.

The tiger has always been a more rare animal than the lion; and yet brings forth an equal number of young, namely, four or five at a litter. The female is furious at all times; but, when her young are attempted to be taken from her, her rage is redoubled: fhe braves every danger: fhe purfues the ravifhers, who are obliged, when hard preffed, to drop one of the young in order to retard her motion; fhe ftops, takes it up, and carries it into fome fecret part of the foreft; but fhe inftantly returns and purfues the hunters into their villages or boats.

The tiger moves the fkin of his face, grinds his teeth, and roars, like the lion; but the found of his voice is very different from that of the lion.

III. *Pardus*, the PANTHER. It is about the fize of a large dog, and has a great refemblance to a domeftic cat. The tongue is rough, and remarkably red; the teeth are ftrong and fharp; the fkin is exceedingly beautiful, being of a yellow colour, variegated with roundifh black fpots, and the hair is fhort. He has a cruel and ferocious afpect; his motions are brifk and lively; his cry refembles the growl of an enraged dog, but is more ftrong and rough.

The panther inhabits Africa, from Barbary to the remoteft parts of Guinea. This fpecies is next in fize to the tiger; next to it in cruelty, and in its general enmity to the animal creation. It is to Africa what the former is to Afia, with this alleviation, that it prefers the flefh of brutes to that of mankind; but when preffed with hunger, attacks every living creature without diftinction. Its manner of taking its prey is the fame with that of the tiger, always by furprife, either lurking in thickets or creeping on its belly till it comes within reach: it will alfo climb up trees in purfuit of monkeys and leffer animals; fo that nothing is fecure from its attacks. He is not fo perfectly ungovernable as the tiger: but, notwithftanding all attempts to render him obedient and tractable, he may rather be faid to be fubdued than tamed; for he never entirely lofes his natural ferocity. Accordingly, when kept with a view to the hunting of bucks, goats, or other animals, great care is neceffary in training him, and ftill greater in conducting him. When leading out to the field, they put him in a cage and carry him on a cart. When the game is fprung, they open the door of the cage; he inftantly fprings towards the animal, often feizes him in a few bounds, throws him to the ground, and ftrangles him. But, if he happens to mifs his aim, he becomes mad with rage, and fometimes falls upon his mafter, who, in order to prevent accidents of this kind, generally carries along with him pieces of flefh, or perhaps a lamb or a kid, which he throws to him in order to appeafe his fury.

The ancients were well acquainted with thefe animals. Thefe, and the leopards, were the *Variæ* and *Pardi* of the old writers: one fhould think that the Romans would have exhaufted the deferts of Africa, by the numbers they drew from thence for their public fhows. Scaurus exhibited at one time 150 panthers; Pompey the Great, 410; Auguftus, 420. Probably they thinned the coafts of Mauritania of thefe animals, but they ftill fwarm in the fouthern parts of Guinea. Oppian defcribes two fpecies of panthers, a large fpecies and a fmall one; the firft of which has a fhorter tail than the leffer, and may poffibly be this kind. An animal of this fpecies is found in Buckharia, called there *Babr:* it is feven feet long, very deftructive to horfes, and even camels; the fkin is fine, and valued in Ruffia at 1l. fterling. In China there is a moft remarkable kind, called there *Louchu*, whofe fkins fell at 6l. fterling a-piece. It muft here alfo be obferved, that there are in the furriers' fhops in London, fkins in moft refpects refembling thofe of the panther; which, they affure us, come from the Spanifh fettlements in the Weft Indies; thefe fkins equal thofe of the old continent in beauty and fize.

Though M. Buffon denies the panther to be an inhabitant of America, yet Mr. Pennant is of opinion that the fame, or a variety at leaft, inhabits that country. 1. The figure of the fpecies defcribed by *Faber*, (*Hift. An. Nov. Hifp.* p. 498.) under the name of *Tigris Mexicana*, agrees exactly with that of the panther, as does alfo the defcription in general. 2. Every other animal of this genus, which has yet been difcovered in America, is far inferior in fize and ftrength to this; whofe common height, Faber fays, is four or five feet, and whofe prey is wild cattle, horfes, &c. *M. Condamine*, and *Le Pere Cajetan Cattaneo*, fpeak of the tigers (*i. e.* the panthers) of America, as equal and even fuperior in fize to thofe of Africa, and the colour as bright as gold; and Ulloa defcribes them as big as a fmall horfe. 3. Notwithftanding the venders of furs are not entirely to be relied on as to the countries their goods come from, yet the general opinion of the whole trade, that thefe fkins were the product of Spanifh America, is a further proof of their being common to both continents.

IV. The *Uncia*, or ONCE, is lefs than the panther; the tail

is longer; the hair is likewife longer, and of a whitifh grey colour. The *once* is eafily tamed; and is employed in hunting in feveral parts of Afia, where dogs are very fcarce. He has not the delicate fcent of a dog; does not trace other animals by the fmell; neither can he run them down in a fair chace; but lies in wait for their approach, and then darts upon them unawares. He leaps fo nimbly, that he eafily clears a ditch or a wall feveral feet high; befides, he often climbs trees, waits till fome animal paffes, and inftantly leaps upon them. This method of catching their prey is practifed by the panther and leopard, as well as by the once. The *once* inhabits Barbary, Perfia, Hyrcania, and China; from which laft place the fkins are brought into Ruffia, and fold for 20s. a-piece. It is an animal of a more gentle and mild nature than moft of the preceding. It is, like the next fpecies, ufed for the chace of antelopes, and even hares; but, inftead of being conveyed in a waggon, is carried on the crupper on horfeback. It is under as much command as a fetting-dog; returns at the leaft call, and jumps up behind its mafter. This animal is fuppofed to be the leffer panther of Oppian, and the panthera of Pliny.

V. *Leopardus*, the Leopard, differs from the panther and the once, in the beauty of his colour, which is a lively yellow, with fmaller fpots than thofe of the two latter, and difpofed in groups. He is larger than the once, and lefs than the panther. He inhabits Senegal and Guinea; and fpares neither man nor beaft. When beafts of chace fail, the leopards defcend from the internal parts of Africa in crowds, and make great havock among the numerous herds that cover the rich meadows of the lower Guinea. It tears its prey to pieces with both claws and teeth; but is always thin, though perpetually devouring. The panther is its principal enemy, and deftroys a great many. The negreffes make collars of their teeth, and attribute to them certain virtues. The negroes take thefe animals in pit-falls, covered at the top with flight hurdles, on which is placed fome flefh as a bait. They make a banquet of their flefh, which is faid to be as white as veal, and very well tafted. Leopards' fkins are often brought to Europe, and reckoned very valuable. In Afia thefe animals are found in the mountains of Caucafus, from Perfia to India; and alfo in China, where they are called *Poupi*. By the Buckharian traders, who often bring their fkins to Ruffia, they are ftyled *Bars*. The leopard inhabits alfo Arabia, where it is called *Nemr*. We are informed by Mr. Forfkal, that in that country, as well as in Egypt, it will do no harm to man unlefs provoked; but will enter houfes by night, and deftroy cats, &c.

VI. The *Onca*, or American Tiger, (the Jaguar of Buffon), is of a bright tawny colour; the top of the back marked with long ftripes of black; the fides with rows of irregular oblong fpots; open in the middle, which is of the ground-colour of the hair: the thighs and legs are marked with full fpots of black, the breaft and belly whitifh; the tail not fo long as the body. This fpecies, which grows to the fize of a wolf, and even larger, inhabits the hotteft parts of South America, from the ifthmus of Darien to Buenos Ayres. It is fierce, and deftructive to man and beaft. Like the tiger, it plunges its head into the body of its prey, and fucks out the blood before it devours it. It makes a great noife in the night, like the howling of a hungry dog; and is a very cowardly animal. It is eafily put to flight, either by the fhepherds' dogs, or a lighted torch, being very fearful of fire. It lies in ambufh near the fides of rivers; and there is fometimes feen a fingular combat between this animal and the crocodile. When the jaguar comes to drink, the crocodile, ready to furprife any animal that approaches, raifes its head out of the water; upon which the former inftantly ftrikes its claws into the eyes of this dreadful reptile, the only penetrable part, who immediately dives under the water, pulling his enemy along with him, where commonly they both perifh.

VII. The *Pardalis*, Mexican panther, or the Ocelot of Buffon, has its head, back, upper part of the rump, and tail, of a bright tawny; a black ftripe extending along the top of the back, from head to tail; and from the noftrils to the corners of the eyes, there alfo runs a ftripe of black; the fides are whitifh, marked lengthways with long ftripes of black, hollow and tawny in the middle, in which are fprinkled fome fmall black fpots; the legs are whitifh, varied with fmall black fpots; and the tail is alfo varied with fmall fpots near its bafe, and larger near the end, which is black. It is above four times the fize of a large cat, and ftrongly made. It inhabits Mexico, the neighbourhood of Carthagena, and Brafil. It lives in the mountains; and is very voracious, but fearful of mankind; preying on young calves, and different forts of game. It lurks amidft the leaves of trees; and fometimes will extend itfelf along the boughs as if dead, till the monkeys, tempted by their natural curiofity, approach to examine it, and become its prey.

VIII. The *Jubata*, or Hunting Leopard, (*Guepard* Buff.) is of the fize of a large greyhound, of a long make, with a narrow cheft and long legs. The colour of the body is a light tawny brown, marked with numbers of fmall round black fpots: the neck is fhaggy, and the tail is longer than the body. It inhabits India; where it is tamed, and trained for the chace of antelopes. For this purpofe it is carried in a fmall kind of waggon, chained and hoodwinked, till it approaches the herd: when firft unchained, it does not immediately make its attempt, but winds along the ground, ftopping and concealing itfelf till it gets a proper advantage, and then darts on the animals with furprifing fwiftnefs. It overtakes them by the rapidity of its bounds: but if it does not fucceed in its firft efforts, confifting of five or fix amazing leaps, it miffes its prey: lofing its breath, and finding itfelf unequal in fpeed, it ftands ftill, gives up the point for that time, and readily returns to its mafter. This fpecies is called in India, *Chittah*. It is ufed for the taking of jackals, as well as other animals.

IX. The *Difcolor*, or Black Tiger, (*Couguar Noir* Buff.), is covered with fhort very gloffy hairs of a dufky colour; the throat, belly, and infide of the legs, white. It grows to the fize of a heifer of a year old, and has vaft ftrength in its limbs. It inhabits Brafil and Guiana; and is a cruel and fierce beaft, but happily is a fcarce fpecies.

X. The *Concolor*, or Puma (*Couguar* Buff.), has a very fmall head, ears a little pointed, and eyes large. The back, neck, rump, fides, are of pale brownifh red, mixed with dufky hairs; the breaft, belly, and infide of the legs, cinereous. The tail is dufky and ferruginous, the tip black; and the teeth are of a vaft fize. It is long bodied, and high on its legs; the length from nofe to tail five feet three inches, of the tail two feet eight. The animal inhabits the continent of America, from Canada to Brafil; in South America is called *Puma*, and by Europeans miftaken for the lion. It is the fcourge of the colonies of the hotter parts of America, being fierce and ravenous to the higheft degree. It fwims over the broad rivers; attacks the cattle in the very inclofures; and, when preffed with hunger, fpares not even mankind. In North America their fury feems to be fubdued by the rigour of the climate; and the fmalleft cur, in company with its mafter, makes them feek for fecurity, by running up trees: but then they are equally deftructive to domeftic animals, and are the greateft nuifance the planter has: when they lay in wait for the moofe, or other deer, they lie clofe on the branch of fome tree till thofe animals pafs beneath, when they drop upon and foon deftroy them. They alfo make wolves their prey. In the Mufeum of the Royal Society, there is the fkin of one which was killed juft as it had pulled down a wolf. When it has fatisfied itfelf with eating, it carefully conceals the reft of the carcafe, covering it with leaves: if any other touches the relics, it never comes near them again. It fometimes purrs

like a cat, and at other times makes a great howling. The fur is foft, and of fome value among the Indians. who cover themfelves with it during winter; and who alfo eat the flefh, which is faid to be as good and as white as veal.

XI. The *Tigrina*, or Margay of Buffon, is about the fize of a common cat. The upper part of the head, the neck, back, fides, fhoulders, and thighs, are of a bright tawny-colour: the face is ftriped downwards with black: the fhoulders and body are marked with ftripes and oblong large black fpots; the legs with fmall fpots: the thighs are whitifh, fpotted with black: the tail is very long, marked with black, tawny and grey. It inhabits South America, where it lives on the feathered game and on poultry. It is untameable. It makes a noife like the common cat; lives much in trees; is very active, and moves by bounds or leaps. It brings forth in all feafons of the year, in hollow trees, and has two at a time.

XII. The *Capenfis*, Cape Tiger, or Tiger-cat of the Cape, is the *Nfuffi* of Labat, who was the firft who noticed this fpecies, which he defcribes as "of the fize of a dog, with a coat as much ftriped and varied as that of a tiger. Its appearance befpeaks cruelty, and its eyes fiercenefs; but it is cowardly, and gets its prey only by cunning and infidious arts." All thefe characters are perfectly applicable to the Cape cat: and it feems the animal is found in all parts of Africa, from Congo to the Cape of Good Hope, in an extent of country of about eleven degrees of latitude. Kolben alfo fpeaks of a tiger bufh-cat, which he defcribes as the largeft of all the wild cats of the Cape countries, and as fpotted fomething like a tiger. A fkin of this animal was feen by Mr. Pennant in a furrier's fhop in London, who thought it came from the Cape of Good Hope; from this fkin Mr. Pennant gave the firft defcription which could be of any utility to a natural hiftorian. All the other authors mention this animal in a vague manner. When Dr. Forfter touched the fecond time at the Cape of Good Hope in the year 1775, an animal of this fpecies was offered him to purchafe; but he refufed buying it becaufe it had a broken leg, which made him apprehenfive of lofing it by death during the paffage from the Cape to London. It was very gentle and tame. It was brought in a bafket to his apartment, where he kept it above 24 hours; which gave him the opportunity of defcribing it more accurately than had hitherto been done, and of obferving its manners and economy. Thefe he found to be perfectly analogous to thofe of our domeftic cats. It ate frefh raw meat, and was very much attached to its feeders and benefactors: though it had broke the fore leg by accident, it neverthelefs was very eafy. After it had been feveral times fed by our author, it foon followed him like a tame favourite cat. It liked to be ftroked and careffed; it rubbed its head and back always againft the perfon's clothes who fed it, and defired to be made much of. It purred as our domeftic cats do when they are pleafed. It had been taken when quite young in the woods, and was not above eight or nine months old; but had already very nearly, if not quite, attained its full growth. The Doctor was told, that the tiger-cats live in mountainous and woody tracts; and that in their wild ftate they are very great deftroyers of hares, rabbits, yerbuas, young antelopes, lambkins, and of all the feathered tribe. A very particular technical defcription of this fpecies is given in the Phil. Tranf. vol. 71. p. 4. with a figure, which the reader will fee copied among other fpecies in our plates.

XIII. The *Catus*, or Cat.

1. The *Ferus*, or wild cat, is three or four times as large as the houfe cat; the head larger, and the face flatter. The teeth and claws are tremendous: its mufcles very ftrong, as being formed for rapine: the tail is of a moderate length, but very thick, marked with alternate bars of black and white, the end always black: the hips and hind part of the lower joints of the leg are black: the fur is very foft and fine. The general colour of thefe animals is of a yellowifh white, mixed with a deep grey; thefe colours, though they appear at firft fight confufedly blended togther, yet on a clofe infpection will be found to be difpofed like the ftreaks on the fkin of the tiger, pointing from the back downwards, rifing from a black lift that runs from the head along the middle of the back to the tail.

This animal, with us, may be called the *Britifh tiger*. It is the fierceft and moft deftructive beaft we have; making dreadful havock among our poultry, lambs, and kids. It inhabits the moft mountainous and woody parts of thefe iflands, living moftly in trees, and feeding only by night. It multiplies as faft as our common cats; and often the females of the latter will quit their domeftic mates, and return home pregnant by the former.

They are taken either in traps or by fhooting; in the latter cafe, it is very dangerous only to wound them; for they will attack the perfon who injured them, and have ftrength enough to be no defpicable enemy. Wild cats were formerly reckoned among the beafts of chace; as appears by the charter of Richard II. to the abbot of Peterborough, giving him leave to hunt the hare, fox, and wild cat. The ufe of the fur was in lining of robes: but it was efteemed not of the moft luxurious kind; for it was ordained, "that no abbefs or nun fhould ufe more coftly apparel than fuch as is made of lambs' or cats' fkins." In much earlier times it was alfo the object of the fportfman's diverfion.

This animal is the ftock or origin of the domeftic cat in all its varieties. It inhabits the woods of moft parts of Europe, but none are found in the vaft woods of Ruffia or Siberia. It dwells with the common lynx in all the wooded parts of the mountains of Caucafus and their neighbourhood; and is moft deftructive to lambs, kids, fawns, and to all forts of feathered game.

2. The *Domefticus*, or tame cat, is fo well known, that it requires no defcription. It is an ufeful, but deceitful domeftic. Although when young they are playful and gay, they poffefs at the fame time an innate malice and perverfe difpofition, which increafe as they grow up, and which education learns them to conceal, but never to fubdue. Conftantly bent upon theft and rapine, though in a domeftic ftate, they are full of cunning and diffimulation: they conceal all their defigns; feize every opportunity of doing mifchief, and then fly from punifhment. They eafily take on the habits of fociety, but never its manners; for they have only the appearance of friendfhip and attachment. This difingenuity of character is betrayed by the obliquity of their movements and the ambiguity of their looks. In a word, the cat is totally deftitute of friendfhip; he thinks and acts for himfelf alone. He loves eafe, fearches for the fofteft and warmeft places to repofe himfelf. The cat is likewife extremely amorous; and, which is very fingular, the female is more ardent than the male: fhe not only invites, but fearches after and calls upon him to fatisfy the fury of her defires; and, if the male difdains or flies from her, fhe purfues, bites, and in a manner compels him. This heat of paffion in the females lafts but nine or ten days, and happens twice in the year, namely, in the fpring and autumn; however, in fome it happens thrice or four times in the year. The female goes with young 55 or 58 days, and generally produces four or five at a litter. As the male has an inclination to deftroy the young, the female takes care to conceal them from him; and, when fhe is apprehenfive of a difcovery, fhe takes them up in her mouth one by one, and hides them in holes or inacceffible places. When fhe has nurfed a few weeks, fhe brings them mice, fmall birds, &c. in order to learn them to eat flefh. But it is worth notice, that thefe careful and tender mothers fometimes become unnaturally cruel, and devour their own offfpring.

The cat is incapable of reſtraint, and conſequently of being educated to any extent. However, we are told, that the Greeks in the iſland of Cyprus trained this animal to catch and devour ſerpents, with which that iſland was greatly infeſted. This, however, was not the effect of obedience, but of a general taſte for ſlaughter; for he delights in watching, attacking, and deſtroying all kinds of weak animals indifferently. He has no delicacy of ſcent, like the dog; he hunts only by the eye: neither does he properly purſue; he only lies in wait, and attacks animals by ſurpriſe; and after he has caught them, he ſports with and torments them a long time, and at laſt kills them (when his belly is full), purely to gratify his ſanguinary appetite.

The eye of the cat differs greatly from that of moſt other animals. The orifice of the pupil is vertical, and capable of a great degree of contraction and dilatation. It is narrow and contracted like a line in a ſtrong light, round and wide in the dark. It is from this conformation of the eye that the cat ſees beſt in the night, which gives him a great advantage in diſcovering and ſeizing his prey.

Although cats live in our houſes, they can hardly be called *domeſtic* animals; they may rather be ſaid to enjoy full liberty; for they never act but according to their own inclination. Beſides, the greater part of the mare half wild: they do not know their maſters; and frequent only the barns, out-houſes, &c. unleſs when preſſed with hunger.

Cats have a natural antipathy to water and cold. They likewiſe hate bad ſmells; but they have an affection for certain aromatic ſmells, and are tranſported with that of the root of the valerian.

Cats take about 18 months before they come to their full growth; but they are capable of propagation in 12 months, and retain this faculty all their life, which generally extends to nine or ten years. They eat ſlowly, and are peculiarly fond of fiſh. They drink frequently; their ſleep is light; and they often aſſume the appearance of ſleeping, when in reality they are meditating miſchief. They walk ſoftly, and without making any noiſe. As their hair is always dry, it eaſily gives out electrical fire, which becomes viſible on rubbing in the dark. Their eyes likewiſe ſparkle in the dark like diamonds. The cat, when pleaſed, purrs, and moves its tail: when angry, it ſpits, hiſſes, and ſtrikes with its foot. It waſhes its face with its fore-foot (Linnæus ſays, at the approach of a ſtorm): it always alights on its feet: it is even proverbially tenacious of life. Our anceſtors ſeem to have had a high ſenſe of the utility of this animal. That excellent prince *Hoel dda*, or Howel the Good, did not think it beneath him, among his laws relating to the prices, &c. of animals, to include that of the cat; and to deſcribe the qualities it ought to poſſeſs.

Of the cat there are the following and ſeveral other varieties: 1. The *Angorenſis*, or cat of Angora, with hair of a ſilvery whiteneſs and ſilky texture, and very long, eſpecially about the neck, where it forms a fine ruff. It is a large variety; found about Angora, the ſame country that produces the fine-haired goat. It degenerates after the firſt generation in our climate. A variety of this kind is found in China with pendent ears, of which the Chineſe are very fond, and ornament their necks with ſilver collars. They are cruel enemies to rats, and ſuppoſed to be the domeſtic animals which the Chineſe call *ſumxi*. 2. The *Hiſpanicus*, or tortoiſe-ſhell cat, has the hair varied with black, white, and orange. 3. *Cæruleus*, or blue cat, a variety of a dun colour, or greyiſh black. It is much cultivated in Siberia on account of its fine fur; but was brought there, as well as the other domeſtic kinds, by the Ruſſians. 4. The *Ruber*, or wild red cat of Kolben, has a ſtreak of bright red running along the ridge of the back to the tail, and loſing itſelf in the grey and white on the ſides. The ſkins are ſaid to give eaſe in the gout, and are much valued on that account at the Cape.

XIV. The Manul, with the tail longer than that of the domeſtic cat, beſet thickly with hair, and of an equal thickneſs in all parts; encircled with ten black rings, the three next to the tip almoſt touching one another, the reſt more remote. It is about the ſize of a fox. The limbs are very robuſt; in which, and in colour, this animal greatly reſembles a lynx, afterwards deſcribed. It inhabits all the middle part of northern Aſia, from the Yaik, or Ural as it is now called, to the very Amur. It loves open, woodleſs, and rocky countries, and preys on the leſſer quadrupeds.

XV. The Lynx is about $2\frac{1}{2}$ feet long and 15 inches high. He has a great reſemblance to the common cat; but his ears are longer, and his tail much ſhorter: his hair is ſtreaked with yellow, white, and black colours. The lynx inhabits the vaſt foreſts of the north of Europe, Aſia, and America. His eyes are brilliant, his aſpect is ſoft, and his air is gay and ſprightly. Like the cat, he covers his urine with earth; he howls ſomewhat like the wolf, and is heard at a conſiderable diſtance; he does not run like the dog or wolf, but walks and leaps like a cat; he purſues his prey even to the tops of trees; neither wild cats nor ſquirrels can eſcape him; he lies in wait for ſtags, goats, hares, &c. and darts ſuddenly upon them; he ſeizes them by the throat and ſucks their blood, then opens the head and eats the brain; after this, he frequently leaves them, and goes in queſt of freſh prey. The colour of his ſkin changes according to the ſeaſon or the climate; the winter furs are more beautiful than thoſe of ſummer. Theſe furs are valuable for their ſoftneſs and warmth: numbers are annually imported from North America, and the north of Europe and Aſia; the farther north and eaſt they are taken, the whiter they are, and the more diſtinct the ſpots. Of theſe the moſt elegant kind is called *irbys*, whoſe ſkin ſells on the ſpot for one pound ſterling. The ancients celebrated the great quickneſs of the lynx's ſight; and feigned that its urine was converted into a precious ſtone.

XVI. The Serval, has the upper part of the body of a duſky colour, interſperſed with round black ſpots; the belly, and the orbits of the eye, are white. This animal, which is very fierce and untameable, inhabits the woods in the mountainous parts of India; where it lives in trees, and breeds in them. It ſcarcely ever deſcends on the ground; but leaps with great agility from tree to tree. It is called by the natives of Malabar the *maraputé*, by the Portugueſe the *ſerval*.

XVII. The Chaus, or Caſpian Lynx, has a round head, a little more oblong than that of the common cat; a ſhining reſtleſs eye, with a moſt brilliant golden pupil; ears erect, oval, and lined with white hairs, the outſide reddiſh, their ſummits tufted with black. The hairs are coarſer than thoſe of the cat or common lynx, but leſs ſo than thoſe of the wolf. They are ſhorteſt on the head, but on the top of the back are above two inches long. The colour of the head and body is a yellowiſh brown; the breaſt and belly of a bright brown, nearly orange. The tail reaches only to the flexure of the leg; is thick and cylindric; of the ſame colour with the back, tipped with black, and thrice obſcurely annulated with black near the end. In general appearance it has the form of the domeſtic cat. Its length is $2\frac{1}{2}$ feet from the noſe to the baſe of the tail: its tail little more than 11 inches: its height before is 19 inches; behind, 20. It is ſometimes found larger, there being inſtances of its reaching the length of 3 feet from the noſe to the tail. This animal, which has been but lately diſcovered, inhabits the reeds and woods in the marſhy parts that border on the weſtern ſides of the Caſpian Sea, particularly about the caſtle Kiſlar on the river Terek, and in the Perſian provinces of Ghilan and Maſenderan, and frequently about the mouth of the Kur, the ancient Cyrus. In manners, voice, and

food, it agrees with the wild cat. It conceals itſelf in the day, and wanders over the flooded tracts in ſearch of prey; feeding on rats, mice, and birds, but ſeldom climbing trees. It is exceſſively fierce, and never frequents the haunts of mankind. It is ſo impatient of captivity, that one which was taken in a trap, and had a leg broken, refuſed for many days the food placed by it; but in its fury devoured the fractured limb, with pieces of the ſtake it was faſtened to, and broke all his teeth in the phrenſy of its rage.

XVIII. The *Caracal*, Sivah Ghush, or Perſian Lynx, with a lengthened face and ſmall head; very long, ſlender ears, terminated with a long tuft of black hairs; eyes ſmall: the upper part of the body is of a very pale reddiſh brown; and the belly and breaſt are whitiſh: the limbs are ſtrong and pretty long; and the tail is about half the length of the body. Theſe animals inhabit Perſia, India, and Barbary; where they are often brought up tame, and uſed in the chace of leſſer quadrupeds, and the larger ſort of birds, ſuch as cranes, pelicans, peacocks, &c. which they ſurpriſe with great addreſs. When they ſeize their prey, they hold it faſt with their mouth, and lie for a time motionleſs on it. They are ſaid to attend the lion, and to feed on the remains of the prey which that animal leaves. They are fierce when provoked: Dr. Charleton ſays, he ſaw one fall on a hound, which it killed and tore to pieces in a moment, notwithſtanding the dog defended itſelf to the utmoſt. The Arabian writers call it *anak el ard*; and ſay, that it hunts like the panther, jumps up at cranes as they fly, and covers its ſteps when hunting.

The Libyan Lynx is a variety, with ſhort black tufts to the ears, which are white within, and of a lively red without; the tail white at the tip, annulated with four black rings, with black marks behind the fore legs. It is generally inferior in ſize to the former; not being larger than a common cat. It inhabits both Libya and Barbary.

XIX. The *Rufa*, or Bay Lynx, with a ſhort tail, yellow irides, and upright ſharp-pointed ears, tufted with long black hairs: the colour of the head, back, ſides, and exterior parts of the legs, bright bay, obſcurely marked with duſky ſpots: from beneath each eye, certain long black ſtripes, of an incurvated form, mark the cheeks; which, with the upper and under lip, whole under ſide of the body, and inſides of the legs, are white: the upper part of the tail is barred with duſky ſtrokes; and next the end, one of a deep black; its tip and under ſide are white. This animal, which is about twice the bigneſs of a large cat, inhabits the inner parts of the province of New York.

XX. The Canadian Lynx, with pale yellow eyes, and erect ears tufted with long black hair. The body is covered with ſoft and long fur, cinereous tinged with tawny, and marked with duſky ſpots, more or leſs viſible in different ſubjects, depending on the age or ſeaſon in which the animal is killed: the legs are ſtrong and thick; the claws large. It is about three times the ſize of a common cat: the tail is only four inches long, tipt with black. This ſpecies inhabits the vaſt foreſts of North Ameriea. It is called in Canada *le chat-cervier*, or *le loup cervier*, on account of its being ſo deſtructive to deer; which it drops on from the trees, like the *puma*, and, fixing on the jugular vein, never quits its hold till the exhauſted animal falls through loſs of blood. The Engliſh call it a *wild cat*. It is very deſtructive to their young pigs, poultry, and all kinds of game. The ſkins are in high eſteem for the ſoftneſs and warmneſs of the fur; and great numbers are annually imported into Europe.

XXI. The *Mountain Lynx*, or Cat-a-mountain, has upright pointed ears, marked with two brown bars; the head and upper part of the body of a reddiſh brown, with long narrow ſtripes of black; the ſides and legs with ſmall round ſpots: the chin and throat are of a clear white; the belly of a dull white. The length of the animal, from noſe to tail, is two feet and a half; of the tail, eight inches. It inhabits North America; and is ſaid to be a gentle animal, and to grow very fat.

FELL (Dr. John), a very learned Engliſh divine and biſhop, entered a ſtudent at Chriſt-church, Oxford, 1636. In 1648 he was ejected by the parliamentary viſitors, being then in holy orders: and from that time to the reſtoration lived at Oxford a retired and ſtudious life. He was inſtalled canon of Chriſt-church, July 1660; and the year following, dean of that church; in which places he did great ſervices to the college, and reformed ſeveral abuſes. He was conſecrated biſhop of Oxford in 1675; and had leave to hold his deanry in *commendam*, that he might continue his ſervices to the college and univerſity. He publiſhed ſeveral works, and died in 1686.

FELLING *of* Timber. Many circumſtances are well known and conſtantly obſerved in the felling of timber for building, which, though to a haſty obſerver they might appear trifling, yet prove, on experience, to be of the utmoſt conſequence. One thing obſerved by M. de Buffon, which very greatly increaſes the ſolidity and ſtrength of timber, is, that the trees intended to be felled for ſervice ſhould firſt be ſtripped of their bark, and ſuffered to ſtand and die upon the ſpot before the cutting. The ſappy part or blea of the oak becomes by this means as hard and firm as the heart; and the real ſtrength and denſity of the wood have been proved, by many experiments, to be greatly increaſed by it: nor is this a practice of any detriment to the proprietor, ſince the remaining ſtumps of theſe trees ſend up their young ſhoots as vigorouſly as if they had been cut down in their natural condition. When any tree is to be cut down for timber, the firſt thing to be taken care of is a ſkilful diſbranching of ſuch limbs as may endanger in its fall: many trees are utterly ſpoiled for want of a previous care of this kind. In arms of timber that are very great, it is always neceſſary to chope or ſink them in cloſe to the bole, and then meeting it with down-right ſtrokes, it will be ſevered from the tree without ſplitting. In felling the tree, take care always to cut it as cloſe to the ground as poſſible, unleſs it is intended to be grubbed up: and the doing that is of advantage both to the timber and to the wood; for timber is never ſo much valued, if it be known to grow out of old ſtocks.

FELLOWSHIP, Company, or *Diſtributive-Proportion*, in arithmetic. See Arithmetic, page 316.

FELO de se, in law, a perſon that deliberately lays violent hands on himſelf, and is the occaſion of his untimely death, whether by hanging, drowning, ſtabbing, ſhooting, or any other way.

FELON, in law, a perſon guilty of felony. See Felony.

FELONY, in the general acceptation of the law, compriſes every ſpecies of crime, which occaſions at common law the forfeiture of lands or goods. This moſt frequently happens in thoſe crimes for which a capital puniſhment either is or was to be inflicted: for thoſe felonies that are called *clergyable*, or to which the benefit of clergy extends, were anciently puniſhed with death in all lay, or unlearned, offenders; though now, by the ſtatute-law, that puniſhment is for the firſt offence univerſally remitted. Treaſon itſelf, ſays Sir Edward Coke, was anciently compriſed under the name of *felony*: and in confirmation of this we may obſerve, that the ſtatute of treaſons, 25 Edw. III. *c.* 2. ſpeaking of ſome dubious crimes, directs a reference to parliament; that it may be there adjudged, "whether they be treaſon or *other* felony." All treaſons, therefore, ſtrictly ſpeaking, are felonies; though all felonies are not treaſon. And to this alſo we may add, that all offences, now capital, are in ſome degree or other felony: but this is likewiſe the caſe with ſome other offences, which are not puniſhed with death; as ſuicide, where

the party is already dead; homicide by chance-medley, or in felf defence; and petit-larceny, or pilfering; all which are (ftrictly fpeaking) felonies, as they fubject the committers of them to forfeitures. So that, upon the whole, the only adequate definition of felony feems to be that which is before laid down; viz. an offence which occafions a total forfeiture of either lands or goods, or both, at the common law; and to which capital or other punifhment may be fuperadded, according to the degree of guilt.

To explain this matter a little farther: the word *felony*, or *felonia*, is of undoubted feodal original, being frequently to be met with in the books of feuds, &c. but the derivation of it has much puzzled the juridical lexicographers, Pratæus, Calvinus, and the reft: fome deriving it from the Greek φηλος, "an impoftor or deceiver;" others from the Latin *fallo fefelli*, to countenance which they would have it called *fellonia*. Sir Edward Coke, as his manner is, has given us a ftill ftranger etymology; that it is *crimen animo felleo perpetratum*, "with a bitter or gallifh inclination." But all of them agree in the defcription, that it is fuch a crime as works a forfeiture of all the offender's lands or goods. And this gives great probability to Sir Henry Spelman's Teutonic or German derivation of it: in which language indeed, as the word is clearly of feodal original, we ought rather to look for its fignification, than among the Greeks and Romans. *Fe-lon* then, according to him, is derived from two northern words: FEE, which fignifies (we well know) the fief, feud, or beneficiary eftate; and LON, which fignifies price or value. Felony is therefore the fame as *pretium feudi*, the confideration for which a man gives up his fief; as we fay in common fpeech, fuch an act is as much as your life, or eftate, is worth. In this fenfe it will clearly fignify the feodal forfeiture, or act by which an eftate is forfeited, or efcheats, to the lord.

To confirm this, we may obferve, that it is in this fenfe, of forfeiture to the lord, that the feodal writers conftantly ufe it. For all thofe acts, whether of a criminal nature or not, which at this day are generally forfeitures of copyhold eftates, are ftyled *feloniæ* in the feodal law: "*fcilicet, per quas feudum amittitur.*" As "*fi domino defervire noluerit; fi per annum et diem ceffaverit in petenda inveftitura; fi dominum ejuravit, i. e. negavit fe a domino feudum habere; fi a domino in jus eum vocante, ter citatus non comparuerit;*" all thefe, with many others, are ftill caufes of forfeiture in our copyhold eftates, and were denominated *felonies* by the feodal conftitutions. So likewife injuries of a more fubftantial or criminal nature were denominated *felonies*, that is, forfeitures: as affaulting or beating the lord; vitiating his wife or daughter, "*fi dominum cucurbitaverit*, i. e. *cum uxore ejus concubuerit*;" all thefe are efteemed felonies, and the latter is exprefsly fo denominated, "*fi fecerit feloniam, dominum forte cucurbitando.* And as thefe contempts, or fmaller offences, were felonies or acts of forfeiture, of courfe greater crimes, as murder and robbery, fell under the fame denomination. On the other hand, the lord might be guilty of felony, or forfeit his feignory to the vaffal, by the fame act as the vaffal would have forfeited his feud to the lord. "*Si dominus commifit feloniam, per quam vafallus amitteret feudum fi eam commiferit in dominum, feudi proprietatem etiam dominus perdere debet.*" One inftance given of this fort of felony in the lord is beating the fervant of his vaffal, fo as that he lofes his fervice: which feems merely in the nature of a civil injury, fo far as it refpects the vaffal. And all thefe felonies were to be determined, "*per juramentum five judicium parium fuorum*," in the lord's court; as with us forfeitures of copyhold lands are prefentable by the homage in the court-baron.

Felony, and the act of forfeiture to the lord, being thus fynonymous terms in the feodal law, we may eafily trace the reafon why, upon the introduction of that law into England, thofe crimes which induced fuch forfeiture or efcheat of lands (and, by a fmall deflexion from the original fenfe, fuch as induced the forfeiture of goods alfo) were denominated *felonies*. Thus it was that fuicide, robbery, and rape, were felonies; that is, the confequence of fuch crimes was forfeiture; till by long ufe we began to fignify by the term of *felony* the actual crime committed, and not the penal confequence. And upon this fyftem only can we account for the caufe, why treafon in ancient times was held to be a fpecies of felony; viz. becaufe it induced a forfeiture.

Hence it follows, that capital punifhment does by no means enter into the true idea and definition of *felony*. Felony may be without inflicting capital punifhment, as in the cafes inftanced of felf-murder, excufable homicide, and petit larceny: and it is poffible that capital punifhments may be inflicted, and yet the offence be no felony; as in cafe of herefy by the common law, which, though capital, never worked any forfeiture of lands or goods, an infeparable incident to felony. And of the fame nature was the punifhment of ftanding mute, without pleading to an indictment; which at the common law was capital, but without any forfeiture, therefore fuch ftanding mute was no felony. In fhort, the true criterion of felony is forfeiture: for, as Sir Edward Coke juftly obferves, in all felonies which are punifhable with death, the offender lofes all his lands in feefimple, and alfo his goods and chattels; in fuch as are not punifhable, his goods and chattels only.

The idea of felony is indeed fo generally connected with that of capital punifhment, that we find it hard to feparate them; and to this ufage the interpretations of the law do now conform. And therefore, if a ftatute makes any new offence felony, the law implies that it fhall be punifhed with death, viz. by hanging, as well as with forfeiture: unlefs the offender prays the benefit of clergy; which all felons are intitled once to have, unlefs the fame is exprefsly taken away by ftatute.

Felonies by ftatute are very numerous; and as this work will not admit of a proper enumeration, we muft refer to the Table of the quarto edition of the Statutes, where they are fet forth in alphabetical order.

FELT, in commerce, a fort of ftuff deriving all its confiftence merely from being fulled, or wrought with lees and fize, without either fpinning or weaving. Felt is made either of wool alone, or of wool and hair. Thofe of French make, $3\frac{1}{2}$ yards long, and $1\frac{1}{2}$ broad, for cloaks, pay each 2l. 14s. $1\frac{10}{20}$d. on importation, and draw-back 1l. 12s. 3d. on exporting them again.

FELT-*Spar*, or *Rhombic Quartz*, the *petuntfe* of the Chinefe, a genus of filiceous earths, according to Cronftedt, refembling the jafper in moft refpects. Its German name is *feld-fpat*, from the word *feld*, which fignifies a field, and likewife a compartment or regular furface. Hence, according to Mr. Forfter, the word *feld-fpat* fignifies a fpar compofed of little compartments of rhombic or other figures. It ftrikes fire with fteel, and melts in a violent heat. Mr. Bayen, who analyfed it by acids, obtained a confiderable quantity of argillaceous and filiceous earths, a fmaller quantity of magnefia, and a ftill fmaller of calcareous earth and iron. It is found either fparry or cryftallized. The former fpecies has feveral varieties. 1. White: 2. Reddifh brown, occurring in the Swedifh and other granites. 3. Pale yellow. 4. Greenifh, refembling the fchorl or cockle fpar, but lefs fufible, and more irregular in the figure. The cryftallized kind is found in an iron mine at Weftmanland in Sweden, feldom in the form of veins, and ftill more rarely conftituting the fubftance of whole mountains, but generally mixed either with quartz or mica; in which cafe it is called *granite*. When mixed with jafper, along with fome particles of quartz, cockle, and horn-blende, it is named *porphyry*.

Another kind of this ftone, named by M. Bayen *white felt-*

ſpar, is found in the duchy of Lorrain. It is of an opaque white colour, ſpotted on the outſide with ochre. It conſiſts of ſhining particles, which give it a ſparry appearance: it is very hard, and ſtrikes fire with ſteel, is affected by acids; and when analyſed by them, appears to contain one-half its weight of ſiliceous earth, the other being compoſed of magneſia and iron.

Analogous to the felt-ſpar is that beautiful ſtone named *Labradore-ſtone*, lately brought to Europe. It was diſcovered ſome years ago by the Moravians, who have a colony among the Eſquimaux, in the country of Labrador in North America. It is found of a light or deep-grey colour, but for the moſt part of a blackiſh grey. When held in the light in various poſitions, it diſcovers a variety of colours, ſuch as the blue of lapis lazuli, graſs-green, apple-green, pea-green, and ſometimes, but more ſeldom, a citron-yellow. Sometimes it has a colour between that of red copper and tombuck-grey; at other times the colours are between grey and violet. For the moſt part theſe colours are in ſpots, but ſometimes in ſtripes on the ſame piece. The ſtones are found in pretty large angular pieces, appear foliated when broken, and the fragments of a rhomboidal figure. Their ſpecific gravity is about 2.755, and in other reſpects they agree with the felt-ſpar. Werner informs us, that he has ſeen a piece of felt-ſpar at Gayer, which ſhowed a great variety of colours, but very pale.

Mr Kirwan obſerves on the felt-ſpar, in general, that it is found of many different colours, as white, yellow, red, brown, green, violet, &c. ſometimes cryſtallized in rhombs, cubes, or parallelopipeds; at other times without any regular figure. It breaks like ſpar, but the texture is cloſe though lamellar. The ſpecific gravity, according to that author, is from 2.400 to 2.600, but Mr. Grechard ſays he found it as high as 3.500; in which caſe Mr. Kirwan is of opinion that it was mixed with ſome metallic particles. It is harder than the fluor ſpars, but leſs ſo than quartz. It alſo melts without addition more perfectly and eaſily than the fluors, forming a whitiſh glaſs, which does not corrode the crucibles as that from fluor does. It is entirely diſſolved without efferveſcence by the microcoſmic ſalt and by borax; but unites with difficulty to fixed alkalis. In its cryſtallized ſtate it decrepitates in the fire, but not otherwiſe. It is found in looſe maſſes, about two inches long at moſt, without forming either veins or ſtrata. It is alſo found mixed with ſand or clay; or it is ſometimes found imbedded in other ſtones, as granite, &c. One hundred parts of the white ſpar contain 67 of ſiliceous, 14 of argillaceous, 11 of ponderous earth, and 8 of magneſia. According to Mr. Kirwan, it is undoubtedly the ſtone uſed by the Saxons, as *petuntſa*, in their porcelain manufactures.

Cronſtedt, who ſuppoſes this ſtone to be of the ſame nature with jaſper, remarks, that "if the rhombic quartz and jaſper were of the ſame ſpecies, that ſort of porphyry which is made up of theſe two bodies ought only to be ranked with the *jaſpers*, inſtead of being placed with the *ſaxa*. It is obſervable, however, in old monuments, which have been long expoſed to the air, that though porphyry had decayed in ſuch a manner as to loſe its poliſh, yet granite, though equally old, and compoſed for the moſt part of rhombic quartz, has preſerved its luſtre. This, however, does not contradict the poſſibility of rhombic quartz being the ſame ſubſtance with the jaſper: the calcareous ſpar, for inſtance, being found to bear the weather, and even fire, better than limeſtone."

FELUCCA, in ſea-affairs, a little veſſel armed with ſix oars, frequent in the Mediterranean; which has this peculiarity, that its helm may be applied either in the head or ſtern, as occaſion requires.

FEMALE, a term peculiar to animals, ſignifying that ſex which conceives and generates its young within itſelf. See the articles SEX and GENERATION.

FEMALE is alſo applied, figuratively, to things without life, from the reſemblance they bear to the females of animals. Thus we ſay a

FEMALE-*Screw*. See SCREW.

FEMALE-*Flower*. See *Fœmineus* FLOS.

FEMALE-*Plant*. See *Fœminea* PLANTA.

FEMME COVERT, in law, a married woman. See COVERTURE.

FEMME *Sole*, an unmarried woman, whoſe debts, contracted before marriage, become thoſe of her huſband after it. A femme-ſole merchant, is where a woman, in London, uſes a trade alone, without her huſband; on which account ſhe ſhall be charged without him.

FEMININE, in grammar, one of the genders of nouns. See GENDER. The feminine gender is that which denotes the noun or name to belong to a female. In the Latin, the feminine gender is formed of the maſculine, by altering its termination; particularly by changing *us* into *a*. Thus, of the maſculine *bonus equus*, "a good horſe," is formed the feminine *bona equa*, "a good mare;" ſo, of *parvus homo*, "a little man," is formed *parva fœmina*, "a little woman," &c. In French, the feminine gender is expreſſed, not by a different termination, but by a different article: thus, *le* is joined to a male, and *la* to a female. In Engliſh, we are generally more ſtrict, and expreſs the difference of ſex, not by different terminations, nor by different particles, but different words; as boar and ſow, boy and girl, brother and ſiſter, &c. though ſometimes the feminine is formed by varying the termination of the male into *eſs*; as in abbot, abbeſs, &c.

FEMUR, OS FEMORIS, the thigh bone. See ANATOMY, page 167.

FEN, a place overflowed with water, or abounding with bogs. See BOG and DRAINING. Fens are either made up of a congeries of bogs; or conſiſt of a multitude of pools or lakes, with dry ſpots of land intermixed, like ſo many little iſlands.

Several ſtatutes have been made for the draining of fens, chiefly in Kent, Cambridgeſhire, Bedfordſhire, and Lincolnſhire; and by the act 11 Geo. II. commiſſioners ſhall be appointed for the effectually draining and preſerving of the fens in the iſle of Ely, who are authoriſed to make drains, dams, and proper works thereon; and they may charge the landholders therein with a yearly acre-tax, and, in default of payment, ſell the defendant's lands.

The wet grounds called *fens*, in Lincolnſhire and elſewhere in England, bring many advantages to the inhabitants of thoſe counties. Fowl and fiſh are very plentiful in them. The pike and eels are large and eaſily caught, but they are uſually coarſe. The duck, mallard, and teal, are in ſuch plenty as is ſcarce to be conceived. They are taken by DECOYS in prodigious flocks at a time. They ſend theſe fowls from Lincolnſhire to London, twice a-week, on horſeback, from Michaelmas to Lady-day; and one decoy will furniſh 20 dozen, or more, twice a-week, for the whole ſeaſon, in this manner. The decoy-men contract with the people, who bring them to London at a certain rate, and they are obliged to take off their hands the whole number that is catched. Two teal are uſually reckoned equal to one duck; and ſix ducks and twelve teal are accounted a dozen of wild-fowl; and the uſual market price is about 9s. for ſuch a dozen. About mid-ſummer, during the moulting ſeaſon, a great number alſo are deſtroyed by the people in the neighbourhoods. The poor birds at this ſeaſon are neither able to ſwim nor fly well; and the people going in with boats among the reeds where they lie, knock them down with long poles,

A little before Michaelmas, vaſt flights of theſe birds arrive at the decoys from other places; they ſoon grow fat in them, and continue there a prey to the maſters or owners, as long as the decoys are unfrozen; but, when they are iced over, they fly away again, and go to the neighbouring ſeas for food.

The fens alſo abound in a ſort of herbage that is very nouriſhing to cattle. Sheep and horſes always grow fat upon it. Theſe fens are common, and the owners of cattle mark them that they may be known. It is remarkable, that, though all is open, the cattle uſed to one particular ſpot of ground ſeldom leave it, but the owner may always find them in or near the ſame place. The fens have many large and deep drains. In theſe the pike and eel grow to a vaſt ſize: and they are full of geeſe which feed on the graſs; but theſe eat rank and muddy, and may even be ſmelt as ſoon as a perſon comes into the room where they are roaſting. But the inhabitants have another very great advantage from theſe birds beſides the eating of them, namely, their feathers and quills; and the produce of theſe is ſo great, that the cuſtom-houſe books in the town of Boſton ſhow, that there are frequently ſent away in one year 300 bags of feathers, each containing a hundred and a half weight. Each pound of feathers brings the owner two-pence; and it may be thought ſtrange by people unacquainted with theſe things, but it is a certain truth, that the owners pull them five or ſix times a-year for the feathers, and three times for the quills. Each pulling comes to about a pound, and many people have 1000 geeſe at a time, or more. They are kept at no charge, except in deep ſnowy weather, when they are obliged to feed them with corn.

Oats alſo grow very well in many of the fen countries, and in good ſeaſons bring great increaſe and advantage to the owners. There is alſo another vegetable of great profit to them. This is the *rapum ſilveſtre*; the ſeed of which they call *cole-ſeed*; and they make an oil from it of great uſe in trade. They grind the ſeed between two large ſtones, the one ſtanding perpendicularly on the other. The ſtones are made of a ſort of black marble, and are brought from Germany. They ſometimes turn them by ſails, and ſometimes by the drains which carry off the water from the fen lands.

The fens lying low, and being of a vaſt extent, are very ſubject to be overflowed by waters from the neighbouring high countries; and though great care and expence is uſed to keep them dry, they are often like a ſea; and the ſheep are obliged to be carried off in boats, and the people to live in their upper rooms, and to be ſupplied with proviſions alſo with boats.

FENCE, a hedge, wall, ditch, bank, or other incloſure, made round fields, woods, gardens, &c. The moſt uſual way of incloſing land is with a ditch and a bank ſet with hawthorn, crabs, black thorn, holly, or white thorn, commonly called quick. Mr. Miller's inſtructions in this reſpect being very full, may be conſulted by thoſe to whom the ſubject is entirely new. Every farmer is acquainted with thoſe methods which are in univerſal practice; for which reaſon we rather prefer, in forming this article, the mention of ſuch improvements on the old practice as have been ſuggeſted by late writers.

Mr. Young, in his Annals of Agriculture, vol. vi. obſerves, that "Mr. Bakewell is very curious in his fences, and plants his quicks in a different manner from what is common in various parts of the kingdom. He plants one row at a foot from ſet to ſet, and, making his ditch, lays the earth which comes out of it to form a bank on the ſide oppoſite to the quick. In the common method, the bank is made on the quick ſide above it. Reaſons are not wanting to induce a preference of this method. The plants grow only in the ſurface earth, uncovered from the atmoſphere, which muſt neceſſarily be a great advantage; whereas, in the uſual way of planting, that earth, which is always the beſt, is loaded by a thick covering, obliquely, of the earth out of the ditch. If the roots ſhoot in the beſt ſoil, they will be out of the reach of the influences of the air, the conſequence of which is, they cannot have ſo large a ſpace of that earth, as if ſet on the flat. The way to have a tree, or a quick, thrive in the beſt manner poſſible, is to ſet it on the ſurface, without any ditch or trench, that cuts off half its paſture. But if a ditch is neceſſary, the next beſt way muſt of courſe be ſtill to keep it on the flat ſurface; and the worſt way, to cover up that ſurface, by loading it with the dead earth out of a trench. To ſay that there are good hedges in the common method is not a concluſive argument, unleſs both were tried in the ſame ſoil and expoſure.

"In ſome caſes, however, there is in this country, and Mr. Bakewell's farm is not free from it, a great waſte of land, in making new fences. The ditch and bank are made as I have deſcribed, and then there are added a double poſt and rail, one on the outſide of that bank, and the other on the outſide of the quick, which altogether take up an enormous ſpace of land."

Mr. Young, in his Annals of Agriculture, inſerts the following new method of fencing, by W. Erſkine, Eſq.

"The importance of good fences is univerſally acknowledged by every lover of huſbandry, although there are various opinions about the kinds of them, every one being naturally prejudiced in favour of thoſe he has been moſt accuſtomed to ſee, or by the opinion of others whoſe judgment he relies on. An intelligent correſpondent, in the ſecond volume of the Bath Papers on Agriculture, is ſo warm an advocate for quickſet hedges, as to make him totally condemn the dead walls which are to be ſeen on the road between Bath and Cirenceſter, and in many other parts of England. I hope he will not take it amiſs, if I cannot abſolutely aſſent to his aſſertion, "that quickſet hedges are more uſeful and profitable:" that they are more ornamental cannot be denied, and they are generally allowed to afford more ſhelter; but the length of time, the conſtant attention, and continual expence of defending them until they bear even a reſemblance of a fence, induces many people in thoſe places where the materials are eaſily procured, to prefer the dry-ſtone walls; for though the firſt coſt is conſiderable, yet as the farmer reaps the immediate benefit of the fence (which is undoubtedly the moſt ſecure one), they are thought on the whole to be the leaſt expenſive: beſides, the cattle in expoſed ſituations, and eſpecially in theſe northern parts, are ſo impatient of confinement at the commencement of the long, cold, wet nights, that no hedges I have ever yet ſeen in any part of this iſland are ſufficient to keep them in. Theſe inconveniencies probably ſuggeſted to the late ſir George Suttie (eminent in Eaſt Lothian for his love of and ſkill in agriculture) an idea of a fence, that at once joined the warmth and ornament of the hedge with the almoſt perpetual fence of the wall.

"If I miſtake not, you have, in ſome of your uſeful works, recommended hedges to be planted againſt the common dry ſtone walls: ſir George Suttie rather improved on this thought; he planted his hedges after the common method here, in the face of the ditch; but inſtead of putting a paling or poſt and rail on the top of the bank, he placed a wall of two feet and an half high; his local ſituation induced him to build with lime, and in places where that commodity is tolerably reaſonable, it is the beſt method, as the ſatisfaction they afford by requiring no repairs, and the duration of them, more than repay the expence; but where the price of lime is high, they may be built without any cement, and anſwer the purpoſe very well, if the work is properly executed.

"I have now experienced the benefit of theſe fences for ſome years, ſo that I can, with great confidence, venture to recommend them; indeed their ſuperiority over all others is ſo maniſeſt to every one who has ſeen them, that they are daily becoming more and more common in this country. As it would afford me great pleaſure, if I could by any means extend the benefit of them to thoſe gentlemen whoſe ſituation is peculiarly adapted for them, I have endeavoured to render the making of them eaſy by the incloſed ſketch and deſcription; which if you think ſufficiently plain and intelligible, I beg of you to favour this with a place in your valuable work, as that may perhaps induce ſome gentleman or other in Glouceſterſhire, Oxfordſhire, Yorkſhire, &c. &c. to make trial of them; and if they are ſucceſsful in getting them properly executed, I am fully perſuaded that every one who ſees them will acknowledge them to be the moſt agreeable and complete fence ever contrived.

"When a new fence is propoſed to be made, the ſurface of the ground of the breadth of the ditch, and likewiſe for two feet more, ſhould be pared off, in order to prevent, as much as poſſible, the weeds and graſs from hurting the growth of the young thorns. For a view of the fence, ſee plate 25.

"The ditch ſhould be 5 feet broad, $2\frac{1}{2}$ deep, and 1 foot broad at the bottom; leave 1 foot for an edging or ſcarcement, then dig the earth one ſpit of a ſpade for about 1 foot, and put about three inches of good earth below the thorn, which ſhould be laid nearly horizontal, but the point rather inclining upwards, in order to let the rain drip to the roots; then add a foot of good earth above it; leave three or four inches of a ſcarcement before another thorn is planted: it muſt not be directly over the lower one, but about nine inches or a foot to one ſide of it; then throw a foot of good earth on the thorn, and trample it well down, and level the top of the bank for about three feet and a half in order for the baſe of the wall to reſt on. The baſe of the wall ſhould be about nine or ten inches (but muſt not exceed one foot) from the thorn. The wall to be about two feet thick at the bottom, and one foot at the top; the cope to be a ſingle ſtone laid flat, then covered with two ſods of turf, the graſs of the undermoſt to be next the wall, and the other ſod muſt have the graſs ſide uppermoſt; the ſods ſhould be of ſome thickneſs in order to retain moiſture, ſo that they may adhere together, and not be eaſily diſplaced by the wind; the height of the wall to be two feet and a half, excluſive of the ſods, which together ſhould be from four to ſix inches, by which means the wall would be near to three feet altogether.

"I would willingly add the coſt of theſe fences; but as the rate of wages, and the quantity of work performed for them, differ ſo widely in one place from another, I can only offer ſome data to enable people in different places to form ſome conjectures about them."

Fences made in marſhy grounds require plants which delight in moiſt ſoils. Of this kind are, particularly, the black-alder, the willow, and the poplar: the birch-tree and the aſh will likewiſe grow very well in ſuch places; but the firſt of theſe, viz. the alder, is reckoned the beſt and moſt profitable.

It likes a ſoil ſo moiſt as few other trees will thrive in, and is propagated either by layers, or planting of truncheons about three feet in length. The beſt time for planting theſe laſt is in February, or the beginning of March, when they ſhould be ſharpened at their larger end, and the ground ſhould be well looſened before they are thruſt into it, leſt the bark ſhould be torn off, which may occaſion their miſcarriage. They ſhould be ſet at leaſt two feet deep, to prevent their being blown out of the ground by violent winds, after they have made ſtrong ſhoots; and they ſhould be kept clear from all ſuch weeds as grow tall, at leaſt till they have got good heads; after this, they will keep down the weeds, and require no farther care.

If alders are raiſed by laying down the branches, this ſhould be performed in October, and by the ſame time twelvemonth they will have roots ſufficient to be tranſplanted, which muſt be done by digging a hole, and looſening the earth in the place where each plant is to ſtand. The young ſets muſt be planted at leaſt a foot and a half deep, and their top ſhould be cut off to within about nine inches of the ground; for this will make them ſhoot out many branches.

The alder tree may be trained into very thick cloſe hedges, to the height of twenty feet and upwards. It will thrive exceedingly on the ſides of brooks, for it grows beſt when part of its roots are in the water, and may, if planted there, as is uſual for willows, be cut for poles every fifth or ſixth year. Its wood makes excellent pipes and ſtaves; for it will laſt a long time under ground, or in water; and it is likewiſe much eſteemed by turners, plough-wrights, &c. and for making ſeveral utenſils neceſſary in agriculture. Its bark yields a good black dye.

All the ſorts of willows, of which Mr. Miller enumerates fourteen, grow beſt in moiſt boggy land, and may be eaſily propagated by planting cuttings or ſets, either in the ſpring or autumn: for theſe readily take root, and are of quick growth.

In countries where there is great plenty of rough flat ſtones, the fences which bound an eſtate, or farm, are frequently made with them. It is a pretty common practice in Devonſhire and Cornwall, where they build as it were two walls with theſe ſtones laid one upon another, firſt two, and then one between; and as the walls riſe, they fill the intermediate ſpace with earth, beat the ſtones in flat to the ſides, which makes them lie very firm, and ſo proceed till the whole is brought to the intended height. They then plant upon theſe walls quick hedges, and even timber trees, which thrive exceedingly; and they eſteem theſe fences the beſt ſecurity that can be to their ground and cattle. However, if theſe ſtones are laid rough and dry, they cannot but be diſagreeable to the eye, and muſt certainly require frequent repairs, becauſe they will often be forced out of their places, or beaten down by cattle.

To prevent this, let ſuch walls be built in the bottom of a ditch, made wide enough for the purpoſe, and ſloped down on each ſide. The deformity will then be hid; and as the cattle cannot ſtand facing the wall, ſo as to attempt to leap over it, the ſtones of which it is compoſed will be the leſs liable to be beaten down. The earth taken out of the ditch may be ſpread on the adjacent ground, and its ſides may be planted with ſuch trees, or under-wood, as beſt ſuit the ſoil. If a ſpace of ſeveral feet, proportioned to the demand which there may be made for timber, is left on the inſide of the fence, it will be attended with every advantage ariſing from a ſupply of that neceſſary commodity, without prejudice to the arable or more valuable paſture.

Another very ſtrong and durable fence may be formed thus, in graſſy places. Dig pieces of turf, four or five inches thick, the breadth of your ſpade, and about a foot long. Lay theſe turfs even, by a line on one ſide, with the graſs outward, at the diſtance of ten or twelve inches within the mark, at which the ditch, afterwards to be dug in the ſolid ground, is to begin. Then lay in the ſame manner, but with their graſs-ſides turned out the contrary way, another row of turfs, at ſuch diſtance as to make a breadth of foundation proportioned to the intended height of the bank. The reaſon for placing theſe turfs thus much within what is to be the edge of the ſolid ground dug away on each ſide, is to prevent the bank from falling in, if the ground underneath it ſhould be any way defective. A ditch, of what breadth or depth you pleaſe, may then be dug; or the ground may be lowered on each ſide with a ſlope; in which laſt caſe there will be no loſs of paſture by the fence, becauſe it may be ſowed with hay-ſeeds, and will bear graſs on both ſides,

Part of the earth taken out of the ditches or ſlopes will fill the chaſm between the rows of the turf, and the reſt may be ſcattered over the adjacent ground. Three, four, or more layers of turf may be thus placed upon one another, and the interval between them filled up as before, till the bank is brought to the deſired height; only obſerving to give each ſide of it a ſmall ſlope, for greater ſtrength. The top of this bank ſhould be about two feet and a half wide, and the whole of it ſhould be filled up with earth to a level with the turfs, excepting a little hollow in the middle to retain ſome rain. Quickſets ſhould then be planted along this top, and they will ſoon form an admirable hedge. By this means, a bank four feet high, and a ſlope only two feet deep, will make, beſides the hedge, a fence ſix feet high, through which no cattle will be able to force their way: for the roots of the graſs will bind the turfs ſo together, that in one year's time it will become entirely ſolid; not a joining will appear, nor a turf can be got out; and it will be yet much ſtronger, when the roots of the quick ſhall have ſhot out among it. The only precautions neceſſary to be obſerved here, are: firſt, not to make this bank when the ground is too dry; becauſe, if a great deal of wet ſhould ſuddenly follow, it will ſwell the earth ſo much, as, perhaps, to endanger the falling of ſome of the outſide, which, however, is eaſily remedied if it ſhould happen: and, ſecondly, if the ſlope be ſuch as ſheep can climb up, to ſecure the young quick at the time of planting them, by a ſmall dead hedge, either on or near the top on both ſides. If any of the quicks ſhould die, which they will hardly be more apt to do here than elſewhere, unleſs perhaps in extreme dry ſeaſons, they may be renewed, as in other places, by planting new ones, or by layers from thoſe which remain.

A fence like this will even do for a park; eſpecially if poſts and rails, about two feet high, are placed a little ſloping over the ſide of the bank, on or near its top: for no deer will be able to jump over this, nor can they creep through it.

This is one of the beſt fences to afford ſhelter for cattle; and if the quick on the bank is kept well clipped, it will form a kind of green wall, pleaſing to the eye.

When the bounding fence is only to guard againſt accidents from without, it may be made in the ha-ha manner; only taking care that the earth be ſo well rammed down at the back of the wall, as that the ſtones may be properly ſupported, and bear equally.

The ingenious author of the Eſſays on Huſbandry recommends the horn-beam plant, as one of the beſt yet known for making fences, according to the method uſed in Germany, where ſuch fences are common.

"When the German huſbandman, ſays he, erects a fence of this nature, he throws up a parapet of earth, with a ditch on each ſide, and plants his horn-beam ſets in ſuch a manner, as that every two plants may be brought to interſect each other in the form of St. Andrew's croſs. In that part where the two plants croſs each other, he gently ſcrapes off the bark, and binds them with ſtraw thwart-wiſe. Here the two plants conſolidate in a kind of indiſſoluble knot, and puſh from thence horizontal ſlanting ſhoots, which form a ſort of living paliſado, or *chevaux de friſe*; ſo that ſuch a projection may be called a rural fortification. The hedges being pruned annually, and with diſcretion, will, in a few years, render the fence impenetrable in every part." *Eſſays on Huſbandry*, Eſſay I. page 14.

High fences are nuiſances on arable land; for when heavy rains fall, the corn of narrow cloſe fields, and every where under high trees, is liable to be lodged; but in large open fields, or where the hedges are low, very little damage will be done. The fences of an arable field ought not to be above four feet high; as a good ditch with a trimmed quick-hedge, Mr. Marſhal ſays, is to be preferred before any other. He alſo ſays, dead hedges are a heavy tax on an incloſed farm; and live fences, except quicks, are barbarouſly treated in this country. Even quicks are generally hacked down to the ground, and a dead hedge raiſed behind the ſtumps, till the young ſhoots get ſtrong enough for a fence. There are few old hedges without a ſufficiency of live ſtuff in them, if it were properly treated, to make a fence. But inſtead of plaſhing and trimming this into the form of a hedge, it is all levelled with the ground; and, that the young ſhoots may not riſe up in judgment on the folly, they are ingeniouſly ſmothered by a rough dead hedge placed immediately on the ſtubs. Should a hardy few eſcape total ſuffocation, they have no other way of enjoying the ſun and air, than by ſhooting out horizontally acroſs the ditch, or into the field; filling both the one and the other with weeds and other trumpery. He ſays alſo, if the hedge wants making, and there be live ſtuff enough for a fence, he recommends it to be plaſhed in the Yorkſhire manner; if the live ſtuff be too thin, fill in with dead boughs. Such as do not require to be re-made, are to be treated as follows: With a ſharp pea-hook or a common reaping-hook (not a ſickle), begin on the ditch-ſide, and ſtrike off every thing, whether oak, hazel, black thorn, or quick, ſtem or ſpray, dead or alive, which overhang the ditch; clearing at the ſame time the bank and ditch from graſs and weeds. If the bank-ſide is free from trees, buſhes, or other incumbrances, he recommends it to be treated in the ſame manner; leaving the hedge, whether crooked or ſtraight, about a foot, or a foot and half thick, clearing away the graſs, weeds, and briars, as on the other ſide. The immediate neatneſs which this gives is pleaſing, and its utility obvious: there will be no waſte ground, no harbour for weed; and where live ſhrubs abound, the freſh ſhoots the following ſpring will make it difficult for even a bird to get through them. If the bank-ſide is encumbered, he recommends to grub and plough cloſe to the hedge, or plough cloſe to the incumbrances, and trim back every thing which overhangs the laſt furrow. This alone gives a garden-like appearance, and will be worth all the trouble: but even this is not without its uſe; the nurſery of weeds in a great meaſure will be deſtroyed, and a convenient path formed round the field. The farmer, who will thus accommodate the ſportſman in hunting, will always be favoured; for it is frequently with great reluctance that he will ride over wheat, becauſe he could not keep the outſide furrow, without the hazard of being torn off his horſe by briars and thorns, or having ſome violent blows from the boughs of the trees. Indeed the moſt pleaſing reflection is, that all this utility, conveniency, and ſightlineſs, may be obtained at a trifling expence. Mr. Marſhall proceeds, and gives the following account: viz. "I ſet a lad to trim the ditch-ſide of a rough black-thorn hedge, which had not been touched for twice ſeven years. The ditch was totally blinded with thorns, briers, graſs, and weeds. The length was about 60 rods. He began about eight in the morning, and finiſhed about five in the afternoon. His wages did not amount to more than 15*d.* or a farthing a rod. The following day he trimmed back the overhangings of the outſide furrow of a field of wheat of four acres, in four or five hours; by which any perſon could walk or ride round with pleaſure, and view the coming crop without injuring it, which, without this trifling labour and expence, could not be done with eaſe or conveniency."

Mr. Marſhall, in his Rural Economy of the Midland Counties, ſpeaking of fences, ſays "At preſent, however, garden quick may be ſaid to be the univerſal hedge-wood; although there was, within the memory of many men, no ſuch thing in uſe.

"The rejection of nurſery plants, however, did not proceed from ignorance in the method of raiſing them, but from principle, founded on a falſe notion, that plants, pampered in the rich ſoil of a garden, were of courſe improper to be planted in a ditch bank of common earth. No, not the planters of thoſe

days knew better. Gather them in woods, where they have been expofed to hardfhips, and have learnt to live upon coarfe fare, and in that cafe, when they come to be tranfplanted into hedges, they muft thrive.

"A gentleman near Tamworth was the firft who ventured to plant garden quick on a large fcale; and his fuccefs ruined the bufinefs, as it had long been, of quick-gathering. The quantity now raifed at Tamworth and its neighbourhood, for the Birmingham and other markets, is extraordinary. It is moftly tranfplanted. Its price, even at Tamworth, feven fhillings a thoufand: at Birmingham, eight to ten fhillings: yet at thofe prices one gardener fells, even when no public inclofures are going forward, three or four hundred thoufand annually.

"The moft judicious planter I met with in the diftricts, and from whom, with the gardener here alluded to, I had thefe particulars, choofes his plants at four years old, tranfplanted at two; and cares not how rich a foil they are raifed in.

"The time of planting, here, is not unfrequently autumn. I had an opportunity of making a comparative obfervation, on a neighbour's practice, between plants fet in autumn and others planted, in continuation of the fame hedge, in fpring. The autumnal planting, in this cafe, had a decided preference. But the fituation was fomewhat dry, and the fpring and fummer proved fo likewife:—under thefe circumftances autumnal planting will generally fucceed beft.

"The method of planting has been faid to be that of putting the plants into a broad flat mound; generally planting two rows, ten or twelve inches apart, and a fimilar diftance from the brink of the trench, by the fide of which they are planted.

"The reafon given for this mode of planting is, that a deep ditch makes a high heavy bank, and this overloads the roots.

"There is, no doubt, fome truth in this reafoning. Plants never thrive fo well as on level ground, provided they are not incommoded by ftanding water: but it is a fact, evident in various parts of the kingdom, and particularly in my own practice in three different and diftant parts of it, that hedges may be raifed with fuccefs in the front of a high bank; and that its difadvantages are by no means equal to the advantage gained by a deep ditch and high bank, as a defence to the rifing hedge.

"Two rows of pofts and rails are here the common guard: incurring an expence equal to twice that of a deep ditch and banklet on one fide, and a high bank and hedge on the other. If the hedge be planted behind a fhelf of fufficient width, and part of the mould of the ditch be applied in forming a banklet on its outer brink, the load incurred by the remainder is little, if any, impediment to the progrefs of the young hedge.

"The method of planting a hedge in this manner is mentioned above.

"The nurfing of young hedges, a bufinefs which in moft parts of the kingdom is in a manner totally neglected, is in many cafes well attended to here. They are pretty generally weeded, and, in fome inftances, hoed: in others, however, they are here, as in other places, feen ftruggling among weeds; principally of the following fpecies.

"I enumerate them here, as I paid more attention to hedge-weeds in this than in any other diftrict: and though they vary in fome degree in different places, they are, upon the whole, very much the fame in all.

"In the treatment of grown hedges, plafhing may be called the univerfal practice of this diftrict. Neverthelefs, I have obferved a few inftances of cutting hedges, that do not come within the defcription of plafhing.

"In this practice, one row of ftems, if double quicked, is cut to the ftub, the other, hedge height; not level off, or all of the fame height, but in fuch a manner as to lean back, away from the ftubs of the fallen row; cutting thofe which ftand foremoft the loweft, and fuch as lean or branch away from them, the higheft; leaving the back fpray on, to form a blind, and affift to make a fence.

"Under this management, two rows of quick are evidently preferable to a fingle row; for although I have feen fingle quick treated fomewhat in this manner, efpecially in Derbyfhire, the effect is very different. In this cafe the ftools and the ftems are fed from the fame roots; the fame fet of fibres; and the ftems with the fpray left upon them rob the lower fhoots, from which the new fence is to rife, of a great part of their fap; while in the other, the ftools not only ftand diftinct from the ftems, but have a diftinct fet of roots to fupport them, entirely independent of the ftems left ftanding as a temporary fence.

"The methods of plafhing are various: the old and ftill moft prevailing method is to leave part of the ftems ftanding, as live ftakes; between which the plafhers are interwoven, in the ufual manner.

"Judicious managers, however, object, and with good reafon, to live ftakes; which, throwing out fpreading heads in the pollard manner, overhang and deftroy the plafhers, and prevent the fhoots of the ftools from rifing; confequently tending to convert the hedge into a row of thorn pollard, in which ftate old hedges that have been thus treated are too evidently feen. On the contrary, when the entire hedge is cut down, or crippled as plafhers to the ftub, the plafhers have no impediment, and the young fhoots are the lefs incommoded, in as much as the plafhers fhoot lefs luxuriantly than the ftakes. Still, however, the fhoots from the ftools, the only offspring of the old hedge from which a new one can be expected, are greatly injured by the plafhers overfpreading them.

"Hence an improvement has been ftruck out, in this diftrict, which probably raifes the art of plafhing to its higheft degree of perfection. This is effected by driving the dead ftakes not in a line with the ftubs, but fome foot or more behind them; and by winding the plafhers among them, and eddering them, according to the cuftom of this country, with brambles, leave the fhoots from the ftubs the fame air and head-room, or nearly the fame, as if the whole were cut down, and a dead hedge raifed behind them.

"The advantage of this method of plafhing, compared with the practice of felling the whole to the ftub, is, that a live hedge, which improves by age, is raifed, inftead of a dead one, which grows worfe every year. The difadvantage, that of part of the fap (of fingle hedges) being drawn away from the young fhoots; which, in this cafe, are left lefs free and open than when the whole of the ftems are cleared away at the ftub.

"However, where there are a fufficiency of young pliable ftems for plafhers, and the ditch does not require much repair, the plafhing here defcribed may have, upon the whole, the preference; efpecially if the plafhers, when the young hedge has got up, be removed from their interference with upright fhoots.

"But, where the hedge has been neglected, the ftems are grown few and large, particularly where vacancies require to be filled up by layers or otherwife, and the ditch requires to be new made, felling to the ftub is indifputably preferable.

"It is obfervable, however, that in the diftrict under furvey the ditch is rarely re-made, and but feldom fcoured: even where the foil is retentive; and a ditch, of courfe, neceffary to good management.

"The reafoning, in this cafe, is the fame as in that of planting by a narrow ditch: namely, the fear of overloading the roots. In that cafe there may be fome fhadow of truth; but in this, in which the roots are feeding feveral feet from the bank, there is probably not the leaft foundation. The practice, no doubt, originates in indolence or falfe economy.

"This cenſure, however, is not intended to be paſſed indiſcriminately. There are many individuals who are aware of the utility of open ditches, in freeing their lands from ſurface water."

FENCE-*Month*, the month wherein deer begin to fawn, during which it is unlawful to hunt in the foreſt. It commences 15 days before mid-ſummer, and ends 15 days after it. This month, by ancient foreſters, is called *defence-month*.

FENCING, the art of making a proper uſe of the ſword, as well for attacking an enemy as for defending one's ſelf. This art is acquired by practiſing with foils, called in Latin *rudes*; whence fencing is alſo denominated *gladiatura rudiaria*. It is one of the exerciſes learnt in the academies; and is an accompliſhment both agreeable and uſeful: agreeable, as it affords gentlemen a noble and diſtinguiſhed amuſement: uſeful, as it forms the body; and furniſhes the faculty of defence, whether it be of their honour or their life, when the one or the other is attacked by thoſe turbulent and dangerous perſons whoſe correction is of ſervice to ſociety in general.

Pyrard aſſures us, that the art of fencing is ſo highly eſteemed in the Eaſt-Indies, that none but princes and noblemen are allowed to teach it. They wear a badge or cognizance on their right arms, called in their language *eſaru*; which is put on with great ceremony, like the badges of our orders of knighthood, by the kings themſelves.

Fencing is divided into two parts, *ſimple* and *compound*. *Simple* fencing is that performed directly and nimbly, on the ſame line; and is either offenſive or defenſive. The principal object of the firſt is whatever may be attempted, in puſhing or making paſſes, from this or that point, to the moſt uncovered part of the enemy. The ſecond conſiſts in parrying and repelling the thruſts aimed by the enemy. *Compound* fencing includes all the poſſible arts and inventions to deceive the enemy, and make him leave that part we have a deſign on bare and unguarded, upon finding we cannot come at it by force, nor by the agility of the ſimple play. The principal means hereof are, on the offenſive ſide, feints, appeals, claſhings, and entanglings of ſwords, half-thruſts, &c.; and, on the defenſive, to puſh in parrying. Of all which a detail would be here uſeleſs, as they are only to be underſtood and acquired from perſonal inſtructions conjoined with practice.

FENELON (Francis de Salignac de la Motte), was of an ancient and illuſtrious family, and born at the caſtle of Fenelon in Perigord in 1651. In 1689 he was appointed tutor to the dukes of Burgundy and Anjou; and in 1695 was conſecrated archbiſhop of Cambray. After this preferment, a ſtorm roſe againſt him, that obliged him to leave the court for ever, occaſioned by his performance intitled, *An Explication of the Maxims of the Saints concerning the Interior Life*; in which he was ſuppoſed to favour the extravagant notions of Madam Guyon, and the principles of Quietiſm. A controverſy on this occaſion was for ſome time carried on between him and M. Boſſuet, biſhop of Meaux: which terminated in an appeal to the pope; when his holineſs condemned the archbiſhop's book, by a brief dated March 12th, 1699. Some friends indeed pretend, that there was more of court-policy than religious zeal in this affair: but be this as it may, the archbiſhop ſubmitted patiently to this determination; and, retiring to his dioceſe of Cambray, acquitted himſelf punctually in all the duties of his ſtation, and led a moſt exemplary life. The work that gained him the greateſt reputation, and which will render his memory immortal, is his *Adventures of Telemachus*; the ſtyle of which is natural, the fictions well contrived, the moral ſublime, and the political maxims tending all to the happineſs of mankind. Hence it is thought, as the printing of this work was ſtopped at Paris, that the prelate's hereſy was in politics inſtead of religion; and though his diſgrace was prior to this work, he had, while he was tutor to the young princes, taught them the ſame principles aſſerted and exemplified in Telemachus. Fenelon died in 1715; and a collection of all his religious works was afterwards printed at Rotterdam, under the care of the marquis de Fenelon, his grand nephew, when ambaſſador to the States-General.

FENNEL, in botany. See ANETHUM.

FENTON (Sir Geoffrey), privy-counſellor and ſecretary in Ireland during the reigns of queen Elizabeth and king James I. is well known for his tranſlation of *Guicciardin's Hiſtory of the Wars of Italy*, dedicated to queen Elizabeth in 1579. He died at Dublin in 1608; after having married his daughter to Mr. Boyle, afterward the great Earl of Corke.

FENTON (Elijah), deſcended from an ancient family, was born at Shelton near Newcaſtle, but in what year is uncertain. He was the youngeſt of 12 children, and was intended for the miniſtry; but embracing principles contrary to the government, while at Cambridge, he became diſqualified for entering into holy orders. After he quitted the univerſity, he was ſecretary to the earl of Orrery; but ſeems to have ſpent the moſt of his life amongſt his friends and relations, and uſed to pay an annual viſit to his elder brother, who enjoyed an eſtate of 1000l. a-year. He was a man of great tenderneſs and humanity, enjoyed the faireſt reputation, and was much eſteemed by Mr. Pope; who, when he died in 1730, paid him the tribute of a very elegant epitaph. He publiſhed a volume of poems in the year 1717; and in 1723 was acted his tragedy of Mariamne, built upon the ſtory collected from Joſephus in the third volume of the Spectator.

FENUGREEK. See TRIGONELLA.

FEOD, or FEUD, is defined to be a right which a vaſſal hath in lands or ſome immoveable thing of his lord's, to uſe the ſame, and take the profits thereof hereditarily, rendering unto the lord ſuch feodal duties and ſervices as belong to military tenure, &c. and the property of the ſoil always remaining to the lord.

FEODAL, of or belonging to a FEUD or FEE.

FEODAL *Syſtem*, the conſtitution of FIEFS or FEUDS. It is about 12 centuries ago, ſince this ſyſtem was ſo univerſally received in Europe, that Sir Henry Spelman calls it *the law of nations in our weſtern world*. Hence it deſerves our attention in a particular manner; a knowledge of the different feuds being indiſpenſably requiſite for a proper underſtanding either of the civil government of our own country, or the laws by which its landed property is regulated.

The military policy of the Celtic or northern nations, known by the names of *Goths*, *Vandals*, *Franks*, *Huns*, and *Lombards*, furniſhed the original conſtitution or ſyſtem of feuds. Theſe people pouring out into vaſt multitudes from the ſame *officina gentium* or "ſtore-houſe of nations," over-ran all the European countries on the declenſion of the Roman empire. They brought the feudal ſyſtem along with them from the countries out of which they emigrated; and, ſuppoſing it to be the moſt proper method of ſecuring their new conqueſts, they introduced it into their more ſoutherly colonies.

According to this ſyſtem, the victorious general allotted conſiderable tracts of land to his principal officers; while they, in like manner, divided their poſſeſſions among the inferior officers, and even thoſe common ſoldiers who were thought to be the moſt deſerving. Allotments of this kind were named *feoda*, *fiefs*, *fees*, or *feuds*, from a combination of words, in the language of theſe barbarians, ſignifying a reward or ſtipend beſtowed on certain conditions. The condition upon which theſe rewards were given was, that the poſſeſſors ſhould faithfully ſerve the perſon from whom they were received, both at home and abroad, in the military way. To this they engaged themſelves by a *juramentum fidelitatis*, or oath of fealty; in the event of a breach of which, either by not performing the ſervice agreed upon, by deſerting their lord in time of battle, &c. the lands were to return to their original poſſeſſor.

Thus the poſſeſſors of feodal allotments became intereſted in the defence of them; and not only the receivers, but thoſe who gave them, were equally and mutually bound to defend their poſſeſſions, none of them being able to pretend any right but that of conqueſt. For this purpoſe, government and ſubordination were abſolutely neceſſary; it being impoſſible to conduct any ſyſtem of defence where every thing was tumultuous and irregular. Every perſon, therefore, who was a feudatory, *i. e.* who had received lands, was bound to do every thing in his power to defend the lord of his fee; while, on the other hand, the latter was no leſs ſubordinate to his immediate ſuperior; and ſo on to the prince himſelf. In like manner a reciprocal bond of defence exiſted down from the prince to the loweſt feodiſts.

Such were the foundations on which the feodal ſyſtem was properly eſtabliſhed; and the natural conſequence was, a military ſubjection throughout the whole community. The prince could always collect an army of feudatories ready to defend not only the kingdom in general, but the particular poſſeſſions of each perſon; and the propriety of this conſtitution was ſoon apparent in the ſtrength which theſe newly-erected kingdoms acquired, and the valour with which their conqueſts were defended.

Beſides theſe feodal grants, however, which were held only on the terms of military ſervice above mentioned, there were others called *allodial*, which were given upon more enlarged principles. To theſe every free man had a title; and could not only claim his territory as well as the reſt, but diſpoſe of it at his pleaſure; and this freedom was denominated *allodiality*. Theſe allodials, however, were not exempted from military ſervice. A part of their freedom conſiſted in liberty to go to the wars; for this, in the barbarous times we ſpeak of, was the only way to acquire any degree of renown. Only the ſlaves were deſtined to follow the arts of peace; while every free perſon was not only at liberty to defend his country, but under an obligation to do it in caſe of any urgent neceſſity.

Thus there was a feodal and a national militia. The free people only were allowed to poſſeſs property; the *feudal vaſſals* conſtituted the army, properly ſo called; while the national militia was compoſed of the allodial proprietors. This allodiality, however, was not confined to landed property, but included likewiſe moveable eſtates or money; ſo that proprietors of the latter kind were obliged alſo in times of danger to bear arms and appear in the field. Between the feodal and allodial proprietors, however, there was this farther difference, that the latter had no concern with any private quarrels which might take place among the lords themſelves; ſo that they were never obliged to appear in the field unleſs when called forth by the ſovereign againſt the enemies of the nation at large. This circumſtance we might ſuppoſe to be an advantage, but it ultimately operated otherwiſe; becoming the means of changing the allodial right into a feodal tenure. For ſome time the holders of fiefs had an eminent advantage over the allodial proprietors. This was owing to the imperfection of government in thoſe days; ſo that the nobles had it in their power to revenge their own quarrels, while the weak were equally expoſed to the inſults of both parties. The lord and his vaſſals therefore were always formidable; but the allodial proprietors had ſcarce any means of defending themſelves. The reaſon of this was, in the firſt place, that the law did not allow them to commit any hoſtilities; and in the next, they were too diſtant and unconnected to form any proper league for mutual defence; and hence proceeded the neceſſity already hinted at, of converting allodial property into feudal tenure. This was indeed owing in a great meaſure to the abſurdity and violence of the times, by which gifts of property, burthened with ſervice, and which might return to the perſon who granted them, were rendered ſuperior in value to the abſolute and unconditional poſſeſſion of a ſubject. Other conſiderations, however, beſides that juſt mentioned, contributed to produce the ſame effect. As in thoſe dark ages no right exiſted but what had its origin in conqueſt, it thence followed, that the greateſt conqueror or warrior was the moſt honourable perſon. The king, in whom the whole exploits of the community centred, as being their head, was the moſt honourable perſon; all others derived from him that portion of honour which they enjoyed, and which was moſt nicely adjuſted in proportion as they approached him. Allodial proprietors therefore having no pretenſions of this kind, were treated with contempt as a kind of poltroons. From this diſagreeable ſituation they wiſhed to free themſelves, by converting their allodial property into feudal tenures; while the princes, ſuppoſing it their intereſt to extend thoſe tenures as much as poſſible, diſcouraged the allodial poſſeſſions. As the feodiſts ſupported the importance of the nation and dignity of the monarch, it was not thought proper to allow the allodial proprietors any greater compenſations than what were given to vaſſals in ſimilar caſes. Thus they were expoſed to continual mortifications in the courts of juſtice; they were neglected by the king; denied ſufficient protection from the laws; expoſed not only to continual inſults, but to have their property on all occaſions deſtroyed by the great: ſo that they were without reſource except from the feodal tenures, and were obliged even to ſolicit the privileges which were beſtowed in other caſes on vaſſals. In theſe unhappy circumſtances, they were glad to yield up their lands to any ſuperior whom they thought moſt agreeable, and to receive them back from him as a feudal gift. Thus the landed property was every where changed into feudal tenures, and fiefs became univerſal.

For ſome time, the feodal ſyſtem was not only uſeful in itſelf, but honourable in its principles; but this continued no longer, than while the importers of it into Europe adhered to their original ſimple and noble maxims. During that period, the lord exerciſed his bounty to the vaſſal, which the latter repaid by acts of gratitude: ſo that the intercourſe betwixt them was of the moſt tender and affectionate kind; and this gave riſe to what are called the *feodal* INCIDENTS.

The expectants of fiefs were educated in the hall of the ſuperior, while the tenures were precarious or only for life: and even when they became hereditary, the lord took care of the ſon and eſtate of his deceaſed vaſſal; not only protecting his perſon, but taking charge of his education, and directing the management of his affairs. He took pleaſure in obſerving his approach to maturity; and when he came of age, never failed to deliver to him the lands, with the care of which he had been entruſted, and which he had been careful to improve. This was called the *incident of wardſhip*.

The incident of *relief* was founded upon the gratitude of the vaſſal; who, upon entering on his fief, brought a preſent to his lord, as an acknowledgment of his care of him during the early part of his life, and in order to conciliate his future regard.

The incident of *marriage* proceeded alſo upon the principle of gratitude on the part of the vaſſal. The latter, conſcious of the favours he had received, did not chooſe to ally himſelf with a family inimical to his chief: while the ſuperior himſelf, ambitious to aggrandiſe and augment the importance of his family, ſought how to find the moſt advantageous match for his vaſſal.

Sometimes the ſuperior himſelf was reduced in his circumſtances by war or other accidents: but from whatever cauſe his diſtreſs proceeded, even though it had ariſen from his own extravagance or prodigality, or when only deſtitute of means to ſupport his ambition or grandeur, his vaſſals were bound to ſupport and relieve him according to their circumſtances; and this was called the *incident of aid*.

The incident of *eſcheat* took place on the part of the vaſſal, when, through cowardice, treachery, or any remarkable miſbehaviour, he rendered himſelf unworthy of his fief. In that caſe, the taking it from him, and giving it to one more worthy, was called an *eſcheat*.

While the lords and vaſſals thus vied with one another in mutual acts of friendſhip and benevolence, univerſal happineſs, liberty, and activity, were diffuſed through the ſociety. The vaſſals behaved courteouſly towards the retainers, who were immediately below them; while they again were courted by the lords, as conſtituting their importance and ſtrength; the lords, laſtly, giving a like importance and dignity to the ſovereign himſelf. Thus a regular, powerful, and compact ſyſtem of government took place; an unanimity and attention pervaded the various departments of ſtate; ſo that while the ſubjects were free, the nation at large was formidable.

During this happy ſtate of affairs, the members of the national aſſembly in every country of Europe appeared there in arms, whether they came perſonally or by their repreſentatives. Such particularly was the caſe under the Anglo-Saxon government; and the happineſs they at that time enjoyed made the oppreſſion and tyranny of the Normans appear the more intolerable. In proceſs of time, however, the ſtate of ſociety began to ſuffer a remarkable alteration. The high and diſintereſted notions, from which the happineſs above mentioned took its origin, declined; the romantic ideas of chivalry ceaſed; and much more intereſted notions of property came in their ſtead. The ſeparation of the intereſts of the lords from their vaſſals was the firſt ſtep towards the deſtruction of the feodal ſyſtem. Thus the *incidents*, which, as has juſt now been mentioned, promoted their happineſs, did the very reverſe. Property, being now looked upon as a diſtinction ſuperior to perſonal merit, naturally introduced the moſt mercenary views. In conſequence of theſe the infant *ward*, the care of whom was wont to be conſidered as a ſacred and honorary truſt, was now only looked upon as a mean of procuring emolument to the ſuperior. The latter now regarded the profits of his vaſſals as ſo many diminutions of his own wealth. Inſtead of taking care to improve the eſtate of his ward as formerly, he impoveriſhed it; not only neglecting the education of the heir, but offering inſults to himſelf; inſomuch that the relations of the unfortunate vaſſal were frequently obliged to ranſom from the avaricious ſuperior both his perſon and effects. By merchandiſe of this kind the coffers of princes were filled, and wardſhips let out to ſtrangers, who might exerciſe their rapacity with greater freedom. When the vaſſal at laſt attained the years of maturity, he came to the poſſeſſion of his lands without any of that joy and feſtivity which uſually took place on the occaſion. He received an inheritance waſted and deſtroyed, while new grievances daily preſented themſelves to augment the horrors of his ſituation. All the *incidents*, which in former times were ſo many expreſſions of gratitude on the part of the vaſſal, were now changed into taxes which might be exacted at the pleaſure of the lord. Before the vaſſal was inveſted in his land, the ſuperior exacted from him a certain ſum or other gift, to be meaſured only by his own rapacity; and, in caſe of delay or inability to pay this demand, the ſuperior continued in poſſeſſion of the eſtate. Such ſcandalous oppreſſion could not but produce the greateſt diſcontent and clamour. Applications were made to the law without ſucceſs; nor were even the laws regarded which were fabricated on purpoſe for their relief. The incident of *marriage* now proved a ſource of the moſt dreadful oppreſſion. The lord aſſumed a right of marrying his vaſſal to whom he pleaſed; and he not only exerted this right himſelf, but would ſell it to a ſtranger, or allow the vaſſal to buy it himſelf; while the penalty annexed to a marriage without the conſent of the ſuperior involved no leſs puniſhment than the loſs of the eſtate itſelf, or ſome grievous infliction as for a crime of the firſt magnitude. The caſe was ſtill worſe with a female ward; whoſe beauty and accompliſhments became a ſource of gain to the ſuperior, or were ſacrificed to pleaſe his whim or caprice: ſo that her relations were frequently obliged to buy from him the privilege of marrying her to the perſon ſhe or they thought moſt proper. In like manner the *aid*, which was formerly a voluntary gift from the vaſſal in caſes of diſtreſs happening to his lord, now became an unavoidable tax. An aid formerly was demanded, when the eldeſt daughter of the ſuperior was married, when his eldeſt ſon was knighted, or when the ſuperior himſelf was taken priſoner in battle. Theſe were the only legal cauſes of making a demand of this kind: but, in the ſubſequent times of degeneracy, the moſt frivolous pretences were every day made uſe of by the prince to oppreſs the lords, and by the lords to oppreſs their vaſſals; demanding ſubſidies at pleaſure, which their inferiors were always obliged to comply with. Laſtly, the *eſcheat*, which in former times took place only in caſes of cowardice, treachery, or ſome other heinous crime, was now inflicted on the moſt trifling occaſions. If the vaſſal happened to be too long in attending the court of his ſuperior to take the oath of fealty; if he committed any action which could in the leaſt be conſtrued an infringement of the oath; if he neglected to give his lord warning of any misfortune which he might ſuppoſe was about to befal him; revealed any thing concerning him; made love to his ſiſter or daughter, &c.; or even if he ſhould grant a tenure of land to another perſon in form different from that in which he held his own; all theſe, nay others ſtill more ridiculous, were judged ſufficient reaſons for the ſuperior to ſeize on the eſtate of the vaſſal, and involve him and his family in ruin.

Notwithſtanding theſe oppreſſions, however, the vaſſal was ſtill obliged to ſubmit to his lord; to own him as his ſuperior; and even, in appearance, to pay him the ſame reſpect as formerly, when the greateſt unanimity and cordial affection ſubſiſted between them. Still he was obliged to perform the ſame military ſervice; becauſe a failure in that reſpect would have ſubjected him to a forfeiture of lands according to the original agreement. A vaſt difference, however, now took place in the valour and activity which inſpired the army. The vaſſals, forced into the field with deſponding hearts, were indifferent as to the ſucceſs of the cauſe in which they were engaged, and frequently obſtructed inſtead of forwarding the operations of the field. Hence the ſovereign found himſelf embarraſſed; and, though nominally at the head of a martial and powerful people, was frequently unable to effect any thing by reaſon of the mutual hatred and diſſenſion which every where prevailed.

Thus the feodal ſtates of Europe became unnaturally weak: a remedy was neceſſary; and it is remarkable, that the ſame remedy was applied all over the continent. This was, in ſhort, the making fiefs hereditary, which till now had only been granted for a long term of years; and, in return, burdening the lands with a certain number of ſoldiers, which were not to be refuſed upon any pretence whatever. Hence was derived the tenure of *knight-ſervice*. A certain portion of land, burdened with the ſervice of one ſoldier or knight, was called a *knight's-fee*; and thus an eſtate, furniſhing any number of ſoldiers, was ſaid to contain as many knight's-fees; ſo that now the manors, baronies, &c. became powerful according to the number of ſoldiers they were bound to furniſh. In the grants from the crown, the nobility were obliged to furniſh a certain number of ſoldiers for the ſervice of the ſovereign; and in thoſe from the nobility to their vaſſals, the like ſervice was required. Even the commons who had grants from the crown furniſhed a certain proportion of knights. The force of the nation was called into action by grants *in capite*, or from the ſovereign and nobility. A numerous and powerful army was inſtantly aſſembled, and at once ready for action. Of this army the king was

the general, the nobility the officers, and the vaſſals ſoldiers; the whole being exactly arranged, and capable of entering upon any expedition without the leaſt delay.

Thus a remedy was found in ſome meaſure for the weakneſs of the feodal ſovereigns: but, though the knights-tenure could accompliſh this, it could not bring back the former affection and cordiality which ſubſiſted between the various ranks of people. On the contrary, by uniting them more firmly to one another by legal ties, it rendered matters rather worſe. The oppreſſion originating from the operation of the feodal *incidents* ſtill continued with unremitting violence. The grants of knights-tenure were attended with the ſame oaths of homage and fealty; the ſame incidents of relief, wardſhip, marriage, aid, and eſcheat, with the feodal tenures. The princes promiſed to abate ſomewhat of their rigour in demanding the feodal perquiſites, but did not keep their word. Laws were occaſionally promulgated, and for ſome time had an effect; but palliatives ſoon became ineffectual, and a new ſtate of weakneſs began to commence.

The two remarkable eras in the feodal hiſtory are, the time before the invention of knight-ſervice, and that during which it continued. Fiefs were in a ſtate of fluctuation from the deſtruction of the Roman empire till the ninth century; but they were rendered perpetual in France about the year 877, and were generally become ſo in every country of Europe about the beginning of the tenth. Du Cange, *voce Militia*, gives us an example of a knight-fee in the year 880. By the year 987, when Hugh Capet was raiſed to the throne of France, knight-ſervice was become general all over Europe, and was introduced into England, after having made its appearance in other countries. In England, however, there have been ſeveral doubts and difficulties among the learned concerning the introduction of the feodal laws. Many are of opinion, that they were firſt introduced by William the Conqueror; and, conſequently, that they were entirely unknown to the Anglo Saxons: but others think, that they exiſted among the latter in the ſame form under which they were continued by the Normans. Dr. Stuart is of opinion, that the Saxons who ſettled in England could not be ſtrangers to fiefs. He ſuppoſes the conformity of manners, which undoubtedly prevailed between the Saxons and other barbarians, a ſufficient proof that the hereditary grant of land, as well as the fluctuating ſtate of feodal tenures which preceded it, were known to the former. Collateral proofs are derived from the ſpirit and tenure of the Anglo-Saxon laws, but eſpecially from the grants of hereditary eſtates on condition of military ſervice. The condition of fiefs under the Anglo-Saxons was very different from what it was afterwards. In their times we find no mention made of thoſe oppreſſions of which ſo much notice has already been taken; and this may eaſily be accounted for from the alteration of the feodal ſpirit in different ages. During the time that a warm and generous affection ſubſiſted between the feodal ſuperiors and vaſſals, the incidents were marks of generoſity on the one part, and gratitude on the other; but as ſoon as a variance had taken place, by reaſon of the intereſted diſpoſition which the introduction of luxury produced, the ſame incidents became ſources of the moſt flagrant oppreſſion. This was remarkably the caſe in the time of William the Conqueror; and during the reign of king John matters were come to ſuch a criſis, that the people every where complained loudly, and demanded the reſtoration of the laws of Edward the Confeſſor. "What theſe laws of Edward the Confeſſor were (ſays Mr. Hume), which the Engliſh, every reign during a century and a half, deſired ſo paſſionately to have reſtored, is much diſputed by antiquarians; and our ignorance of them ſeems one of the greateſt defects of the ancient Engliſh hiſtory." Dr. Stuart has offered an explanation; but this is in fact no more than a conjecture, that "by the laws or cuſtoms of the Confeſſor, that condition of felicity was expreſſed which had been enjoyed during the fortunate ſtate of the feodal aſſociation. The cordiality, equality, and independence, which then prevailed among all ranks in ſociety, continued to be remembered in leſs proſperous times, and occaſioned an ardent deſire for the revival of thoſe laws and uſages which were the ſources of ſo much happineſs."

Beſides the great diſtinction (of which an account has already been given) between the ſtate of fiefs under the Anglo-Saxons and under the Normans, they were no leſs diſtinguiſhed by the introduction of knight-ſervice. Hitherto the refinement of the Engliſh had been obſtructed by the invaſion of the Danes, and the inſular ſituation of the kingdom; but after the Norman conqueſt the fiefs were made perpetual. Still, however, the knight-fee and knight-ſervice were altogether unknown. William, the ſixth prince who enjoyed the duchy of Normandy, was well acquainted with every thing relating to fiefs; for that duchy had experienced all the variety incidental to them, from the time of its being granted to Rollo by Charles the Simple, in the year 912, to the year 1066, when William was put in poſſeſſion of England by the battle of Haſtings.

On his acceſſion to the throne, a number of forfeitures took place among thoſe who had followed the fortune of Harold. Their eſtates were to be diſpoſed of at the pleaſure of the conqueror; and it was natural to ſuppoſe that he would follow the method practiſed in his own country. Hence the origin of knight-ſervice in England. A grant of land, to any perſon whatever, was eſtimated at a certain number of knights-fees; and each of theſe required the ſervice of a knight. The grants of lands were even renewed to the old tenants under this tenure; ſo that by degrees the whole military people in the kingdom acquieſced in it. To accompliſh this, Domesday *Book* is ſuppoſed to have been compiled, which contained an exact account of all the landed property in the kingdom. Hence it is to be concluded, not that William introduced fiefs into England, as ſome have imagined, but that he brought them to their ultimate ſtate of perfection by the introduction of knight-ſervice. This is evident from the laws enacted during his reign. In theſe it is not only mentioned that knight-ſervice was enacted, but that it was done expreſsly with the conſent of the common council of the nation; which at that time was equivalent to an act of parliament.

The invention of knight-ſervice proved generally agreeable: for, as only few of the Anglo-Saxon fiefs were hereditary, the advancement of the reſt to perpetuity, under the tenure of knight-ſervice, muſt have been accounted an acquiſition of ſome importance; as not only augmenting the grandeur and dignity of the ſovereign, but ſecuring the independence of the ſubject, and improving his property. In the happy ſtate of the feodal aſſociation, there was indeed no neceſſity for the knight's-fee; but when the diſcordance and oppreſſion ſo often mentioned began to take place, it became then neceſſary to point out particularly every duty of the vaſſal, as well as of the lord; and this was fully done by the invention of knight-ſervice. The nobles poſſeſſed duchies, baronies, and earldoms; which extenſive poſſeſſions were divided into as many fees, each of them to furniſh a knight for the ſervice of the king, or of the ſuperior. ſo that every feudal ſtate could command a numerous army and militia, to ſupport and defend it in caſe of any emergency. The knights were alſo bound to aſſemble in complete armour whenever the ſuperior thought proper to call, and to hold themſelves in readineſs for action whenever the king or ſuperior found it convenient to take the field: ſo that thus the militia might be marched at the ſhorteſt notice to defend or ſupport the honour of the nation.

The knights were uſually armed with an helmet, ſword, lance, and ſhield; and each was beſides obliged to keep a horſe. This laſt requiſite was owing to the contempt into which the infan-

try had fallen, through the prevalence of tournaments and luxuries of various kinds, though it was by means of the infantry that the barbarians had originally diftinguifhed themfelves in their wars with the Romans, and become able to cope with thefe celebrated warriors. All proprietors of fees or tenants by knight-fervice fought on foot: the cavalry were diftinguifhed by the name of *battle*; and the fuccefs of every encounter was fuppofed to depend on them alone. They only were completely armed: the infantry, being furnifhed by the villages under the jurifdiction of the barons, had at firft only bows and flings; though afterwards they were found worthy of much greater attention.

While the feodal affociation remained in perfection, the fuperior could at any time command the military fervice of his vaffals; but, in the fubfequent degeneracy, this fervice could neither be depended upon when wanted, nor was it of the fame advantage when obtained, as formerly. The invention of knight-fervice tended in a great degree to remedy this inconvenience. Thofe who were poffeffed of knights-fees were now obliged to remain 40 days in the field, at their own expence; and this without exception, from the great crown vaffals to the fmalleft feudatories; but if longer fervice was required, the prince was obliged to pay his troops. In thofe times, however, when the fate of nations was frequently decided by a fingle battle, a continuance in the field for 40 days was fufficient for ordinary occafions.

Thus matters feemed once more to be reftored nearly to their former ftate. It was now, as much as ever, the intereft of the nation to act with unanimity in its defence, not only againft foreign enemies, but againft the tyranny of the prince over his fubjects, or of one part of the fubjects over the other. New inconveniencies, however, foon began to take place, owing to the gradual improvements in life and the refinement of manners. From the firft inftitution of military fervice, a fine had been accepted inftead of actual appearance in the field. In the times of barbarity, however, when men accounted rapine and bloodfhed their only glory, there were but few who made an offer of this compenfation; but as wealth and luxury increafed, and the manners of people became fofter, a general unwillingnefs of following the army into the field became alfo prevalent. A new tenure, called ESCUAGE, was therefore introduced; by which the vaffal was only obliged to pay his fuperior a fum of money annually inftead of attending him into the field. Hence originated taxes and their mifapplication; for as the king was lord paramount of the whole kingdom, it thence happened that the whole efcuage money collected throughout the nation centred in him. The princes then, inftead of recruiting their armies, frequently filled their coffers with the money, or diffipated it otherwife, hiring mercenaries to defend their territories when threatened with any danger. Thefe being compofed of the dregs of the people, and difbanded at the end of every campaign, filled all Europe with a diforderly banditti, who frequently proved very dangerous to fociety. To avoid fuch inconveniencies, ftanding armies were introduced, and taxations began to be raifed in every European kingdom. New inconveniencies arofe. The fovereigns in moft of thefe kingdoms, having acquired the right of taxation, as well as the command of the military power, became completely defpotic: but in England the fovereign was deprived of this right by Magna Charta, which was extorted from him, as related in our Englifh hiftories; fo that, though allowed to command his armies, he could only pay them by the voluntary contributions of the people, or their fubmitting to fuch taxations as were virtually impofed by themfelves.

FEOFFMENT, in law (from the verb *feoffare* or *infeudare*, "to give one a feud"); the gift or grant of any corporeal hereditament to another. He that fo gives, or enfeoffs, is called the *feoffer*; and the perfon enfeoffed is denominated the *feoffee*. This is plainly derived from, or is indeed itfelf the very mode of, the ancient feodal donation; for though it may be performed by the word "enfeoff" or "grant," yet the apteft word of feoffment is *do* or *dedi*. And it is ftill directed and governed by the fame feodal rules; infomuch that the principal rule relating to the extent and effect of the feodal grant, *tenor eft qui legem dat feudo*, is in other words become the maxim of our law with relation to feoffments, *modus legem dat donationi*. And therefore, as in pure feodal donations, the lord, from whom the feud moved, muft exprefsly limit and declare the continuance or quantity of eftate which he meant to confer, *ne quis plus donaffe præfumatur, quam in donatione expreffferit*; fo, if one grants by feoffment lands or tenements to another, and limits or expreffes no eftate, the grantee (due ceremonies of law being performed) hath barely an eftate for life. For, as the perfonal abilities of the feoffee were originally prefumed to be the immediate or principal inducements to the feoffment, the feoffee's eftate ought to be confined to his perfon, and fubfift only for his life; unlefs the feoffer, by exprefs provifion in the creation and conftitution of the eftate, hath given it a longer continuance. Thefe exprefs provifions are indeed generally made; for this was for ages the only conveyance, whereby our anceftors were wont to create an eftate in fee-fimple, by giving the land to the feoffee, to hold to him and his heirs for ever; though it ferves equally well to convey any other eftate of freehold. But by the mere words of the deed the feoffment is by no means perfected: there remains a very material ceremony to be performed, called *livery of feifin*; without which the feoffee has but a mere eftate at will. See SEISIN.

FERÆ, in zoology, an order of quadrupeds. See ZOOLOGY.

FERALIA, in antiquity, a feftival obferved among the Romans on February 21ft, or, according to Ovid, on the 17th of that month, in honour of the manes of their deceafed friends and relations. Varro derives the word from *inferi*, or from *fero*; on account of a repaft carried to the fepulchres of fuch as the laft offices were that day rendered to. Feftus derives it from *ferio*, on account of the victims facrificed. Voffius obferves, that the Romans called death *fera*, "cruel," and that the word *feralia* might arife thence. Macrobius Saturn. lib. i. cap. 13. refers the origin of the ceremony to Numa Pompilius. Ovid, in his Fafti, goes back as far as Æneas for its inftitution. He adds, that on the fame day a facrifice was performed to the goddefs Muta, or Dumb; and that the perfons who officiated were an old woman attended with a number of young girls. During the continuance of this feftival, which lafted eleven days, prefents were made at the graves of the deceafed, marriages were forbidden, and the temples of the gods fhut up. While the ceremonies continued, they imagined that the ghofts fuffered no punifhments in hell, but that their tormentors allowed them to wander round their tombs, and feaft upon the meats which their furviving friends had prepared for them. See INFERIÆ and SILICERNIUM. Sometimes at the feralia public feafts were given to the people, at the tombs of the rich and great, by their heirs or particular friends.

FER DE FOURCHETTE, in heraldry, a crofs having at each end a forked iron, like that formerly ufed by foldiers to reft their mufkets on. It differs from the crofs-fourché, the ends of which turn forked; whereas this has that fort of fork fixed upon the fquare end. See HERALDRY.

FER *de Moulin, Milrinde, Inke de Moulin*, in heraldry, is a bearing fuppofed to reprefent the iron-ink, or ink of a mill, which fuftains the moving mill-ftone.

FERENTARII, in Roman antiquity, were auxiliary troops, lightly armed; their weapons being a fword, bow, arrows, and a fling.

FERETRIUS, a furname of Jupiter, *a ferendo*, becaufe he

had affifted the Romans; or *a feriendo*, becaufe he had conquered their enemies under Romulus. He had a temple at Rome built by Romulus. It was there that the fpoils called *opima* were always carried.

FERETRUM, among the Romans, the bier ufed in carrying out the bodies of the dead, which duty was performed by the neareft male relations of the deceafed: thus, fons carried out their parents, brothers their fifters, &c.

FERG, or FERGUE, (Francis Paul), a charming landfcape-painter, was born at Vienna in 1689, and there learned the firft principles of his art. He fucceffively practifed under Hans Graf, Orient, and Thiele. This laft, who was painter to the court of Saxony, invited him to Drefden to infert fmall figures in his landfcapes. Ferg from thence went into Lower Saxony, and painted for the duke of Brunfwick, and for the Gallery of Salzdahl. From Germany he went to London, where he might have lived in the higheft efteem and affluence, if, by an indifcreet marriage, he had not been fo effectually depreffed, that he was ever after involved in difficulties. The neceffities which arofe from his domeftic troubles compelled him to diminifh the prices of his paintings, in order to procure an immediate fupport; and, as thofe neceffities increafed, his pictures were ftill more funk in their price, though not in their intrinfic value. By a feries of misfortunes he was over-run with debts; and, to avoid the purfuit of his creditors, he was conftrained to fecrete himfelf in different parts of London. He died fuddenly in the ftreet one night as he was returning from fome friends about the year 1738, not having attained his 50th year; and left four children. This pleafing artift, Mr. Walpole obferves, had formed a manner of his own from various Flemifh painters, though refembling Poelemburg moft in the enamelled foftnefs and mellownefs of his colouring: but his figures are greatly fuperior; every part of them is fufficiently finifhed, every action expreffive. He painted fmall landfcapes, fairs, and rural meetings, with the moft agreeable truth; his horfes and cattle are not inferior to Wouvermans; and his buildings and diftances feem to owe their refpective foftnefs to the intervening air, not to the pencil. More faithful to nature than Denner, he knew how to omit exactnefs, when the refult of the whole demanded a lefs precifion in parts. The greateft part of his works are in London and Germany; and they now bear fuch a price as is the moft indubitable evidence of their real merit. He alfo etched well with aquafortis; and his prints of that kind are much efteemed by the curious.

FERGUSON (James), an eminent experimental philofopher and mechanic, was born in Scotland, of very poor parents. At the earlieft age his extraordinary genius began to exert itfelf. He firft learned to read, by overhearing his father teach his elder brother: and he had made this acquifition before any one fufpected it. He foon difcovered a peculiar tafte for mechanics, which firft arofe on feeing his father ufe a lever. He purfued this ftudy a confiderable length, even whilft very young; and made a watch in wood-work, from having once feen one. As he had no inftructor, nor any help from books, every thing he learned had all the merit of an original difcovery; and fuch, with infinite joy, he believed it to be. As foon as his age would permit, he went to fervice; in which he met with hardfhips, which rendered his conftitution feeble through life. Whilft he was fervant to a farmer (whofe goodnefs he acknowledges, in the modeft and humble account of himfelf which he prefixed to his laft publication), he frequently contemplated the ftars; and began the ftudy of aftronomy, by laying down, from his own obfervations only, a celeftial globe. His kind mafter, obferving thefe marks of his ingenuity, procured him the countenance and affiftance of his fuperiors. By their help and inftructions, he went on gaining farther knowledge, and was fent to Edinburgh. There he began to take portraits; an employment by which he fupported himfelf and family for feveral years, both in Scotland and England, whilft he was purfuing more ferious ftudies. In London he firft publifhed fome curious aftronomical tables and calculations; and afterwards gave public lectures in experimental philofophy, which he repeated (by fubfcription) in moft of the principal towns in England, with the higheft marks of general approbation. He was elected a Fellow of the Royal Society, without paying for admiffion (an honour fcarcely ever conferred on a native); and had a penfion of 50l. per ann. given him, unfolicited, by our gracious king, at his acceffion, who had heard lectures from him, and frequently fent for and converfed with him on curious topics. He alfo received feveral prefents from his majefty, the patron of real merit. To what a degree of confideration Mr. Fergufon mounted by the ftrength of his natural genius, almoft every one knows. He was univerfally confidered as at the head of aftronomy and mechanics in this nation of philofophers. And he might juftly be ftyled felf-taught, or rather heaven-taught; for in his whole life he had not above half a year's inftruction at fchool. He was a man of the cleareft judgment, and the moft unwearied application to ftudy; benevolent, meek, and innocent in his manners as a child; humble, courteous, and communicative. Inftead of pedantry, philofophy feemed to produce in him only diffidence and urbanity, a love for mankind and for his Maker. His whole life was an example of refignation and Chriftian piety. He might be faid to be an enthufiaft in his love of God, if religion, founded on fuch fubftantial and enlightened grounds as his was, could be ftyled enthufiafm. He died in 1776.

FERIÆ, in Roman antiquity, holidays, or days upon which they abftained from work. Proclamation was generally made by a herald, by command of the *Rex Sacrorum*, or *Flamines*, that all fhould abftain from bufinefs; and whoever tranfgreffed the order was feverely fined. The feriæ were of two kinds, public and private. The *public* feriæ were fourfold. 1. *Stativæ*, which were kept as public feafts by the whole city, upon certain immoveable days appointed in their kalendar: fuch were the *Compitalia, Carmentalia, Lupercalia, &c.* 2. *Feriæ Conceptivæ*, which were moveable feafts, the days for the celebration of which were fixed by the magiftrates or priefts; of this fort were the *Feriæ Latinæ, Paganalia, Compitalia*, &c. which happened every year, but the days for keeping them were left to the difcretion of the magiftrates or priefts. 3. *Feriæ Imperativæ*, which were fixed and inftituted by the mere command of confuls, prætors, dictators, upon the gaining of fome victory or other fortunate event. 4. *Nundinæ*. See the articles NUNDINÆ, AGONALIA, CARMENTALIA, &c. The *private* feriæ were holidays obferved by particular perfons or families on feveral accounts, as birth-days, funerals, &c. The feriæ belonged to, and were one divifion of, the *dies fefti*. See FESTI.

FERIÆ *Latinæ*, a feftival at which a white bull was facrificed, and the Latin and Roman towns provided each a fet quantity of meat, wine, and fruits; and, during the celebration, the Romans and Latins fwore eternal friendfhip to each other, taking home a piece of the victim to every town. The feftival was inftituted by Tarquinius Superbus when he overcame the Tufcans and made a league with the Latins, propofing to build a common temple to Jupiter Latialis, at which both nations might meet and offer facrifices for their common fafety. At firft the folemnity lafted but one day, but it was at different times extended to ten. It was held on the Alban mount, and celebrated with chariot races at the capitol, where the victor was treated with a large draught of wormwood drink.

FERIA, in the Romifh breviary, is applied to the feveral days of the week; thus, Monday is the *feria fecunda*, Tuefday the *feria tertia*; though thefe days are not working days, but holidays. The occafion of this was, that the firft Chriftians

were ufed to keep the eafter-week holy, calling Sunday the *prima feria*, &c. whenee the term *feria* was given to the days of every week. But befides thefe, they have extraordinary feriæ, viz. the three laft days of paffion-week, the two following eafter-day, and the fecond feriæ of rogation.

FERIANA, the ancient city of Thala in Africa, taken and deftroyed by Metellus in the war with Jugurtha. It was vifited by Mr. Bruce in his late travels through Africa, who expected to have found many magnificent ruins in the place, but was difappointed. The only remarkable objects he met with were the baths, which are exceffively warm. Thefe are without the town, and flow from a fountain named *El Tarmid*. Notwithftanding the exceffive heat of its water, the fountain is not deftitute of fifhes. They are of the fhape of a gudgeon, above four inches in length; and he fuppofed that there might have been about five or fix dozen of them in the pool. On trying the water with a thermometer, he found the heat fo great, that he was furprifed the fifh were not boiled in it. That fifh fhould exift in this degree of heat is very furprifing; but it feems no lefs wonderful that Mr. Bruce, while ftanding naked in fuch water, fhould leifurely make obfervations on its heat, without fufpecting that he himfelf would be boiled by continuing there. We have to regret, that the accidental wetting of the leaf on which he wrote down his remarks has deprived the public of the knowledge of the precife degree to which the thermometer is raifed by this water. The fifh are faid to go down the ftream to fome diftance during the day, and to return to the fpring or warmeft part at night.

FERMANAGH, a county in Ireland, in the province of Ulfter, 38 miles in length, and 23 in breadth, bounded on the N. by Donegal and Tyrone, on the E. by Tyrone and Monaghan, on the S. by Cavan and Leitrim, and on the W. by Leitrim and the ocean. It contains 19 parifhes, and fends four members to parliament. Innifkilling is the capital.

FERMENT, any body which being applied to another produces fermentation.

Ferments are either matters already in the act of fermentation, or that foon run into this act. Of the firft kind are the flowers of wine, yeaft, fermenting beer, or fermenting wine, &c.; and of the fecond are the new expreffed vegetable juices of fummer fruit.

Among diftillers, ferments are all thofe bodies which, when added to the liquor, only correct fome fault therein, and, by removing fome obftacle to fermentation, forward it by fecondary means: as alfo fuch as, being added in time of fermentation, make the liquor yield a larger proportion of fpirit, and give it a fine flavour.

FERMENTATION, may be defined a fenfible internal motion of the conftituent particles of a moift, fluid, mixed or compound body; by the continuance of which motion, thefe particles are gradually removed from their former fituation or combination, and again, after fome vifible feparation is made, joined together in a different order and arrangement, fo that a new compound is formed, having qualities very fenfibly different from thofe of the original fluid.

Fermentation, properly fo called, is confined to the vegetable and animal kingdoms; for the effervefcences between acids and alkalis, however much they may refemble the fermentation of vinous liquors, are neverthelefs exceedingly different. It is divided into three kinds; or rather, there are three different ftages of it, viz. the vinous, the acetous, and the putrefactive. Of the firft, vegetables alone are fufceptible; the flefh of young animals is in fome flight degree fufceptible of the fecond; but animal fubftances are particularly fufceptible of the third, which vegetables do not fo eafily fall into without previoufly undergoing the firft and fecond. The produce of the firft ftage is wine, or fome other vinous liquor; of the fecond, vinegar; and of the third, volatile alkali. See BREWING, VINEGAR, BARM, &c.

Fermentation is one of the moft obfcure proceffes in nature, and no attempt has been made to folve it with any degree of probability. All that we know with regard to it is, that the liquor, however clear and tranfparent at firft, no fooner begins to ferment, than it becomes turbid, depofits a fediment, emits a great quantity of fixed air, and throws up a fcum to the top, acquiring at the fame time fome degree of heat.

Thefe phenomena feem to point out fermentation as a procefs ultimately tending to the entire diffolution of the fermenting fubftance, and depending upon the action of the internal heat, ethereal fluid, or whatever elfe we pleafe to call it, which pervades, and makes an effential ingredient in, the compofition of all bodies. From fuch experiments as have been made upon this fubject, it appears, that whether fixed air is the bond of connection between the particles of terreftrial bodies or not, yet the emiffion of it from any fubftance is always attended with a diffolution of that fubftance. We cannot, however, in the prefent cafe, fay that the emiffion of the fixed air is the *caufe* of the fermentation. It is in fact otherwife. Fixed air hath no tendency to fly off from terreftrial fubftances with which it is united; on the contrary, it will very readily leave the atmofphere after it hath been united with it, to join itfelf to fuch terreftrial fubftances as are capable of abforbing it. The emiffion of it, therefore, muft depend upon the action of fome other fluid; moft probably the fire or heat, which is difperfed through all fubftanees in a latent ftate, and in the prefent cafe begins fenfibly to manifeft itfelf. But from what caufe the heat originally begins to operate in this manner, feems to be entirely unknown and inexplicable, except that it appears fomehow or other to depend on the air; for, if that is totally excluded, fermentation will not proceed.

Mr. Henry, in the Memoirs of the Literary and Philofophical Society of Manchefter, relates fome experiments, in which he produced fermentation not only in bread and wort, but in liquors which we fhould think quite incapable of it, viz. punch and whey. Having previoufly fufpected, from fome obfervations and experiments, that yeaft was only a quantity of fixed air involved and detained among the mucilaginous parts of the fermenting liquor, he attempted to prepare it in the following manner: Having boiled wheat-flour and water to the confiftence of a thin jelly, he put this vifcous fluid into the middle part of Dr. Nooth's machine for impregnating water with fixed air. The gas was abforbed in confiderable quantity; and next day the matter was in a ftate of fermentation. The third day it had acquired fo much of the appearance of yeaft, that an experiment was made on fome pafte for bread; and, after five or fix hours baking, it was found to have anfwered the purpofe tolerably well. Another experiment was made with wort; but here the artificial yeaft was not made ufe of. Inftead of this, part of the wort itfelf was put into Nooth's machine, and impregnated with fixed air, of which it imbibed a large quantity. On being poured into the remainder of the liquor, a brifk fermentation came on in 24 hours, "a ftrong head of yeaft began to collect on its furface, and on the third day it feemed fit for tunning." In profecuting the experiment, good bread was made with the yeaft taken off from the furface; beer was produced by keeping the fermented liquor; and good ardent fpirit was yielded by diftilling it. In another experiment, in which a fourth part of the wort was impregnated but not faturated with fixed air, the fermentation did not commence fo foon, though it is probable that it would alfo have taken place at laft without any farther addition. The experiment commenced about midnight; but in the morning there were no figns of fermentation. At five in the afternoon there was only a flight *mantling* on the furface. A bottle with a perforated

ſtopper and valve, containing an effervefcing mixture of chalk and vitriolic acid, was then let down to the bottom of the veſſel; the diſcharge of air from this mixture was going on rapidly at nine o'clock; while the liquor at the ſame time ſeemed to be in a ſtate of effervefcence. At 11 o'clock the bottle was withdrawn, as the fermentation was commenced beyond a doubt, the liquor having a pretty ſtrong head of yeaſt upon it. Next day the fermentation ſeemed to be on the decline, but was recovered by a ſecond immerſion of the mixture. When the vinous fermentation was finiſhed, the liquor, by being kept too long, was found converted into vinegar; ſo that, in the courſe of theſe experiments, ale, bread, yeaſt, ardent ſpirit, and vinegar, had all been produced by the introduction of fixed air alone.

We ſhould naturally be led to ſuppoſe from theſe experiments, that fixed air was the *cauſe* of fermentation, contrary to what has been already laid down. But in fact there is not any contradiction here to the poſition juſt mentioned; for the quantity of fixed air introduced into the liquor, on Mr. Henry's experiments, was too great for it to contain. Some part of the latent heat, by which the elaſticity of that fluid is produced, may likewiſe have been abſorbed, and diſpoſed the liquor to run into the fermenting ſtate ſooner than it would otherwiſe have done. Or, perhaps, when any fluid ſubſtance of the aqueous kind contains an extraordinary proportion of fixed air, it may be thus inclined to run into the fermentative proceſs, by ſome diſpoſition of the air itſelf to reaſſume its elaſtic ſtate. This ſeems probable, from Mr. Henry's experiments with Pyrmont water. Having made ſome punch with an artificial water of this kind, he put a pint of it into a quart bottle, and ſtopped it with a cork. On opening it three or four days after, he found that it creamed and mantled like the briſkeſt bottled cyder; ſo that it was taken for ſome delicious liquor hitherto unknown. This length of time he found was neceſſary to give the briſkneſs juſt mentioned to the fluid; for artificial Pyrmont water itſelf aſſumes a briſk and ſparkling appearance after being kept three or four days, though it has it not at firſt, unleſs a very great quantity of air be forced into it at its preparation. In like manner, a quantity of whey, impregnated with fixed air, was changed into a briſk and ſparkling vinous liquor, by keeping for ſome time in a bottle corked in a ſlight way.

On certain ſubſtances, however, both fluid and ſolid, fixed air hath a different effect. Thus, when mixed with alkaline ſalts, whether fixed or volatile, fluid or ſolid, it firſt neutraliſes, and renders them acid, without the leaſt tendency to fermentation, unleſs an acid be added. Then indeed a great effervefcence will enſue; but this, as we have already ſaid, is not a true fermentation. On calcareous earths its effect is ſomewhat ſingular: for theſe earths, when pure, are ſoluble in water; when joined with a certain proportion of fixed air, they become inſoluble; and with an over-proportion they become ſoluble again; but none of them ſhow any diſpoſition to fermentation, though kept ever ſo long in either ſtate. As water therefore contains a great quantity of latent heat which it readily parts with, the probability ſtill is, that a diſpoſition to unite with the ſolid part of fixed air exiſts in that element, rather than to remain combined with the water. It is likewiſe well known that all fermentable ſubſtances, ſuch as the juices of ripe fruits, ſugar, &c. contain much fixed air, and therefore fall ſpontaneouſly into fermentation when kept in a gentle warmth. This laſt circumſtance ſupplies a quantity of ſenſible heat, or elementary fire acting in its expanſive form, which the water more readily parts with, than that which acts upon its own particles in ſuch a manner as to keep them eaſily moveable upon one another, and thus occaſion its fluidity. Other ſubſtances contain leſs fixed air, as infuſion of malt, potatoes, turnips, &c. whence it is neceſſary to add an extraordinary quantity to them, either enveloped in mucilaginous matter which is analogous to yeaſt, or pure, after the mode that Mr. Henry adopted.

Hence it ſhould ſeem, that fermentation conſiſts in the action of elementary fire expanding the fixed air naturally contained in the fluid, or artificially introduced into it; in conſequence of which certain changes are produced in the nature of the fluid itſelf; and it becomes a vinous, acetous, or putrid liquor, according to the degree of action which takes place. This ſeems to coincide with the opinion of Dr. Penington of Philadelphia, who, in his inaugural diſſertation on this ſubject, makes a change of the ſenſible qualities of the ſubſtance the only criterion of fermentation. Hence he denies that any true fermentation exiſts in the raiſing of bread, as is commonly ſuppoſed; and indeed his arguments on this ſubject ſeem deciſive. To aſcertain this, he put into a retort ſome dough which had been raiſed in three quarters of an hour; and, on applying a gentle heat, ſome aqueous liquid came over, which did not ſhow the leaſt veſtige of vinous ſpirit, though the remainder of the ſame dough afforded a good and well-fermented bread. On adding a little water to the dough which remained in the retort, and letting the mixture ſtand in a gentle warmth for nine hours, no ſign of fermentation appeared; but in 16 hours the proceſs ſeemed to have been going on for ſome time; and on diſtillation yielded a ſmall quantity of vinous ſpirit. Hence it appears that flour requires more than nine hours before it ferments; but as bread frequently riſes in one hour, the proceſſes muſt ſomehow or other be eſſentially different. "From a variety of facts (ſays our author), I am induced to give the following explanation of the proceſs (making of bread). Yeaſt is a fluid containing a large quantity of fixed air or aerial acid; and the proportion is greater as the fluid is colder. As ſoon as the yeaſt is mixed with the dough, heat is applied; this extricates the air in an elaſtic ſtate; and as it is now diffuſed through every particle of dough, every particle muſt be raiſed; the viſcidity of the maſs retains it: it is now baked, and a ſtill greater quantity of air is extricated by the increaſed heat; and as the cruſt forms, the air is prevented from eſcaping; the water is diſſipated: the loaf is rendered ſomewhat dry and ſolid; and between every particle of bread we find a particle of air, as appears from the ſpongy appearance of the bread, owing to the apparent vacancies which the air had made by inſinuating itſelf into it." This explanation he finds alſo confirmed by what is called the *falling* of bread after it has once been raiſed; and which takes place ſo rapidly, that we cannot ſuppoſe the proceſs of fermentation to have been finiſhed in the time: nay, bread will fall before we are warranted from his experiment to ſay that the fermentation is well begun; for this, as we have ſeen, required from 9 to 16 hours for its accompliſhment.

The fact that bread is raiſed, not by fermentation but a mere *effervefcence* or eſcape of fixed air, is likewiſe evident from ſeveral facts mentioned by Dr. Penington. In Philadelphia, the bakers find ſome difficulty in getting good yeaſt in the ſummer time, on account of the heat of the weather, which very ſoon turns it ſour. In this caſe, they diſſolve a ſmall quantity of potaſh in water, and mix it with their yeaſt; when the effervefcence produced between the acid and alkali produces ſuch a diſcharge of fixed air, as raiſes the bread in leſs than ten minutes. He informs us alſo, on the authority of Dr. Ruſh, that "near Saratoga there are two mineral ſprings, the waters of which have all the properties of the famous Pyrmont water, being highly impregnated with fixed air. When this water is mixed with flour into dough, it is ſufficient, without yeaſt, to make a very light and palatable bread." A third fact is ſtill more deciſive. "I procured (ſays the Doctor) ſome nice cryſtals of the ſalt formed by the foſſile alkali and fixed air, and diſſolved them in water ſufficient to make a ſmall loaf of bread.

To this I added a little of the marine acid, commonly called ſpirit of ſea-ſalt; fixed air was generated, but was abſorbed by the cold-water; it was then mixed with flour, ſet in a warm place to riſe, and ſhortly after baked; and I had the exquiſite pleaſure to obtain a tolerably light loaf of bread, ſuch as any one would have ſuppoſed to have been fermented, which was ſeaſoned by the ſea-ſalt, formed by the union of the foſſile alkali and ſpirit of ſea-ſalt; whilſt the fixed air of the foſſile alkali was diſengaged, in order to raiſe it."

But to theſe facts adduced by our author we may add two others, which tend to ſhow that fixed air is not even neceſſary to the raiſing of bread; and of conſequence we cannot ſuppoſe that fermentation, which produces a great quantity of it, is the foundation of the proceſs. One is, that eggs, when beaten into a froth, are ſometimes made uſe of for raiſing bread; but more eſpecially for puddings, &c. in which they perform an operation ſimilar to that of raiſing and rendering bread light and ſpongy. This is done by the rarefaction of the particles of air enveloped among the glutinous particles of the egg: and hence ſnow, on account of its porous and ſpongy nature, containing a great quantity of air enveloped amongſt its particles, will do the ſame thing. This laſt particular Dr. Rotheram of Newcaſtle has mentioned in his late publications.

The remaining experiments of Mr. Henry ſeem to Dr. Penington not to be altogether unobjectionable. He doubts the juſtice of Mr. Henry's idea, " that *wort* cannot be brought into the vinous fermentation without the addition of a ferment." When we conſider the analogy betwixt the infuſion of malt and other fermentable liquids, the Doctor ſuppoſes that wort, as well as they, might ſpontaneouſly fall into a ſtate of fermentation. He ſays, indeed, that he has not as yet been able to diſprove the idea by experiment: but Captain Cook has already made the experiment, and the event has decided the matter in the Doctor's favour. We are told by that celebrated navigator, that the inſpiſſated wort would have anſwered the purpoſe excellently, provided it could have been kept from fermentation in its inſpiſſated ſtate. But this was found impoſſible: of conſequence we muſt conclude, that wort, as well as other liquors, will fall into a ſtate of fermentation ſpontaneouſly, though perhaps not ſo readily, or with ſuch a ſmall degree of heat, as other fermentable liquors. Hence we are not altogether certain, as Dr. Penington hints, whether the fermentation in Mr. Henry's experiments might not have taken place without it. " In the memoir (Mr. Henry's) above mentioned, ſays the Doctor, the author ſeems to think, that *fixed air* is the true cauſe of fermentation in vinous liquors; and he tells us of the excellent taſte afforded to punch by being impregnated with it. Fixed air, it is well known, improves the *taſte* of liquors; but we cannot ſuſpect that it made the punch ferment in his experiment: but he tells us, that he made an artificial yeaſt; that with this yeaſt he made beer (perhaps he might have made it without it) and vinegar; and that he fermented bread with it. As for its fermenting bread, we might readily allow that it would raiſe bread, upon the principles already laid down: and when he tells us how quick the fermentation takes place in his liquors when expoſed to a gentle heat, may we not juſtly ſuppoſe, that the warmth extricated the fixed air that he had artificially combined with it, and that from this phenomenon alone he had ſuppoſed fermentation to be going on in them? Fixed air is the cauſe of the briſkneſs, pungent taſte, and ſparkling appearance, of vinous liquors; and it is remarkable, that, in equal circumſtances, the colder they are, the more air they contain. It is alſo a curious fact, that the fixed air in liquors muſt be in a peculiar ſtate, otherwiſe they do not poſſeſs that briſkneſs or pungency we ſpoke of; in fact, it muſt be on the point of aſſuming its elaſtic form: hence liquors are not ſo briſk in cold as in warm weather; and a connoiſſeur in porter, for inſtance, will tell you, that a bottle ſhall open very briſkly in a warm day; and upon the coming on of cold weather, all the reſt ſhall be flat and dead; but let them be corked up and kept in a warm room for a few days, they will all recover their former briſkneſs; nay, I have ſeen a bottle opened in a cold day, that has been quite vapid, which was made briſk and lively by corking it up tight again, and ſetting it for ten or twelve minutes in a baſon of water a little more than milk warm."

Dr. Penington's theory of fermentation is to the following purpoſe: 1. The heat occurring in the mixture, he explains on Dr. Black's principle of latent heat. 2. In the fermenting proceſs, he ſuppoſes the inflammable part of the mixture to have a tendency to combine with pure air, and thus to form what is called *fixed air*. 3. The pure air is ſuppoſed to be derived from the atmoſphere, while inflammable air is furniſhed by the fermenting liquor. 4. The fixed air, found in ſuch plenty above the liquid while in a ſtate of fermentation, does not exiſt in it originally, but is formed by a combination of the two ingredients juſt mentioned. 5. On theſe principles, the heat which takes place in the mixture may be particularly explained in the following manner: " Suppoſe that the quantity of heat in the two airs before combination was in each as *ten*; or, in other words, that they were capable of containing that quantity in a latent ſtate eſſential to their exiſtence as matter in that form; when they unite, they form a very different kind of air, which is not capable of combining with ſo much heat, and perhaps quite foreign to its exiſtence as that kind of matter: we will ſuppoſe then, that it can combine with but a quantity of that heat as *five*; the conſequence muſt then be, that there is a quantity of redundant heat as *fifteen*; and there being no bodies at hand undergoing any changes in their properties, by which their capacities to unite with heat as a principle are increaſed, it becomes *mechanically diffuſed* among thoſe bodies which are neareſt to it; it gives the redundant heat to the hand," &c.

The proceſs of fermentation is one of the great preparatives of the diſtillery. This, however, in the hands of the diſtiller, differs from the fermentation uſed in the making of potable vinous liquors, as being much more violent and active. A large quantity of yeaſt is added; the free air is admitted, and every thing is contrived to quicken the operation, ſo that it is ſometimes finiſhed in two or three days. Yet this great diſpatch, however neceſſary to the large dealer, has its inconveniences; for the ſpirit is by this means always fouler and more groſs, than if the liquor has undergone fermentation in a ſlower manner. It alſo ſuffers a diminution in quantity; eſpecially if the liquor be not immediately committed to the ſtill as ſoon as the fermentation is fairly completed. It is indeed a very difficult taſk to render the buſineſs of fermentation perfect and advantageous. To ferment in perfection neceſſarily requires length of time, careful attendance, cloſe veſſels, and nice management, which cannot be expected when practiſed in the large way, on account of the trouble and expence; unleſs it could be proved to the diſtillers, as poſſibly it ſome time may, that the quantity of ſpirit would be ſo much greater from the ſame quantity of materials ſo managed. They would poſſeſs at leaſt the great advantage, of the ſpirit, thus procured by perfect fermentation, being much finer than if obtained in the common way. Till this, however, ſhall be made out, it may not be amiſs to ſee how far the more perfect art of vinous fermentation is practicable by the diſtiller in the preſent circumſtances of things. The improvements to be made in this will principally regard, 1. The preparation or previous diſpoſition of the fermentable liquor. 2. The additions tending to the general or ſome particular end. 3. The ad-

miſſion or excluſion of the air. 4. The regulation of the external heat or cold. 5. A ſuitable degree of reſt at laſt. When proper regard is had to theſe particulars, the liquor will have its due fermentation, and thence yield a pure and copious inflammable ſpirit by diſtillation. The liquor intended for fermentation, for the ſtill, ſhould be rather thin and aqueous. That ſort of richneſs there is in the fourteen ſhilling ſmall beer is the utmoſt that ought to be allowed to it. This property not only fits it to ferment readily, but alſo to yield a larger proportion of ſpirit than it would do if more rich or clammy. It will alſo ſooner become fine by ſtanding before fermentation; whence it may be commodiouſly drawn off from its dregs, which muſt always, in caſe of corn, malt, or any other mealy ſubſtance, be kept out, where the purity of the ſpirit is conſulted. A certain degree of warmth ſeems neceſſary in all the northern climates, to all ſorts of artificial liquors intended for immediate fermentation, eſpecially in winter; but the natural juices of vegetables, which have never been inſpiſſated, as that of grapes and other fruits when fully ripened, will uſually ferment, as ſoon as they are expreſſed, without any external aſſiſtance. But as a certain degree of inſpiſſation prevents the tendency to fermentation in all vegetable juices, though otherwiſe ſtrongly diſpoſed to ferment: ſo a long continuance, or an increaſe of the inſpiſſating heat, eſpecially if it acts immediately through a metalline or ſolid body upon the juice, will deſtroy its fermenting property; and it will do this the more effectually, as the heat employed approaches to that of ſcorching, or the degree capable of giving an empyreuma. After the ſame manner, ſeveral experiments make it appear that there is a certain degree of heat, the continuance or leaſt increaſe of which proves detrimental or deſtructive to fermentation, as there is another which in a wonderful manner encourages and promotes it. Theſe two degrees of heat ought to be carefully noted and ſettled by the thermometer.

The juices of plants are ſtrangely altered by fermentation; and are ſuſceptible of many, and thoſe very various, changes from it. And it is not only the juices of fruits that are thus to be wrought upon, as thoſe of apples, pears, grapes, and the like, in the common way; but there is an artificial change to be made in the ſeeds of plants by what is called MALTING. Neither is it grain alone that is thus to be wrought upon, but any other ſeed whatever may be made to yield its juices and virtues freely to water by this proceſs. The juices of roots alſo, for inſtance that of liquorice, will be wrought upon in the ſame manner; and the juices of the bodies of trees, as of the birch, and the like. If in the month of March a hole be bored into the body of a birch-tree, and this hole be ſtopped with a cork, through the middle of which there is thruſt a quill open at both ends, the juices of the tree will drop out of the quill at the rate of a large drop every ſecond of a minute, and a great quantity will in time be obtained in this manner. This liquor is not unpleaſant to the taſte, and looks tolerably clear, reſembling water into which a little milk had been ſpilt. There are many ways of fermenting this juice, by all of which it is converted into a ſort of wine. Theſe are well known. But there is another remarkable property in our maples, both the common ſmall kind and the great one, which we call the ſycamore: theſe being tapped in the ſame manner, will bleed freely in winter; and their juices, after a hard froſt breaks, will flow out in ſo copious a manner as is ſcarce to be conceived. The willow, the poplar, and the walnut-tree, will all bleed alſo; and fermentation, of which their ſeveral juices are eaſily ſuſceptible, will turn them all into palatable and ſtrong wines.

FERN, FILIX, in botany. See FILICES. Fern is very common in dry and barren places. It is one of the worſt weeds for lands, and very hard to deſtroy where it has any thing of a deep ſoil to root in. In ſome grounds, the roots of it are found to the depth of eight feet. One of the moſt effectual ways to deſtroy it is by often mowing the graſs; and, if the field is ploughed up, plentiful dunging likewiſe is very good: but the moſt certain remedy for it is urine. However, fern, cut while the ſap is in it, and left to rot upon the ground, is a very great improver of land. In ſome parts of the north, the inhabitants mow it green; and, burning it to aſhes, make thoſe aſhes up into balls with a little water. They then dry them in the ſun, and make uſe of them to clean their linen with; looking upon it to be near as good as ſoap for that purpoſe.

Male FERN. See POLYPODIUM.

Female FERN. See PTERIS.

FERNANDO, or FERNANDES, an iſland in the Pacific ocean. See JUAN *Fernandes.*

FERONIA, the pagan goddeſs of woods and orchards. This deity took her name from the town Feronia, ſituated at the foot of mount Soracte in Italy, where were a wood and temple conſecrated to her. That town and wood are mentioned by Virgil, in the catalogue of Turnus's forces. Strabo relates, that thoſe who ſacrificed to this goddeſs walked barefoot upon burning coals, without being hurt. She was the guardian deity of freed-men, who received their cap of liberty in her temple.

FERRARA, a large, handſome, and famous town of Italy, capital of a duchy of the ſame name, with a biſhop's ſee. Its magnificent ſtreets, and number of fine buildings, evince that it was formerly a rich and flouriſhing city. The preſent inhabitants, however, who are very few in proportion to the extent of the town, bear every mark of poverty. But they ſtill retain an old privilege of wearing ſwords by their ſide; a privilege extended to the loweſt mechanics, who ſtrut about with great dignity. Fencing is the only ſcience in a flouriſhing condition in this town, which furniſhes all Italy with ſkilful fencing-maſters. It was famous formerly for a manufactory of ſword-blades. The Scotch Highlanders, who had a greater demand for ſwords, and were nicer in their choice of blades than any other people, uſed to get them from a celebrated maker of this town, of the name of Andrea di Ferrara; and the beſt kind of broad ſwords are ſtill called by the Highlanders, "True Andrew Ferraras." In the Benedictine church, Arioſto the poet is interred. Ferrara is ſeated on the river Po, 25 miles N. E. of Bologna. Lon. 11. 41. E. lat. 44. 54. N.

FERRARA, or the FERRARESE, a province of Italy, in the territory of the Church; bounded on the N. by the Poleſino di Rovigno, on the W. by the duchy of Mantua, on the S. by the Bologneſe and Romagna, and on the E. by the gulf of Venice. It had its own dukes till 1597, when pope Clement VIII united it to the apoſtolic chamber. Since that time it has been almoſt all uncultivated, though it was one of the fineſt countries in Italy. The air is unwholeſome, on account of the marſhes, and the inhabitants are too few to drain them. Ferrara is the capital.

FERRARIA, in botany; a genus of the triandria order, belonging to the gynandria claſs of plants; and in the natural method ranking under the ſixth order, *Enſatæ.* The ſpathæ are uniflorous; the petals ſix in number, and wavingly curled; the ſtigmata, cucullated or cowled; the capſule is trilocular, inferior. There are two ſpecies, natives of the Cape of Good Hope. There is a great ſingularity in the root of one of theſe ſpecies, that it vegetates only every other year, and ſometimes every third year; in the intermediate time it remains inactive, though very ſound and good.

FERRARS (George), a lawyer, poet, hiſtorian, and accompliſhed gentleman, was deſcended from an ancient family in Hertfordſhire, and born about the year 1510, in a village near St. Alban's. He was educated at Oxford, and thence removed to Lincoln's inn; where applying with uncommon diligence to

the ſtudy of the law, he was ſoon diſtinguiſhed for his elocution at the bar. Cromwell earl of Eſſex, the great miniſter of Henry VIII, introduced him to the king, who employed him as his menial ſervant, and in 1535 gave him a grant of the manor of Flamſtead in his native county. This is ſuppoſed to have been a profitable eſtate; nevertheleſs, Mr. Ferrars being a gay courtier, and probably an expenſive man, about ſeven years after was taken in execution by a ſheriff's officer for a debt of 200 merks, and lodged in the compter. Being at this time member for Plymouth, the houſe of commons immediately interfered, and he ſoon obtained his liberty. He continued in favour with the king to the end of his reign; and in that of Edward VI he attended the lord protector Somerſet, as a commiſſioner of the army, in his expedition to Scotland in 1548. In the ſame reign, the young king being then at Greenwich, Mr. Ferrars was proclaimed *lord of miſrule*, that is, prince of ſports and paſtimes; which office he diſcharged during 12 days, in Chriſtmas holidays, to the entire ſatisfaction of the court. This is all we know of Mr. Ferrars; except that he died in 1579 at Flamſtead in Hertfordſhire, and was buried in the pariſh-church. He was not leſs celebrated for his valour in the field, than for his other accompliſhments as a gentleman and a ſcholar. He wrote, 1. Hiſtory of the Reign of Queen Mary; publiſhed in Grafton's chronicle, 1569, fol. 2. Six tragedies, or dramatic poems; publiſhed in a book called the *Mirror for Magiſtrates*, firſt printed in 1559, afterwards in 1587, and again in 1610.

Ferrars (Henry), a Warwickſhire gentleman of a good family, was eminent in antiquities, genealogics, and heraldry. Mr. Wood ſays, that out of the collections of this gentleman Sir William Dugdale laid part of the foundation of his celebrated *Antiquities of Warwickſhire*. Cambden alſo makes honourable mention of his aſſiſtance in relation to Coventry. Some ſcattered poems of his were publiſhed, among others, in the reign of queen Elizabeth; and he died in 1633.

FERRET, in zoology. See Mustela.

Ferret, among glaſs-makers, the iron with which the workmen try the melted metal, to ſee if it be fit to work. The term is alſo uſed for thoſe irons which make the rings at the mouth of a bottle.

FERRETTO, in glaſs making, a ſubſtance which ſerves to colour glaſs. This is made by a ſimple calcination of copper, but it ſerves for ſeveral colours: there are two ways of making it. The firſt is this: Take thin plates of copper, and lay them on a layer of powdered brimſtone, in the bottom of a crucible; over theſe lay more brimſtone, and over that another layer of the plates, and ſo on alternately till the pot is full. Cover the pot, lute it well, place it in a wind-furnace, and make a ſtrong fire about it for two hours. When it is taken out and cooled, the copper will be found ſo calcined, that it may be crumbled to pieces between the fingers like a friable earth. It will be of a reddiſh, and, in ſome parts, of a blackiſh colour. This muſt be powdered and ſifted fine for uſe. Another way of making ferretto is as follows: Make a number of ſtratifications of plates of copper and white vitriol alternately in a crucible; which place on the floor of the glaſs furnace near the eye; and let it ſtand there three days; then take it out, and make a new ſtratification with more freſh vitriol; calcine again as before. Repeat this operation ſix times; and a moſt valuable ferretto will be obtained.

FERRI (Ciro), a ſkilful painter, born of a good family at Rome, in 1634. He was bred under Peter Cortona; and the works of the ſcholar are often miſtaken for thoſe of the maſter. The great duke of Tuſcany nominated him chief of the Florentine ſchool; and he was as good an architect as a painter. He died in 1689.

FERRO, or Hiero, one of the Canary Iſles, remarkable for this circumſtance, that ſeveral geographers have reckoned their firſt meridian from its weſternmoſt extremity. It is a dry and barren ſpot, affording no water except what is ſupplied, in a ſurpriſing manner, by the fountain-tree, which grows in this iſland, and diſtils water from its leaves, in ſuch plenty as to anſwer all the purpoſes of its inhabitants. This tree (according to the author of the Hiſtory of the Canary Iſlands, who has given an ample deſcription of it) is not peculiar to this iſland, as one of the ſame kind is ſaid to be in the iſland of St. Thomas in the gulf of Guinea. Lon. 17. 46. W. Lat. 27. 47. N.

Ferro, Faro, Farro, or Feroe Islands, a cluſter of ſmall iſlands in the Northern Ocean, between 5° and 8° W. lon. and 61° and 63° N. lat. They are ſubject to Denmark. There are 17 which are habitable, each of which is a lofty mountain riſing out of the waves, divided from the others by deep and rapid currents. Some of them are deeply indented with ſecure harbours, all of them ſteep, and moſt of them faced with tremendous precipices. The ſurface conſiſts of a ſhallow ſoil of remarkable fertility; for barley, the only corn grown here, yields above 20 for one; and the graſs affords abundant paſturage for ſheep. The exports are ſalted mutton, tallow, gooſe-quills, feathers, eider-down, knit woollen waiſtcoats, caps, and ſtockings. No trees above the ſize of a juniper, or ſtunted willow, will grow here; nor are any quadrupeds to be ſeen except the ſheep, and rats and mice, originally eſcaped from ſhips. Vaſt quantities of ſea-fowls frequent the rocks, and the taking of them furniſhes a perilous employment for the inhabitants. Sometimes a dreadful whirlwind agitates the ſea to a great degree, catches up a vaſt quantity of water, ſo as to leave a great temporary chaſm on the ſpot on which it falls, and carries away with it, to an amazing diſtance, any fiſh within reach of its fury. Thus, great ſhoals of herrings have been found here on the higheſt mountains.

FERROL, a town of Spain, in Galicia, with a famous harbour, not only one of the beſt in Spain, but even of all Europe; for here the veſſels lie ſafe from all winds, and here the Spaniſh ſquadrons frequently rendezvous in time of war. It is ſeated on a bay of the Atlantic, 20 miles N. E. of the Groyne. Lon. 8. 4. W. Lat. 43. 30. N.

FERRUGO, rust. See Rust.

FERRUM, iron. See Iron.

FERRY, a liberty by preſcription, or by the king's grant, to have a boat for paſſage, on a frith or river, for carrying paſſengers, horſes, &c. over the ſame for a reaſonable toll.

FERTILITY, that quality which denominates a thing fruitful or prolific. Nothing can produce fertility in the human ſpecies, but what promotes perfect health. To increaſe the fertility of *vegetables*, ſays lord Bacon, we muſt not only increaſe the vigour of the earth and of the plant, but alſo preſerve what would otherwiſe be loſt: whence he infers, that much may be ſaved by ſetting, in compariſon of ſowing. Evelyn's Sylva, the Philoſophical Tranſactions, the French Memoirs, and the works of our modern agriculturiſts may be conſulted on this ſubject.

FERULA, a little wooden pallet or ſlice, reputed the ſchoolmaſter's ſceptre, wherewith he chaſtiſes the boys, by ſtriking them on the palm of the hand. The word is Latin, and has alſo been uſed to denote the prelate's croſier and ſtaff. It is ſuppoſed to be formed of the Latin *ferire* "to ſtrike." Under the eaſtern empire, the ferula was the emperor's ſceptre, as is ſeen on divers medals; it conſiſts of a long ſtem or ſhank, and a flat ſquare head. The uſe of the ferula is very ancient among the Greeks, who uſed to call their princes ναρθηκοφοροι, q. d. "ferula-bearers." In the ancient eaſtern church, ferula or *narthex* ſignified a place ſeparated from the church; wherein the penitents or the catechumens of the ſecond order, called *auſcultantes*, ακροαματικοι, were kept, as not being allowed to

enter the church; whence the name of the place, the perfons therein being under penance or difcipline: *fub* ferula *erant ecclefiæ*.

Ferula, *Fennel-giant*, in botany; a genus of the digynia order, belonging to the pentandria clafs of plants; and in the natural method ranking under the 45th order, *Umbellatæ*. The fruit is oval, compreffed plane, with three ftriæ on each fide. There are nine fpecies; all of them herbaceous perennials, rifing from three to ten or twelve feet high, with yellow flowers. They are propagated by feeds, which fhould be fown in autumn; and, when planted out, ought to be four or five feet diftant from each other, or from any other plants; for no other will thrive under their fhade. The drug affafetida is obtained from a fpecies of ferula, though not peculiarly; being alfo produced by fome other plants.

FESCENNINE verses, in antiquity, were a kind of fatirical verfes, full of wanton and obfcene expreffions, fung or rehearfed by the company, with many indecent geftures and dances, at the folemnization of a marriage among the Romans. *Hor.* ep. i. lib. v. 145. The word is borrowed, according to Macrobius, from *fafcinum*, "a charm;" the people taking fuch fongs to be proper to drive away witches, or prevent their effect; but its more probable origin is from Fefcennium, a city of Campania, where fuch verfes were firft ufed.

FESSE, in heraldry, one of the nine honourable ordinaries. See Heraldry.

Fesse-*Point*, is the exact centre of the efcutcheon. See Point.

Fesse-*Ways*, or *in* Fesse, denotes any thing borne after the manner of a feffe; that is, in a rank acrofs the middle of the fhield.

Party per Fesse, implies a parting acrofs the middle of the fhield, from fide to fide, through the feffe point.

FESTI dies, in Roman antiquity, certain days in the year devoted to the honour of the gods. Numa, when he diftributed the year into 12 months, divided the fame into the *dies fefti*, *dies profefti*, and *dies intercifi*. The fefti were again divided into days of facrifice, banquets, games, and feriæ. See Feriæ. The *profefti* were thofe days allowed to men for the adminiftration of their affairs, whether of a public or private nature: thefe were divided into fafti, comitiales, &c. See Fasti, Comitiales, &c. The *intercifi* were days common both to gods and men, fome parts of which were allotted to the fervice of the one, and fome to that of the other.

FESTINO, in logic, the third mood of the fecond figure of the fyllogifm, the firft propofition whereof is an univerfal negative, the fecond a particular affirmative, and the third a particular negative; as in the following example:

FES No bad man can be happy.
TI Some rich men are bad men.
NO *Ergo*, fome rich men are not happy.

FESTIVAL, a time of feafting. See Feast. The term is particularly applied to anniverfary days of civil or religious exultation.

FESTOON, in architecture and fculpture, &c. an ornament in form of a garland of flowers, fruits, and leaves, intermixed or twifted together. It is in the form of a ftring or collar, much the wideft in the middle, where it falls down in an arch; being extended by the two ends, the extremities of which hang down perpendicularly. Feftoons are now chiefly ufed in friezes, and other vacant places which want to be filled up and adorned; being done in imitation of the long clufters of flowers, which the ancients placed on the doors of their temples and houfes on feftival occafions.

FESTUCA, fescue, in botany; a genus of the digynia order, belonging to the triandria clafs of plants; and in the natural method ranking under the 34th order, *Gramina*. The calyx is bivalved; and the fpicula or partial fpike is oblong and a little roundifh, with the glumes acuminated. There are 16 fpecies; two of which, as being the moft remarkably ufeful, are defcribed under the articles Grass and Agriculture. Another fpecies, called the *fluitans*, or *floating fefcue*, from its growing in wet ditches and ponds, is remarkable for the ufes that are made of its feeds. Thefe feeds are fmall, but very fweet and nourifhing. They are collected in feveral parts of Germany and Poland, under the name of *manna feeds*; and are ufed at the tables of the great, in foups and gruels, on account of their nutritious quality and grateful flavour. When ground to meal, they make bread very little inferior to that in common ufe. The bran, feparated in preparing the meal, is given to horfes that have worms; but they muft be kept from water for fome hours afterwards. Geefe are alfo very fond of thefe feeds. Mr. Lightfoot recommends this as a proper grafs to be fown in wet meadows.

FESTUS (Pompeius), a celebrated grammarian of antiquity, who abridged a work of Verrius Flaccus, *De Significatione Verborum*; but took fuch liberties in caftration and criticifing, as, Gerard Voffius obferves, are not favourable to the reputation of his author. A complete edition of his fragments was publifhed by M. Dacier in 1681, for the ufe of the Dauphin. Scaliger fays, that Feftus is an author of great ufe to thofe who would attain the Latin tongue with accuracy.

FETLOCK, in the manege, a tuft of hair growing behind the paftern joint of many horfes; for thofe of a low fize have fcarce any fuch tuft.

FETTI (Domenico), an eminent painter in the ftyle of Julio Romano, was born at Rome in 1589, and educated under Ludovico Civoli of Florence. He painted but little for churches, but excelled in hiftory; his pictures are much fought after, and are fcarce. He abandoned himfelf to diforderly courfes; and put an end to his life, by exceffes, in the 35th year of his age.

FETUS. See Foetus.

FEUD, in our ancient cuftoms, is ufed for a capital quarrel or enmity, not to be fatisfied but with the death of the enemy; and thence ufually called *deadly feud*. *Feud*, called alfo *feida*, and *faida*, in the original German fignifies *guerram*, i. e. *bellum*, "war." Lambert writes it *feeth*, and faith it fignifies *capitales inimicitias*, or "implacable hatred." In Scotland and the north of England, feud is particularly ufed for a combination of kindred to revenge the death of any of their blood, againft the killer and all his race, or any other avowed enemy.

Feud, *Feoda*, the fame with *Fief*, or *Fee*. See Feodal *Syftem*.

FEUDATORY, or Feodatory, a tenant who formerly held his eftate by feodal fervice. See *Feodal* Tenure.

FEVER. See Medicine. The ancients deified the difeafes as well as the paffions and affections of men. Virgil places them in the entrance into hell. *Æn.* vi. 273. Among thefe, *Fever* had a temple on mount Palatine, and two other parts of ancient Rome; and there is ftill extant an infcription to this goddefs. FEBRI. DIVÆ. FEBRI. SANCTÆ. FEBRI. MAGNÆ. CAMILLA. AMATA. PRO. FILIO. MALE. AFFECTO.

Fever, in farriery. See Farriery, p. 414.

FEVERFEW, in botany. See Matricaria.

FEVERSHAM, a large town in Kent, feated on a creek of the Medway, and much frequented by fmall veffels. It is a member of the port of Dover, and is governed by a mayor, 12 aldermen, and 24 jurats. It has a market every Wednefday and Saturday; is famous for the beft oyfters for laying in ftews; and has feveral gun-powder mills in its neighbourhood. Here are the remains of a ftately abbey, built by king Stephen, who was interred in it with his queen and fon. Here that mifguided

prince James II attempted to embark for France, after the success of the prince of Orange, but was stopped by the populace, and conveyed back to London. Feversham is nine miles W. of Canterbury, and 48 E. by S. of London. Lon. 0. 55. E. Lat. 51. 22. N.

FEVILLEA, in botany; a genus of the pentandria order, belonging to the diœcia class of plants; and in the natural method ranking under the 34th order, *Cucurbitaceæ*. The male calyx is quinquefid; the corolla the same; there are five stamina; and the nectarium consists of five filaments connivent or closing together. The female calyx is quinquefid; the styles are three; and the fruit is an hard trilocular apple with an hard bark.

FEVRE (Tanegui le), of Caen in Normandy, born 1615, was an excellent scholar in the Greek and Roman learning. Cardinal de Richelieu gave him a pension of 2000 livres, to inspect all the works published at the Louvre, and designed to have made him principal of a college he was about to erect at Richelieu. But the cardinal's death cut off his hopes; and Cardinal Mazarine having no great relish for learning, his pension was ill paid. Some time after, the Marquis de Franciere, governor of Langres, took him along with him to his government, and there he embraced the Protestant religion: after which he was invited to Saumur, where he was chosen Greek professor. He there taught with extraordinary reputation. Young men were sent to him from all the provinces in the kingdom, and even from foreign countries, while divines and professors themselves gloried in attending his lectures. He was preparing to go to Heidelberg, whither he was invited by the prince Palatine, when he died, aged 57. He wrote, 1. Notes on Anacreon, Lucretius, Longinus, Phædrus, Justin, Terence, Virgil, Horace, &c. 2. A short account of the lives of the Greek poets. 3. Two volumes of letters; and many other works.

FEVRE (Claud le), an eminent French painter, was born at Fontainebleau in 1633, and studied in the palace there, and then at Paris under Le Sueur and Le Brun; the latter of whom advised him to adhere to portraits, for which he had a particular talent, and in his style equalled the best masters of that country. He died in England in 1675, aged 42.

FEZ, the capital of Fez, in Africa. It is an ancient, strong, and one of the largest and handsomest cities in all Africa, composed of three towns, called Beleyde, Old Fez, and New Fez. Old Fez is the most considerable, and contains about 80,000 inhabitants. The palaces are magnificent, and there are 700 mosques, 50 of which are very considerable, adorned with marble pillars, and other ornaments. The houses are built of brick or stone, and adorned with Mosaic work: those of brick are ornamented with glazing and colours, like Dutch tiles, and the wood-work and ceilings are carved, painted, and gilt. There is a court to every house, in which are square marble basons. The roofs are flat, and they sleep thereon in the summer. Here are two colleges for students, finely built of marble and adorned with paintings: one of those has 100 rooms, and the sides are adorned with marble pillars of various colours, whose capitals are gilt, and the roof glitters with gold, azure, and purple. Here are many hospitals, and above 100 public baths, many of which are stately structures. All the trades live in a separate part of the city, and the exchange full of all sorts of rich merchandise, is itself as large as a small town. The gardens are beautiful, and full of all kinds of fragrant flowers and shrubs, so that the city, in general, is a sort of terrestrial paradise. The inhabitants are clothed like the Turks, and the ladies dress very expensively in the winter; but in the summer, they wear nothing but a shift. It is the centre of the trade of this empire, and hence caravans go to Mecca, carrying with them ready-made garments, Cordovan leather, indigo, cochineal, and ostrich feathers, for which they bring in return silks, muslins, and drugs. Other caravans go to Tombuctoo, and the river Niger; one of which consists of 20,000 men. They travel over such dry barren deserts, that every other camel carries water. Their commodities are salt, cowries, wrought silk, British cloth, and the woollen manufactures of Barbary. Here are a great number of Jews, who have handsome synagogues; but the bulk of the inhabitants are Moors, of a tawny complexion: there are also a great number of blacks. It is 160 miles S. of Gibraltar, and 250 N. E. of Morocco. Lon. 5. 5. W. Lat. 33. 40. N.

FEZZAN, a country of Africa, whose small and circular domain, placed in the vast wilderness, as an island in the midst of the ocean, is bounded on the N. by Tripoli, on the E. by deserts that divide it from Egypt, on the S. by Bornou, and on the W. by the deserts of Zahara, lying between 25° and 30° N. lat. An extensive plain, encompassed by mountains, except to the W. composes this kingdom. To the influence of these heights it may be owing, that here, as well as in Upper Egypt, no rain is ever known. But though the character of the surface (which, in general, is a light sand), and the want of rain, may seem to announce an eternal sterility, yet the springs are so abundant, and there is such an ample store of subterranean water supplied by the neighbouring heights, that few of the regions in the N. of Africa exhibit a richer vegetation. From wells of 8 or 10 feet deep, with several of which every garden and every field is furnished, the husbandman waters, at sunrise, the natural or artificial productions of his land; among which are the date tree, the olive, lime, apricot, pomegranate, fig, Indian corn and barley, wheat, pompions or calabash, carrots, cucumbers, onions, and garlic. Among their tame animals are the sheep, cow, goat, camel, and a species of the domestic fowl of Europe. The wild animals are the ostrich, and antelopes of various kinds; one of which is called the huaddee, and is celebrated for the singular address with which, when chased by the hunters amid its craggy heights, it plunges from the precipice, and lighting on its hams, without danger of pursuit, continues till evening in the vale below. The heats of the summer, which continue from April to November, are so intense, that from nine in the morning to sunset the streets are frequented by the labouring people only; and, even in the houses, respiration would be difficult, if the expedient of wetting the rooms did not furnish its salutary aid. From May to the end of August, when the wind is usually from the E. the S.E. the S. or the S.W. the heat is often such as to threaten instant suffocation; but if it change, as for a few days it sometimes does, to the W. or N.W. a reviving freshness immediately succeeds. But nature and custom have formed their constitutions to such high degrees of heat, that any approach to the common temperament of Europe entirely destroys their comfort; for Mr. Lucas (the geographical missionary from the African Association) often observed, in his journey to Mesurata, that when the scorching heat of the meridian sun had compelled him to seek the shade, his fellow-travellers, especially if the wind were in the N. laid themselves down upon the sand, in the open sun, to receive a double portion of its warmth; and, when they inquired after his health, they almost always concluded with the expression, "Heack m'andick berd—We hope you are not cold." The diseases to which the inhabitants are most subject are those of the inflammatory and putrid kind. The small pox is common; violent headachs attack them in the summer; and they are afflicted with rheumatic pains. Their old women are the principal physicians. For headachs, they prescribe cupping and bleeding; for pains in the limbs, they send their patients to bathe in the hot lakes; and for obstinate achs and strains and long-continued stiffness in the muscles, they have recourse, like the horse-doctors of Europe, and the physicians of Barbary, to the application of a burning iron. The greater part of their diseases may be the consequence of the climate, which is cer-

tainly the caufe of the multitude of noxious animals that infeft the country. Adders, fnakes, fcorpions, and toads, are the conftant inhabitants of their fields, their gardens, and their houfes. The air is crowded with mofquitos; and perfons of every rank are over-run with all the different kinds of vermin that attack the beggars of Europe; and, though in the fummer the fleas entirely difappear, they are fcarcely fenfible of relief. The natives are of a deep, fwarthy complexion; inclining, in their perfons, more to the Negro than to the Arab caft; their hair a fhort curly black, their lips thick, their nofes flat and broad, and the fkin emitting a very fetid effluvia. They are tall, but not ftrong; well-fhaped, yet indolent and inactive. The towns are chiefly inhabited by hufbandmen and fhepherds; for, though they alfo contain the merchants, artificers, minifters of religion, and officers of government, yet agriculture and paf-turage are the principal occupations. The houfes are built of clay, with a flat roof compofed of boughs of trees, on which a quantity of earth is laid. Their drefs is fimilar to that of the Moors of Barbary. In their common intercourfe, all diftinctions of rank feem forgotten: the fhereef (or governor) and the loweft plebeian, the rich and the poor, the mafter and the fervant, converfe familiarly, and eat and drink together. Generous and hofpitable, let his fare be fcanty or abundant, the Fezzanner is defirous that others fhould partake of it; and if 20 perfons were unexpectedly to vifit his dwelling, they muft all participate as far as it will go. When they fettle their money tranfactions, they fquat upon the ground, and having levelled a fpot with their hands, make dots as they reckon: if they are wrong, they fmooth the fpot again, and repeat the calculation. Even the byftanders are as eager to correct miftakes as if the affair were their own. In religion, they are rigid but not intolerant Mahometans. The government is purely monarchical; but its powers are adminiftered with fuch paternal regard to the happinefs of the people, the rights of property are fo revered, the taxes fo moderate, and juftice is directed by fuch a firm yet temperate hand, that the people are ardently attached to their fovereign; a circumftance, to which, no doubt, his acknowledged defcent from the prophet has contributed. Gold duft con-ftitutes the chief medium of payment with the Fezzanners; and value, in that medium, is always expreffed by weight. Of the adminiftration of juftice, Mr. Lucas thus relates a remark-able circumftance: "If any man has injured another, and re-fufes to go with him to the judge, the complainant, drawing a circle round the oppreffor, folemnly charges him, in the king's name, not to leave the place till the officers of juftice, in fearch of whom he is going, fhall arrive; and fuch (if they are to be credited) is, on the one hand, his fear of the punifhment in-flicted on thofe who difobey the injunction; and fo great, on the other, is his dread of the perpetual banifhment, which, if he feeks his fafety by withdrawing from the kingdom, muft be his inevitable lot, that this imaginary prifon operates as a real confinement, and the offender fubmiffively waits the arrival of the officers." Mourzook is the capital of this country.

FIASCONE, an epifcopal town of Italy, in the territory of the church, on a mountain near Lake Bolfena, 12 miles N. W. of Viterbo. It is noted for fine mufcadine wine. Lon. 12. 13. E. Lat. 42. 34. N.

FIAT, in law, a fhort order or warrant, figned by a judge, for making out and allowing certain proceffes.

FIBRARIÆ, a clafs of foffils, naturally and effentially fim-ple, not inflammable nor foluble in water, and compofed of parallel fibres, fome fhorter, others longer; their external ap-pearance being bright, and in fome degree tranfparent: add to this, that they never give fire with fteel, nor ferment with or are foluble in acid menftrua.

FIBRE, in anatomy, a perfect fimple body, or at leaft as fimple as any thing in the human ftructure; being fine and flender like a thread, and ferving to form other parts. Hence fome fibres are hard, as the bony ones; and others foft, as thofe deftined for the formation of all the other parts. The fibres are divided alfo, according to their fituation, into fuch as are ftraight, oblique, tranfverfe, annular, and fpiral; being found arranged in all thefe directions in different parts of the body.

Fibre is alfo ufed to denote the flender filaments which com-pofe other bodies, whether animal, vegetable, or mineral; but more efpecially the capillary roots of plants.

FIBROSE, or Fibrous, fomething confifting of fibres, as the roots of plants. See Root.

FIBULA, in anatomy, the outer and flenderer of the two bones of the leg. See Anatomy, p. 168.

Fibula, in furgery, an inftrument in ufe among the ancients for the clofing of gaping wounds. Celfus fpeaks of the fibula as to be ufed when the wound was fo patent as not eafily to admit of being fewed.

Fibula, in antiquity, was a fort of button, buckle, or clafp, made ufe of by the Greeks and Romans, for keeping clofe or tying up fome part of their clothes. They were of various forms, and often adorned with precious ftones. Men and women wore them in their hair and at their fhoes. Players and muficians, by way of preferving the voices of children put under their care to learn their arts, ufed to keep clofe the prepuce with a fibula, left they fhould have commerce with women.

FICINUS (Marfilius), a celebrated Italian, was born at Flo-rence in 1433, and educated at the expence of Laurence de Medicis. He attained a perfect knowledge of the Greek and Latin tongues, and became a great philofopher, a great phy-fician, and a great divine. He was in the higheft favour with Laurence and Cofmo de Medicis, who made him a canon of the cathedral church of Florence. He applied himfelf intenfely to the ftudy of philofophy; and, while others were ftriving who fhould be the deepeft read in Ariftotle, who was then the philo-fopher in fafhion, he devoted himfelf wholly to Plato. He was indeed the firft who reftored the Platonic philofophy in the weft; for the better effecting of which, he tranflated into Latin the whole works of Plato. There goes a ftory, but we know not how true it is, that when he had finifhed his tranflation, he communicated it to his friend Marcus Mufurus, to have his ap-probation of it; but that Mufurus difliking it, he did it all over again. He next tranflated Plotinus; and afterwards the works, or part of them at leaft, of Proclus, Jamblicus, Porphyrius, and other celebrated Platonifts. In his younger years, Ficinus lived like a philofopher; and too much fo, as is faid, to the neglect of piety. However, Savanorola coming to Florence, Ficinus went with every body elfe to hear his fermons; and while he attended them for the fake of the preacher's eloquence, he imbibed a ftrong fenfe of religion, and devoted himfelf hence-forward more efpecially to the duties of it. He died at Cor-reggio in 1499; and, as Baronius affures us upon the teftimony of what he calls credible authors, appeared immediately after his death to his friend Michael Mercatus: to whom, it feems, he had promifed to appear, in order to confirm what he had taught concerning the immortality of the foul. His writings, facred and profane, which are very numerous, were collected and printed at Venice in 1516, at Bafil in 1561 and 1576, and at Paris 1641, in two vols. folio. Twelve books of his Epiftles, among which are many treatifes, were printed feparately in folio at Venice 1495, and at Nuremberg 1497, in 4to.

FICOIDES, a name given to feveral diftinct plants, as the mefembryanthemum, mufa, and opuntia. See Mesembry-anthemum, &c.

FICTION. See Fable and Poetry.

FICUS, the fig-tree. See Banian *Tree*.

FIDD, an iron pin ufed at fea to fplice or faften ropes toge-

ther; it is made tapering and ſharp at one end. There are alſo fidds of wood, which are much larger than the iron ones. The pin alſo in the heel of the topmaſt, which bears it upon the cheſs-tree, is called a *fidd*.

FIDD-*Hammer*, is uſed for a hammer, the handle of which is a fidd, or made tapering into that form.

FIDDLE. See VIOLIN.

FIDDLE-*Wood*. See CITHAREXELON.

FIDDES (Richard), a learned divine and polite writer, was born in 1671, and educated at Oxford. He was preſented to the living of Halſham in Yorkſhire, where he was ſo admired for the ſweetneſs of his voice and the gracefulneſs of his delivery, that the people for ſeveral miles round flocked to his ſermons. Coming to London in 1712, he was, by the favour of Dean Swift, introduced to the earl of Oxford, who made him one of his chaplains, and the queen ſoon after appointed him chaplain to the garriſon at Hull: but loſing his patrons upon the change of the miniſtry, he loſt his chaplainſhip; and, being obliged to apply himſelf to writing, compoſed, 1. A Body of Divinity; 2. The Life of Cardinal Wolſey; 3. A Treatiſe of Morality, &c. He died in 1725.

FIDE-JUSSORES *Aſſidui*. See ASSIDUUS.

FIDE-*Juſſor*, in the civil law, is a ſurety, or one that obliges himſelf in the ſame contract with a principal, for the greater ſecurity of the creditor or ſtipulator.

FIDEI-COMMISSUM, in Roman antiquity, an eſtate left in truſt with any perſon, for the uſe of another. See TRUSTEE.

FIDES, FAITH or FIDELITY, one of the virtues deified by the Pagans. She had a temple near the Capitol, founded by Numa Pompilius; but no animals were offered, or blood ſpilt, in her ſacrifices. During the performance of her rites, her prieſts appeared in white veſtments, with their heads and hands covered with linen, to ſhow that fidelity ought to be ſacred.

FIDIUS, in Pagan worſhip, a god who preſided over alliances and promiſes. This deity, which the Romans borrowed from the Sabines, was alſo called *Sanctus*, *Semon*, and *Semipater*.

FIELD, in agriculture, a piece of ground incloſed, whether for tillage or paſture.

FIELD, in heraldry, is the whole ſurface of the ſhield or the continent, ſo called becauſe it containeth thoſe achievements anciently acquired in the field of battle. It is the ground on which the colours, bearing, metals, furs, charges, &c. are repreſented. Among the modern heralds, field is leſs frequently uſed in blazoning than ſhield or eſcutcheon. See the article SHIELD, &c.

FIELD-*Book*, in ſurveying, is that wherein the angles, ſtations, diſtances, &c. are ſet down.

FIELD-*Colours*, in war, are ſmall flags of about a foot and a half ſquare, which are carried along with the quarter-maſter general, for marking out the ground for the ſquadrons and battalions to encamp on.

FIELD-*Fare*, in ornithology. See TURDUS.

FIELD-*Officers*, in the art of war. See OFFICER.

FIELD-*Pieces*, ſmall cannons, from three to twelve pounders, carried along with an army in the field.

FIELD-*Staff*, a weapon carried by artillery men, about the length of a halbert, with a ſpear at the end; having on each ſide ears ſcrewed on, like the cock of a match-lock, where the gunners fix in lighted matches when they are upon command; and then the field ſtaffs are ſaid to be armed.

FIELD-*Works*, in fortification, are thoſe thrown up by an army in beſieging a fortreſs, or by the beſieged to defend the place. Such are the fortifications of camps, highways, &c.

Elyſian FIELDS. See ELYSIAN.

FIELDING (Henry), a well-known writer of the preſent age, ſon of lieutenant-general Fielding who ſerved under the duke of Marlborough, was born in 1707. He had four ſiſters; of whom Sarah is well known, as writer of The Adventures of David Simple. On the death of his mother, his father married again; and Sir John Fielding, who ſucceeded him in the commiſſion of the peace for Middleſex, was his brother by this marriage. Henry was ſent to ſtudy at Leyden; but a failure in his remittances obliged him to return in two years, when his own propenſity to gaiety and profuſion drove him to write for the ſtage at 20 years of age. His firſt dramatic piece, Love in ſeveral Maſques, which was well received, appeared in 1727: and all his plays and farces, to the amount of 18, were written before the year 1737; and many of them are ſtill acted with applauſe. While he was thus employed, he married a young lady with 1500l. fortune, and inherited an eſtate of 200l. a-year from his mother: all which, though on the plan of retiring into the country, he contrived to diſſipate in three years; and then applied himſelf to the ſtudy of the law for a maintenance. In loſing his fortune, he acquired the gout: which rendering it impoſſible for him to attend the bar, he with a ſhattered conſtitution had recourſe to many extempore applications of his pen for immediate ſupplies; until, ſoon after the late rebellion, he accepted the office of acting juſtice for Middleſex, an employment much more profitable than honourable in the public eſteem. Reduced at length by the fatigues of this office, and by a complication of diſorders, he by the advice of his phyſicians went to Liſbon, where he died in 1754. He wrote a great number of fugitive pamphlets and periodical eſſays; but is chiefly diſtinguiſhed by his Adventures of Joſeph Andrews, and Hiſtory of Tom Jones. His works have been collected and publiſhed, with his life prefixed, by Mr. Murphy.

FIENUS (Thomas), an ingenious and learned phyſician, born at Antwerp in 1566. He went into Italy to ſtudy phyſic under Mercurialis and Aldrovandus; and on his return diſtinguiſhed himſelf ſo much in the univerſity of Louvain, that he was there choſen profeſſor of phyſic, and was afterwards made phyſician to the duke of Bavaria. He wrote ſeveral works, among which were, *De viribus imaginationis*; and *De formatione fœtus*. He died at Louvain in 1631.

FIERI FACIAS, in law, a writ that lies where a perſon has recovered judgment for debt or damages in the king's courts againſt one, by which the ſheriff is commanded to levy the debt and damages on the defendant's goods and chattels.

FIFE, in muſic, is a ſort of wind inſtrument, being a ſmall pipe. See PIPE.

FIFESHIRE, a county of Scotland, bounded on the N. by the frith of Tay; on the E. by the Britiſh ocean; on the S. by the frith of Forth; and on the W. by the counties of Kinroſs, Perth, and Clackmannan. It is above 50 miles long; its greateſt breadth 16. "This county," ſays Mr. Pennant, "is ſo populous, that excepting the environs of London, ſcarce one in S. Britain can vie with it; fertile in ſoil, abundant in cattle; happy in collieries, in iron, in lime, and freeſtone; bleſſed in manufactures; the property remarkably well divided; none inſultingly powerful to diſtreſs, and often depopulate a country; moſt of the fortunes of a uſeful mediocrity. The number of towns is almoſt unparalleled in an equal tract of coaſt; for the whole ſhore, from Crail to Culroſs, about 40 miles, is one continued chain of towns and villages."

FIFE-*Rails*, in a ſhip, are thoſe that are placed on baniſters, on each ſide of the top of the poop, and ſo along with hauncers or falls. They reach down to the quarter-deck, and to the ſtair of the gang-way.

FIFTH, in muſic. See INTERVAL.

FIG, or FIG-TREE. See BANIAN *Tree*.

FIGHT, a battle or combat between two or any greater number of perſons. See BATTLE.

Cock-FIGHT, a furious battle between two game cocks, whoſe legs are armed with ſteel ſpurs, by means of which they continue to engage till one or the other is deſtroyed.

It muſt appear aſtoniſhing to every reflecting mind, that a mode of diverſion ſo cruel and inhuman as that of cock-fighting ſhould have been ſo general, that not only the Ancients, Barbarians, Greeks, and Romans, ſhould have adopted it: but that a practice ſo ſavage and brutal ſhould be continued by Chriſtians even in theſe more enlightened times.

The ancient Greeks and Romans, as is well known, were wont to call all the nations in the world barbarians; yet certainly, if we conſider the many inſtances of cruelty practiſed among them, there was very little reaſon for the diſtinction. Human ſacrifices were common both to them and the barbarians; and with them the expoſing of infants, the combats of men with wild beaſts, and of men with men in the gladiatorial ſcenes, were ſpectacles of delight and feſtivity.

The iſlanders of Delos, it ſeems, were great lovers of cock-fighting; and Tanagra, a city in Bœotia, the iſle of Rhodes, Chalcis in Eubœa, and the country of Media, were famous for their generous and magnanimous race of chickens. The kingdom of Perſia was probably included in the laſt, from whence this kind of poultry was firſt brought into Greece; and if one may judge of the reſt from the fowls of Rhodes and Media, the excellence of the broods at that time conſiſted in their weight and largeneſs (as the fowls of thoſe countries were heavy and bulky), and of the nature of what our ſportſmen call *ſhakebags* or *turnpokes*. The Greeks, moreover, had ſome method of preparing the birds for battle, by feeding; as may be collected from Columella.

It ſhould ſeem, that at firſt, cock-fighting was partly a religious and partly a political inſtitution at Athens; and was there continued for the purpoſe of improving the ſeeds of valour in the minds of their youth; but was afterwards abuſed and perverted, both here and in the other parts of Greece, to a common paſtime, without any moral, political, or religious intention, and as it is now followed and practiſed among us.

At Rome, as the Romans were prone to imitate the Greeks, we may expect to find them following their example in this mode of diverſion, and in the worſt way, *viz.* without any good or laudable motives; ſince, when they took and brought it to Rome, the Greeks had forgotten every thing that was commendable in it, and had already perverted it to a low and unmeaning ſport. Signior Hyam thinks the Romans borrowed the paſtime from Dardanus in Aſia; but there is little reaſon for making them go ſo far for it, when it was ſo generally followed in Greece, whoſe cuſtoms the Romans were addicted to borrow and imitate. However, it is probable, they did not adopt this opinion very early. It may be gathered from Columella, that the Romans did not uſe the ſport in his time. This author ſtyles cock-fighting a *Grecian diverſion*; and ſpeaks of it in terms of ignominy, as an expenſive amuſement, unbecoming the frugal houſeholder, and often attended with the ruin of the parties that followed it. The words are remarkable. "Nos enim cenſemus inſtituere vectigal induſtrii patris-familias, non rixoſarum avium laniſtæ, cujus plerumque totum patrimonium pignus aleæ, victor gallinaceus pyctes abſtulit:" when he deſcribes, as we think, the manner, not of the Romans, but of the Greeks, who had in his time converted the diverſion of cock-fighting into a ſpecies of gaming, and even to the total ruin of their families, as happens but too often in England at this day. The Romans, however, at laſt gave into the cuſtom, though not till the decline of the empire. The firſt cauſe of contention between the two brothers Baſſianus and Geta, ſons of the emperor Septimus Severus, happened, according to Herodian, in their youth, about the fighting of their cocks: and if the battling between theſe two Princes was the firſt inſtance of it, probably they had ſeen and learned it in Greece, whither they had often accompanied the emperor their father.

It is obſervable, that cocks and quails pitted for the purpoſe of engaging one another, *a outrance*, or to the laſt gaſp, for diverſion, are frequently compared, and with much propriety, to gladiators. Hence Pliny's expreſſion, *Gallorum —— ſeu gladiatorum*; and that of Columella, *rixoſarum avium laniſtæ*; *laniſta* being the proper term for the maſter of the gladiators. Conſequently one would expect, that when the bloody ſcenes of the amphitheatre were diſcarded, as they were ſoon after the Chriſtian religion became the eſtabliſhment of the empire, the wanton ſhedding of men's blood in ſport being of too cruel and ſavage a nature to be patroniſed and encouraged in an inſtitution ſo harmleſs and innocent as the Chriſtian was, one might juſtly expect that the ορτυγομανια and the αλεκτρυομανια would have ceaſed of courſe. The fathers of the church are continually inveighing againſt the ſpectacles of the arena, and upbraiding their adverſaries with them. Theſe indeed were more unnatural and ſhocking than a main of cocks; but this, however, had a tendency towards infuſing the like ferocity and implacability in the breaſts and diſpoſitions of men. Beſides, this mode of diverſion has been in fact the bane and deſtruction of thouſands here, as well as thoſe of *laniſtæ avium*, "cock-feeders," mentioned by Columella, whoſe patrimonial fortunes were totally diſſipated and deſtroyed by it.

The cock is not only an uſeful animal, but ſtately in his figure, and magnificent in his plumage. "*Imperitant ſuo generi*, ſays Pliny, *et regnum*, in quacunque ſunt domo, *exercent*." Ariſtophanes compares him to the king of Perſia; moſt authors alſo take notice of the "ſpectatiſſimum inſigne, ſerratum, quod eorum verticem *regiæ coronæ modo* exornat." His tenderneſs towards his brood is ſuch, that, contrary to the cuſtom of many other males, he will ſcratch and provide for them with an aſſiduity almoſt equal to that of the hen; and his generoſity is ſo great, that, on finding a hoard of meat, he will chuckle the hens together, and, without touching one bit himſelf, will relinquiſh the whole of it to them. He was called *the bird* κατ εξοχην by many of the ancients; he was highly eſteemed in ſome countries, and in others was even held ſacred, inſomuch that one cannot but regret that a creature ſo uſeful and noble ſhould, by a ſtrange fatality, be ſo enormouſly abuſed by us. It is true, our αλεκτρυομανια, or the maſſacre of Shrove Tueſday, is now in a declining way; and, in a few years, it is to be hoped will be totally diſuſed: but the cock-pit ſtill continues a reproach to the humanity of Engliſhmen, and to their religion; the pureſt, the tendereſt, and moſt compaſſionate, of all others, not excepting even the Brachmannic.

It is unknown when the pitched battle firſt entered England: but it was probably brought thither by the Romans. The bird was here before Cæſar's arrival, but no notice of his fighting occurs earlier than the time of William Fitz-Stephen, who wrote the life of archbiſhop Becket, ſome time in the reign of Henry II. and deſcribes the cocking as a ſport of ſchool-boys on Shrove Tueſday. From this time at leaſt, the diverſion, however abſurd, and even impious, was continued amongſt us. It was followed, though diſapproved and prohibited, 39 Edward III.; alſo in the reign of Henry VIII: and A. D. 1569. It has by ſome been called a *royal diverſion*; and, as every one knows, the cock-pit at Whitehall was erected by a crowned head, for the more magnificent celebration of it. There was another pit in Drury-lane, and another in Javin-ſtreet. It was prohibited, however, by one of Oliver's acts, March 31, 1664. What aggravates the reproach and diſgrace upon Engliſhmen, are thoſe ſpecies of fighting which are called the *battle-royal* and the *Welſh-main*, known no where in the world

but there; neither in China, nor in Perſia, nor in Malacca, nor among the ſavage tribes in America. Theſe are ſcenes ſo bloody as almoſt to be too ſhocking to relate; and yet, as many may not be acquainted with the horrible nature of them, it may be proper, for the excitement of our averſion and deteſtation, to deſcribe them in a few words. In theſe fights, an unlimited number of cocks are pitted, and when they have ſlaughtered one another for the diverſion *(Dii boni!)* of the otherwiſe generous and humane Engliſhman, the ſingle ſurviving bird is eſteemed the victor, and carries away the prize.

FIGWORT, a plant, called by the botaniſts Scrophularia.

FIGURAL, Figurate, or *Figurative*, a term applied to whatever is expreſſed by obſcure reſemblances. The word is chiefly applied to the types and myſteries of the Moſaic law; as alſo to any expreſſion which is not taken in its primary and literal ſenſe.

FIGURE, in phyſics, expreſſes the ſurface or terminating extremities of any body.

Figures, in arithmetic, are certain characters whereby we denote any number which may be expreſſed by any combination of the nine digits, &c. See Arithmetic.

Figure, among divines, is uſed for the myſteries repreſented under certain types.

Figure, in dancing, denotes the ſeveral ſteps which the dancer makes in order and cadence, conſidered as they mark certain figures on the floor. See Dancing.

Figure, in painting and deſigning, denotes the lines and colours which form the repreſentation of any animal, but more particularly of a human perſonage. See the article Painting.

Figure, in the manufactures, is applied to the various deſigns repreſented or wrought on ſilks, ſattins, and other ſtuffs and cloths. The moſt uſual figures for ſuch deſigns are flowers, &c. It is the woof of the ſtuff that forms the figures; the warp only ſerves for the ground. In working figured ſtuffs, there is required a perſon to ſhow the workman how far he muſt raiſe the threads of the warp, to repreſent the figure of the deſign with the woof, which is to be paſſed acroſs between the threads thus raiſed. This ſome call *reading the deſign*.

For the figures uſually wrought on tapeſtry, brocade, &c. ſee Tapestry, &c.

For thoſe given by the calenders, printers, &c. ſee the article Calender, &c.

Figure, in logic, denotes a certain order and diſpoſition of the middle term in any ſyllogiſm. Figures are fourfold. 1. When the middle term is the ſubject of the major propoſition, and the predicate of the minor, we have what is called the firſt figure. 2. When the middle term is the predicate of both the premiſſes, the ſyllogiſm is ſaid to be in the ſecond figure. 3. If the middle term be the ſubject of the two premiſſes, the ſyllogiſm is in the third figure: and, laſtly, by making it the predicate of the major, and ſubject of the minor, we obtain ſyllogiſms in the fourth figure. Each of theſe figures has a determinate number of moods, including all the poſſible ways in which propoſitions differing in quantity or quality can be combined, according to any diſpoſition of the middle term, in order to arrive at a juſt concluſion. See Logic.

Figure, in compoſition. See Oratory; alſo Allegory, Apostrophe, Hyperbole, Metaphor, Personification, &c.

A Figure, *the mean or inſtrument conceived to be the agent.* When we ſurvey a number of connected objects, that which makes the greateſt figure employs chiefly our attention; and the emotion it raiſes, if lively, prompts us even to exceed nature in the conceptions we form of it. Take the following examples:

> For Peleus' ſon Alcides' *rage* had ſlain.
> A broken rock the *force* of Pirus threw.

In theſe inſtances, the rage of Hercules and the force of Pirus, being the capital circumſtances, are ſo far exalted, as to be conceived the agents that produce the effects.

In the firſt of the following inſtances, hunger, being the chief circumſtance in the deſcription, is itſelf imagined to be the patient.

> Whoſe hunger has not taſted food theſe three days.
> *Jane Shore.*
>
> ———————As when the *force*
> Of ſubterranean wind tranſports a hill. *Paradiſe Loſt.*
>
> ———————As when the *potent rod*
> Of Amram's ſon, in Egypt's evil day
> Wav'd round the coaſt, upcall'd a pitchy cloud
> Of locuſts. *Paradiſe Loſt.*

A Figure, *which, among related objects, extends the properties of one to another.* This figure is not dignified with a proper name, becauſe it has been overlooked by writers. *Giddy brink, jovial wine, daring wound*, are examples of this figure. Here are adjectives that cannot be made to ſignify any quality of the ſubſtantives to which they are joined: a *brink*, for example, cannot be termed *giddy* in a ſenſe, either proper or figurative, that can ſignify any of its qualities or attributes. When we examine attentively the expreſſion, we diſcover, that a *brink* is termed *giddy*, from producing that effect in thoſe who ſtand on it: in the ſame manner, a wound is ſaid to be *daring*, not with reſpect to itſelf, but with reſpect to the boldneſs of the perſon who inflicts it: and wine is ſaid to be *jovial*, as inſpiring mirth and jollity. Thus the attributes of one ſubject are extended to another with which it is connected; and the expreſſion of ſuch a thought muſt be conſidered as a figure, becauſe the attribute is not applicable to the ſubject in any proper ſenſe.

How are we to account for this figure, which we ſee lies in the thought, and to what principle ſhall we refer it? Have poets a privilege to alter the nature of things, and at pleaſure to beſtow attributes upon a ſubject to which they do not belong? It is obſerved in Lord Kaimes's *Elements of Criticiſm*, ch. ii. part 1. § 6. that the mind paſſes eaſily and ſweetly along a train of connected objects, and, where the objects are intimately connected, that it is diſpoſed to carry along the good or bad properties of one to another; eſpecially when it is in any degree inflamed with theſe properties. From this principle is derived the figure under conſideration. Language, invented for the communication of thought, would be imperfect, if it were not expreſſive even of the ſlighter propenſities and more delicate feelings: but language cannot remain ſo imperfect among a people who have received any poliſh; becauſe language is regulated by internal feeling, and is gradually improved to expreſs whatever paſſes in the mind. Thus, for example, when a ſword in the hand of a coward is termed *a coward ſword*, the expreſſion is ſignificative of an internal operation; for the mind, in paſſing from the agent to its inſtrument, is diſpoſed to extend to the latter the properties of the former. Governed by the ſame principle, we ſay *liſtening* fear, by extending the attribute *liſtening* of the man who liſtens, to the paſſion with which he is moved. In the expreſſion *bold dead*, or *audax facinus*, we extend to the effect what properly belongs to the cauſe. But to give a complete idea of the ſubject, we inſert the following view of the different relations that may give occaſion to this figure. And here it will be obſerved, that the figure can never have any grace but where the relations are of the moſt intimate kind.

1. An attribute of the cauſe expreſſed as an attribute of the effect.

An impious mortal gave the *daring* wound.
——————To my *advent'rous* song,
That with no middle flight intends to soar.
Paradise Lost.

2. An attribute of the effect expressed as an attribute of the cause.

Quos periisse ambos *misero* censebam in mari. *Plautus.*
No wonder, fallen such a *pernicious* height.
Paradise Lost.

3. An effect expressed as an attribute of the cause.

Casting a dim *religious* light. MILTON, *Comus.*
And the *merry* bells ring round,
And the *jocund* rebecks sound. MILTON, *Allegro.*

4. An attribute of a subject bestowed upon one of its parts or members.

Longing arms.
It was the nightingale, and not the lark,
That pierc'd the *fearful* hollow of thine ear.
Romeo and Juliet, *act* 3. *sc.* 7.

5. A quality of the agent given to the instrument with which it operates.

Why peep your *coward* swords half out their shells?

6. An attribute of the agent given to the subject upon which it operates.

High-climbing hill. MILTON.

7. A quality of one subject given to another.

Then, nothing loth, th' enamour'd fair he led,
And sunk transported on the *conscious* bed.
Odyssey, viii. 337.
A *stupid* moment motionless she stood.
THOMSON's *Summer*, *l.* 1336.

8. A circumstance connected with a subject, expressed as a quality of the subject.

'Tis ours the chance of *fighting* fields to try.
Iliad, i. 301.
Oh! had I dy'd before that *well-fought* wall.
Odyssey, v. 395.

From this account it appears, that the adorning a cause with an attribute of the effect is not so agreeable as the opposite expression. The progress from cause to effect is natural and easy: the opposite progress resembles retrograde motion; and therefore *panting height*, *astonish'd thought*, are strained and uncouth expressions, which a writer of taste will avoid.

It is not less strained, to apply to a subject in its present, an epithet that may belong to it in some future state:

Submersasque obrue puppes. *Æneid*, i. 73.
And mighty *ruins* fall. *Iliad*, v. 411.
Impious sons their *mangled* fathers wound.

Another rule regards this figure, that the property of one subject ought not to be bestowed upon another with which that property is incongruous.

K. Rich.———How dare thy joints forget
To pay their *awful* duty to our presence?
Richard II. *act* 3. *sc.* 6.

The connection between an awful superior and his submissive dependent is so intimate, that an attribute may readily be transferred from the one to the other: but awfulness cannot be so transferred, because it is inconsistent with submission.

FIGURE *of Speech*, as peculiarly distinguished from the above, and from those first referred to.] Under the article METAPHOR *and Allegory*, a figure of speech is defined, "The using a word in a sense different from what is proper to it;" and the new or uncommon sense of the word is termed *the figurative sense*. The figurative sense must have a relation to that which is proper; and the more intimate the relation is, the figure is the more happy. How ornamental this figure is to language, will not be readily imagined by any one who hath not given it peculiar attention; and therefore we shall endeavour to unfold its capital beauties and advantages. In the first place, a word used figuratively, or in a new sense, suggests at the same time the sense it commonly bears: and thus it has the effect to present two objects; one signified by the figurative sense, which may be termed *the principal object*; and one signified by the proper sense, which may be termed *accessory*: the principal makes a part of the thought; the accessory is merely ornamental. In this respect, a figure of speech is precisely similar to concordant sounds in music, which, without contributing to the melody, make it harmonious.

To explain the matter by examples. *Youth*, by a figure of speech, is termed *the morning of life*: This expression signifies *youth*, the principal object which enters into the thought; it suggests, at the same time, the proper sense of *morning*; and this accessory object, being in itself beautiful, and connected by resemblance to the principal object, is not a little ornamental. *Imperious ocean* is an example of a different kind, where an attribute is expressed figuratively: together with *stormy*, the figurative meaning of the epithet *imperious*, there is suggested its proper meaning, viz. the stern authority of a despotic prince; and these two are strongly connected by resemblance. Upon this figurative power of words, Vida descants with elegance, *Poet. lib.* iii. 44.

In the next place, this figure possesses a signal power of aggrandizing an object, by the following means. Words, which have no original beauty but what arises from their sound, acquire an adventitious beauty from their meaning: a word signifying any thing that is agreeable, becomes by that means agreeable; for the agreeableness of the object is communicated to its name. This acquired beauty, by the force of custom, adheres to the word even when used figuratively; and the beauty received from the thing it properly signifies, is communicated to the thing which it is made to signify figuratively. Consider the foregoing expression *Imperious ocean*, how much more elevated it is than *Stormy ocean*.

Thirdly, this figure hath a happy effect by preventing the familiarity of proper names. The familiarity of a proper name is communicated to the thing it signifies by means of their intimate connection; and the thing is thereby brought down in our feeling. This bad effect is prevented by using a figurative word instead of one that is proper; as for example, when we express the sky, by terming it *the blue vault of heaven*; for though no work of art can compare with the sky in grandeur, the expression, however, is relished, because it prevents the object from being brought down by the familiarity of its proper name. With respect to the degrading the familiarity of proper names, Vida has the following passage:

Hinc si dura mihi passus dicendus Ulysses,
Non illum vero memorabo nomine, sed qui
Et mores hominum multorum vidit, et urbes,
Naufragus eversæ post sæva incendia Trojæ.
Poet. lib. ii. l. 46.

Lastly, by this figure, language is enriched, and rendered more copious; in which respect, were there no other, a figure of speech is a happy invention. This property is finely touched by Vida; *Poet. lib.* iii. 90.

The beauties we have mentioned belong to every figure of speech. Several other beauties peculiar to one or other sort, we shall have occasion to remark elsewhere.

Not only subjects, but qualities, actions, effects, may be expressed figuratively. Thus, as to subjects, *gates of breath* for the lips, *the watery kingdom* for the ocean. As to qualities,

fierce for stormy, in the expression *fierce winter*; *altus* for profundus, *altus puteus*, *altum mare*; *breathing* for perspiring, *breathing plants*. Again, as to actions, The sea *rages*, Time will *melt* her frozen thoughts, Time *kills* grief. An effect is put for the cause, as *lux* for the sun; and a cause for the effect, as *boum labores* for corn. The relation of resemblance is one plentiful source of figures of speech; and nothing is more common than to apply to one object the name of another that resembles it in any respect. Height, size, and worldly greatness, resemble not each other; but the emotions they produce resemble each other, and, prompted by this resemblance, we naturally express worldly greatness by height or size: one feels a certain uneasiness in seeing a great depth; and, hence depth is made to express any thing disagreeable by excess, as *depth* of grief, *depth* of despair: again, height of place, and time long past, produce similar feelings; and hence the expression, *Ut altius repetam!* Distance in past time, producing a strong feeling, is put for any strong feeling; *Nihil mihi antiquius nostra amicitia*: Shortness with relation to space, for shortness with relation to time; *Brevis esse laboro, obscurus fio*: Suffering a punishment resembles paying a debt; hence *pendere pœnas*. In the same manner, light may be put for glory, sunshine for prosperity, and weight for importance.

Many words, originally figurative, having by long and constant use lost their figurative power, are degraded to the inferior rank of proper terms. Thus the words that express the operation of the mind have in all languages been originally figurative: the reason holds in all, that when these operations came first under consideration, there was no other way of describing them but by what they resembled: it was not practicable to give them proper names, as may be done to objects that can be ascertained by the sight and touch. A *soft* nature, *jarring* tempers, *weight* of woe, *pompous* phrase, *beget* compassion, *assuage* grief, *break* a vow, *bend* the eye downward, *shower* down curses, *drown'd* in tears, *wrapt* in joy, *warm'd* with eloquence, *loaded* with spoils, and a thousand other expressions of the like nature, have lost their figurative sense. Some terms there are that cannot be said to be altogether figurative, or altogether proper: originally figurative, they are tending to simplicity, without having lost altogether their figurative power. Virgil's *regina saucia cura* is perhaps one of these expressions: with ordinary readers, *saucia* will be considered as expressing simply the effect of grief: but one of a lively imagination will exalt the phrase into a figure.

For epitomising this subject, and at the same time for giving a clear view of it, Lord Kames gives a list of the several relations upon which figures of speech are commonly founded. This list he divides into two tables; one of subjects expressed figuratively, and one of attributes. See *Elements of Criticism*, vol. ii. p. 305.

It is not sufficient that a figure of speech be regularly constructed, and be free from blemish: it requires taste to discern when it is proper, when improper; and taste perhaps is our only guide. One, however, may gather from reflections and experience, that ornaments and graces suit not any of the dispiriting passions, nor are proper for expressing any thing grave and important. In familiar conversation, they are in some measure ridiculous: Prospero, in the *Tempest*, speaking to his daughter Miranda, says,

> The fringed curtains of thine eyes advance,
> And say what thou seest yond.

No exception can be taken to the justness of the figure; and circumstances may be imagined to make it proper: but it is certainly not proper in familiar conversation.

Lastly, though figures of speech have a charming effect when accurately constructed and properly introduced, they ought, however, to be scattered with a sparing hand: nothing is more luscious, and nothing consequently more satiating, than redundant ornaments of any kind.

Figure is used, in theology, for the mysteries represented or delivered obscurely to us, under certain types or actions, in the Old Testament. Thus manna is held a figure or type of the eucharist; and the death of Abel a figure of the suffering of Christ. Many divines and critics contend, that all the actions, histories, ceremonies, &c. of the Old Testament, are only figures, types, and prophecies, of what was to happen under the New. The Jews are supposed to have had the figures or shadows, and we the substance.

Figure is also applied in a like sense to profane subjects; as the emblems, enigmas, fables, symbols, and hieroglyphics, of the ancients.

FIGURED, in general, something marked with figures. The term *figured* is chiefly applied to stuffs, whereon the figures of flowers, and the like, are either wrought or stamped.

Figured, in music, is applied either to simple notes or to harmony: to simple notes, as in the words *figured bass*, to express a bass whose notes carrying chords are subdivided into many other notes of lesser value; to harmony, when, by supposition and in a diatonick procedure, other notes than those which form the chord are employed. See Supposition. To *figure* is to pass several notes for one; to form runnings or variations; to add some notes to the air, in whatever manner it be done; in short, it is to give to harmonious sounds a figure of melody, by connecting them with other intermediate sounds.

FILAGO, in botany; a genus of the polygamia superflua order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, *Compositæ*. The receptacle is naked; there is no pappus; the calyx is imbricated; the female florets placed among the scales of the calyx.

FILAMENT, in anatomy, natural history, &c. a term used in the same sense with fibre, for those fine threads whereof the flesh, nerves, skin, plants, roots, &c. are composed. See Fibre.

Vegetable Filaments form a substance of great use in the arts and manufactures; furnishing thread, cloth, cordage, &c. For these purposes the filamentous parts of the *Cannabis* and *Linum*, or hemp and flax, are employed among us. See Hemp, Flax, Cotton, &c. But different vegetables have been employed in different countries for the same uses. Putrefaction destroys the pulpy or fleshy matter, and leaves the tough filaments entire: by curiously macerating the leaf of a plant in water, we obtain the fine flexile fibres, which constituted the basis of the ribs and minute veins, and which now form as it were a skeleton of the leaf.

The Sieur de Flacourt, in his history of Madagascar, relates, that different kinds of cloth are prepared in that island from the filaments of the bark of certain trees boiled in strong lye; that some of these cloths are very fine, and approach to the softness of silk, but in durability come short of cotton; that others are coarser and stronger, and last thrice as long as cotton; and that of these the sails and cordage of his vessel were made. See also the article Bark.

The same author informs us, that the stalks of nettles are used for the like purposes in France. And Sir Hans Sloane relates, in one of his letters to Mr. Ray, that he has been informed by several, that muslin and callico, and most of the Indian linens, are made of nettles.

In some of the Swedish provinces, a strong kind of cloth is said to be prepared from hop-stalks: and in the Transactions of the Swedish academy for the year 1750, there is an account of an experiment made in consequence of that report. Of the stalks, gathered in autumn, about as many were taken, as

equalled in bulk a quantity of flax that would have produced a pound after preparation. The stalks were put into water, and kept covered therewith during the winter. In March they were taken out, dried in a stove, and dressed as flax. The prepared filaments weighed nearly a pound, and proved fine, soft, and white: they were spun and woven into six ells of fine strong cloth. The author, Mr. Shisler, observes, that hop-stalks take much longer time to rot than flax; and that, if not fully rotted, the woody part will not separate, and the cloth will neither prove white nor fine.

Hemp, flax, and all other vegetable filaments, and thread or cloth prepared from them, differ remarkably from wool, hair, silk, and other animal productions, not only in the principles into which they are resoluble by fire, but likewise in some of their more interesting properties, particularly in their disposition to imbibe colouring matters; sundry liquors, which give a beautiful and durable die to those of the animal, giving no stain at all to those of the vegetable kingdom.

Fishing-nets are usually boiled with oak-bark or other such astringents, which render them more lasting. Those made of flax receive from this decoction a brownish colour, which, by the repeated alternations of water and air, is in a little time discharged, whilst the fine glossy brown, communicated by the same means to silken nets, permanently resists both the air and water, and lasts as long as the animal filaments themselves. In like manner the stain of ink, or the black dye from solutions of iron, mixed with vegetable astringents, proves durable in silk and woollen; but from linen, the astringent matter is extracted by washing, and only the yellow iron-mould remains.

Many other instances of this kind are known too well to the callico-printer; whose grand desideratum it is, to find means of making the *fibres* of cotton receive the same colours that wool does. The physical cause of the difference is wholly unknown; and indeed, of the theory of dyes in general, we know as yet very little. (See DYEING.) Are animal filaments tubular, and the colouring atoms received within them? Are vegetable filaments solid, and the colour deposited on the surface? Or does not their different susceptibility of colour depend rather on the different intrinsic properties of the two?

FILAMENTS, among botanists. See BOTANY, p. 33.

FILANDERS, in falconry, a disease in hawks, &c. consisting of filaments of coagulated blood; occasioned by the rupture of some vein, by which the blood is extravasated, and hardens into cords which inflame and become painful.

FILANDERS, are also worms as small as thread, and about an inch long, that lie wrapt up in a thin skin or net, near the reins of a hawk, apart from either gut or gorge. This malady is known by the hawk's poverty; by ruffling her tail; by her straining the fist, or perch, with her pounces; and, lastly, by croaking in the night, when the filanders prick her. The disease usually proceeds from bad food; and may be remedied by giving the hawk a clove of garlic. Indeed it will be prudent in the falconer, afterwards, whenever he observes the hawk poor and low, to give her a clove of garlic by way of preventive.

FILBERT, or FILBERD, the fruit of the corylus, or hazel. See CORYLUS.

FILE, among mechanics, a tool used in metal, &c. in order to smooth, polish, or cut. This instrument is of iron or forged steel, cut in little furrows, with chisels and a mallet, this and that way, and of this or that depth, according to the grain or touch required. After cutting the file, it must be tempered with a composition of chimney-soot, very hard and dry, diluted and wrought up with urine, vinegar, and salt; the whole being reduced to the consistence of mustard. Tempering the files consists in rubbing them over with this composition, and covering them in loam; after which they are put in a charcoal fire, and taken out by the time they have acquired a cherry colour, which is known by a small rod of the same metal put in along with them. Being taken out of the fire, they are thrown into cold spring water; and when cold, they are cleaned with charcoal and a rag; and being clean and dry, are kept from rust by laying them up in wheat bran. Iron files require more heating than steel ones. Files are of different forms, sizes, cuts, and degrees of fineness, according to the different uses and occasions for which they are made. See FILING.

We find the following account of a MACHINE *for cutting Files*, in the Transactions of the American Philosophical Society. See plate 25. where A A A A is a bench made of well-seasoned oak, and the face of it planed very smooth. B B B B B, the feet of the bench, which should be substantial. C C C C, the carriage on which the files are laid, which moves along the face of the bench A A A A, parallel to its sides, and carries the files gradually under the edge of the cutter or chisel H H, while the teeth are cut: this carriage is made to move by a contrivance somewhat similar to that which carries the log against the saw of a saw-mill, as will be more particularly described. D D D are three iron rods, inserted into the ends of the carriage C C C C, and passing through holes in the studs E E E, which are screwed firmly against the ends of the bench A A A A, for directing the course of the carriage C C C C, parallel to the sides of the said bench. F F, two upright pillars, mortised firmly into the bench A A A A, nearly equidistant from each end thereof, near the edge, and directly opposite to each other. G, the lever or arms, which carries the cutter H H, (fixed by the screw I,) and works on the centres of two screws K K, which are fixed into the two pillars F F, in a direction right across the bench A A A A. By tightening or loosening these screws, the arm which carries the chisel may be made to work more or less steady. L is the regulating-screw, by means of which the files may be made coarser or finer; this screw works in a stud M, which is screwed firmly upon the top of the pillar F. The lower end of the screw L bears against the upper part of the arm G, and limits the height to which it can rise. N, a steel spring, one end of which is screwed to the other pillar F, and the other end presses against the pillar O, which is fixed upon the arm G; by its pressure, it forces the said arm upwards, until it meets with the regulating-screw L. P is an arm with a claw at one end, marked 6, the other end is fixed by a joint into the end of the stud or pillar O; and, by the motion of the arm G, is made to move the ratch-wheel Q. This ratch-wheel is fixed upon an axis, which carries a small trundle-head or pinion R, on the opposite end; this takes into a piece S S, which is indented with teeth, and screwed firmly against one side of the carriage C C C C; by means of this piece the carriage has motion communicated to it. T is a clamp, for fastening one end of the file Z Z in the place or bed on which it is to be cut. V is another clamp or dog, at the opposite end, which works by a joint W, firmly fixed into the carriage C C C C. Y, a bridge, likewise screwed into the carriage, through which the screw X passes, and presses with its lower end against the upper side of the clamp V; under which clamp the other end of the file Z Z is placed, and held firmly in its place while it is cutting, by the pressure of the said clamp or dog V. 7 7 7 7 Is a bed of lead, which is let into a cavity formed in the body of the carriage, something broader and longer than the largest sized files; the upper face of this bed of lead is formed variously, so as to fit the different kinds of files which may be required. 2 2, Two catches, which take into the teeth of the ratch-wheel Q, to prevent a recoil of its motion. 3 3 Is a bridge to support one end of the axis 4, of the ratch wheel Q. 5, A stud to support the other end of the axis of the ratch-wheel Q.

When the file or files are laid in their place, the machine

muft be regulated to cut them of the due degree of finenefs, by means of the regulating-fcrew L; which, by fcrewing farther through the arm M, will make the files finer, and, *vice verfa*, by unfcrewing it a little, will make them coarfer; for, the arm G will, by that means, have liberty to rife the higher, which will occafion the arm P, with the claw, to move farther along the periphery of the ratch-wheel, and confequently communicate a more extenfive motion to the carriage C C C C, and make the files coarfer.

When the machine is thus adjufted, a blind man may cut a file with more exactnefs than can be done in the ufual method with the keeneft fight; for, by ftriking with a hammer on the head of the cutter or chifel H H, all the movements are fet at work; and, by repeating the ftroke with the hammer, the files on one fide will at length be cut; then they muft be turned, and the operation repeated, for cutting the other fide. It is needlefs to enlarge much on the utility or extent of this machine; for, on an examination, it will appear to perfons of but indifferent mechanical fkill, that it may be made to work by water as readily as by hand, to cut coarfe or fine, large or fmall, files, or any number at a time; but it may be more particularly ufeful for cutting very fine fmall files for watchmakers, as they may be executed by this machine with the greateft equality and nicety imaginable. As to the materials and dimenfions of the feveral parts of this machine, they are left to the judgment and fkill of the artift who may have occafion to make one, only obferving that the whole fhould be capable of bearing a good deal of violence.

FILE, in the art of war, a row of foldiers, ftanding one behind another, which is the depth of the battalion or fquadron. The files of a battalion of foot are generally three deep; as are fometimes thofe of a fquadron of horfe. The files muft be ftraight and parallel to one another.

FILE, in law, a thread, ftring, or wire, upon which writs and other exhibits in courts and offices are faftened or filed, for the more fafe keeping, and ready turning to the fame. A file is a record of the court; and the filing of a procefs of a court makes it a record of it. An original writ may be filed after judgment given in the caufe, iffued forth before; declarations, &c. are to be filed, and affidavits muft be filed, fome before they are read in court, and fome prefently when read in court. Before filing a record removed by *certiorari*, the juftices of B. R. may refufe to receive it, if it appears to be for delay, &c.; and remand it back for the expedition of juftice: but if the *certiorari* be once filed, the proceedings below cannot be revived. An indictment, &c. cannot be amended after it is filed.

FILIAL, fomething belonging to the relation of fon. See SON.

The divines ufually diftinguifh between a *fervile* and a *filial* fear. The moft abandoned may have a fervile fear of God, fuch as that of a flave to his mafter; but not a filial fear, *i. e.* a fear refulting from love and refpect. See FEAR.

FILIAL *Piety*, the affectionate attachment of children to their parents; including in it love, reverence, obedience, and relief. Thefe are duties prompted equally by nature and by gratitude, independent of the injunctions of religion. For where fhall we find the perfon who hath received from any one benefits fo great, or fo many, as children from their parents? And it may be truly faid, that if perfons are undutiful to their parents, they feldom prove good to any other relation. Profane hiftory furnifhes many fine examples of this amiable virtue; we fhall here introduce two from Valerius Maximus, who relates the following very fingular fact. A woman of illuftrious birth had been condemned to be ftrangled. The Roman prætor delivered her up to the triumvir, who caufed her to be carried to prifon, in order to her being put to death. The gaoler, who was ordered to execute her, was ftruck with compaffion, and could not refolve to kill her. He chofe therefore to let her die of hunger. Neverthelefs, he fuffered her daughter to fee her in prifon; taking care, however, that fhe brought her nothing to eat. As this continued many days, he was furprifed that the prifoner lived fo long without eating; and fufpecting the daughter, upon watching her, he difcovered that fhe nourifhed her mother with her own milk. Amazed at fo pious, and at the fame time fo ingenious an invention, he told the fact to the triumvir, and the triumvir to the prætor, who believed the thing merited relating in the affembly of the people. The criminal was pardoned, and a decree was paffed that the mother and daughter fhould be fubfifted for the reft of their lives at the expence of the public.

The fame author gives a fimilar inftance of filial piety in a young woman named Xantippe to her aged father Cimonus, who was likewife confined in prifon, and which is univerfally known by the name of the *Roman Charity*. Both thefe inftances appeared fo very extraordinary and uncommon to that people, that they could only account for them, by fuppofing that the love of children to their parents was the firft law of nature. *Putaret aliquis* (fays our author) *hoc contra naturam factum effe, nifi prima naturæ lex effet diligere parentes.*

FILIBEG, or FILLEBEG. See FILLEBEG.

FILICACIA (Vincent), a celebrated Italian poet, was born at Florence in 1642. He was a member of the Academy della Crufca and of that of the Arcadi, and became fecretary to the duke of Tufcany. He died in 1707. His poems are much efteemed for the delicacy and noblenefs of their fentiments. Scipio de Filicacia, his fon, had them all printed together under the title of *Poefie Tofcano di Vincenzo da Filicacia*, in 1707, 4to.

FILICES, from *filum* "a thread," *quafi filatim incifa*, FERNS; one of the feven tribes or families of the vegetable kingdom, according to Linnæus, by whom it is thus characterized: "having their fructification on the back fide of the frondes." They conftitute the firft order in the clafs cryptogamia; and confift of 16 genera, which are divided into *fructificationes, fpicatæ, frondofæ, & radicales.* This order comprehends the entire 16th clafs of Tournefort, in whofe fyftem the filices make only a fingle genus, in the firft fection of the above mentioned clafs.

FILICES, is alfo the 55th order of plants in the *Fragmenta methodi naturalis* of Linnæus. See BOTANY, p. 54.

FILIGRANE, FILIGREE, or FILLAGREE, *Work.* See FILLAGREE.

FILING, one of the principal operations in fmithery, &c. See FILE. The coarfer-cut files are always to be fucceeded by finer; and in all the kinds the rule is, to lean heavy on the file in thrufting it forward, becaufe the teeth of the file are made to cut forwards. But in drawing the file back again for a fecond ftroke, it is to be lightly lifted juft above the work, by reafon it cuts not coming back. The rough or coarfe-toothed file (which, when large, is called a *rubber*) ferves to take off the unevenneffes of the work left by the hammer in forging. The baftard-toothed file is to take out too deep cuts, and file ftrokes made by the rough file. The fine-toothed file takes out the cuts or file-ftrokes the baftard file made; and the fmooth file thofe left by the fine file. In this order, the files of feveral cuts are to fucceed each other, till the work is as fmooth as it can be filed. After which it may be made yet fmoother with emery, tripoli, &c. See POLISHING.

FILIPENDULA, in botany. See SPIRÆA.

FILIX, in botany. See FILICES.

FILLAGREE, FILIGREE, or FILIGRANE, *work*, a kind of enrichment on gold or filver, wrought delicately, in manner of little threads or grains, or both intermixed. The word is compounded of *fil* or *filum* "thread," and *granum* "grain." In Latin it is called *filatim elaboratum opus, argentum, aurum.*

There is no manufacture in any part of the world that has been more admired and celebrated, than the fine gold and silver fillagree of Sumatra: and what renders it a matter of greater curiosity is the coarseness of the tools employed in the workmanship, and which, in the hands of an European, would not be thought sufficiently perfect for the most ordinary purposes. The whole of this ingenious process is circumstantially related in *Marsden's Account of Sumatra*, p. 141.

The work usually executed by young ladies in this country under the title of *fillagree*, and of which tea-caddies, vases, work-baskets, &c. are constructed, is formed of narrow slips of coloured paper gilt at the edges, and curiously rolled up and glued in various fanciful forms, with the gilt edge outwards.

FILLET, or FILET, in architecture, denotes a little square member or ornament used in divers places and on divers occasions, but generally as a sort of corona over a greater moulding. The fillet is the same with what the French call *reglet*, *bande*, and *bandelette*; the Italians, *lista* or *listella*. See ARCHITECTURE, p. 289.

FILLET, in heraldry, a kind of orle or bordure, containing only a third or fourth part of the breadth of the common bordure. It is supposed to be withdrawn inwards, and is of a different colour from the field. It runs quite round, near the edge, as a lace does over a cloak.

FILLET is also used for an ordinary, drawn like the bar from the sinister point of the chief across the shield, in manner of a scarf; though it is sometimes also seen in the situation of a bend, fesse, cross, &c. According to Guillim, the fillet is a fourth part of the chief, and is placed in the chief point of the escutcheon.

FILLET is also used among painters, gilders, &c. for a little rule or reglet of leaf-gold, drawn over certain mouldings; or on the edges of frames, pannels, &c. especially when painted white, by way of enrichment.

FILLETS, in the manege, are the loins of a horse, which begin at the place where the hinder part of the saddle rests.

FILLY, a term among horse-dealers, to denote the female or mare colt.

FILM, a thin skin or pellicle. In plants, it is used for that thin, woody skin, which separates the seeds in the pods, and keeps them apart.

FILTER, or FILTRE, in chemistry, &c. a piece of woollen cloth, linen, paper, or other matter, some of which are in the form of hollow inverted cones, used to filtrate or strain liquors through. The filtre has the same use and effect with regard to liquids that the sieve or searce has on dry substances. Filters are of two sorts. The first are simple pieces of paper or cloth, through which the liquor is passed without farther trouble. The second are twisted up like a skain or wick, and first wetted, then squeezed, and one end put in the vessel that contains the liquor to be filtrated; the other end is to be out, and hang down below the surface of the liquor: by means hereof the purest part of the liquor distils drop by drop out of the vessel, leaving the coarser part behind. This filter acts as a siphon.

FILTER is also a charm, supposed to have a virtue of inspiring love. The word is derived from φίλτρον, which signifies the same thing, of φιλεω, *amo* "I love. The Greeks, when their love was without success, had several arts to procure the affections of their beloved. The Thessalian women were famous for their skill in this as well as other magical practices. The means whereby it was effected were of various sorts; it was sometimes done by potions called φιλτρα, which are frequently mentioned in authors of both languages. Juvenal speaks thus:

Hic magicus affert cantus, hic Thessala vendit
Philtra, *quibus valeant mentem vexare mariti.*

Their operations were violent and dangerous, and commonly deprived such as drank them of their reason. Plutarch and Cornelius Nepos report, that Lucullus, the Roman general, first lost his reason, and afterwards his life, by one of them. Lucretius the poet ended his life by the same way; and Caius Caligula, as Suetonius reports, was driven into a fit of madness by a filter given him by his wife Cæsonia, which story is mentioned by the same poet. Ovid likewise assures us, that this was the usual effect of such potions. The ingredients they were made of were of various sorts; several of which applied by themselves were thought effectual.

FILTRATION, the act of passing any liquor through a filtre, called also *colature*, *percolation*, and *transcolation*. See the article FILTER.

FIMBRIÆ, *Fringes*. The extremities or borders of the tubæ fallopianæ are commonly thus called; the word signifying a *fringed border*, which that part resembles. See ANATOMY, p. 209.

FIMBRIATED, in heraldry, an ordinary with a narrow border or hem of another tincture.

FIN, in natural history, a well-known part of a fish, consisting of a membrane supported by rays, or little bony or cartilaginous ossicles. The office of the fins has been commonly supposed analogous to that of feathers in fowls; and to assist the fish in its progressive motion, or swimming; but the later naturalists find this a mistake. The tail is the great instrument of swimming: the fins only serve to keep the fish upright, and prevent vacillation or wavering. See ICHTHYOLOGY.

FINAL, in general, whatever terminates or concludes a thing; as *final* judgment, *final* sentence, &c.

FINAL *Cause*, is the end for which the thing is done. The final cause is the first thing in the intention of a person who does a thing; and the last in the execution. See CAUSE.

FINAL *Letters*, among the Hebrew grammarians, five letters so called, because they have a different figure at the end of words from what they have in any other situation.

FINAL, in geography, a port-town of Italy, subject to Genoa, and situated on the Mediterranean, about 37 miles southwest of that city. It was sold to the Genoese in 1713, by the emperor Charles VI. E. long. 9. 12. N. lat. 44. 30.

FINANCES, in the former French policy, denoted the revenues of the king and state: much the same with the English treasury or exchequer, and the fiscus of the Romans. The word is derived from the German *finantz*, "scraping, usury." Though Du Cange chooses rather to deduce it from the barbarous Latin *financia*, *præstatio pecuniaria*.

FINCH-KIND, in ornithology, an appellation given to a genus of birds known among authors by the name of FRINGILLA. See that article.

FINCH (Heneage), earl of Nottingham, the son of Sir Heneage Finch, some time recorder of London, and of a younger branch of the Winchelsea family, was born in 1621. By his good parts and diligence, he became a noted proficient in the municipal laws; was made solicitor general by Charles II. on his restoration, and was very active in the prosecution of the regicides. In 1670 he was appointed attorney-general; about three years after, lord keeper of the great seal, on the removal of the earl of Shaftesbury; and lord chancellor in 1675. He was created earl of Nottingham in 1681; and died the year following, being quite worn out by the fatigues of business. He published several speeches on the trials of the judges of king Charles I. with some few other things; and left behind him Chancery Reports in MS.

FINE, that which is pure and without mixture. The term is particularly used in speaking of gold or silver.

FINE, in law, hath various applications. Sometimes it is used for a formal conveyance of lands or tenements, or of any thing inheritable, being *in esse temporis finis*, in order to cut off all controversies. Others define it to be a final agreement be-

tween perſons, concerning any lands or rents, &c. of which any ſuit or writ is depending between them in any court.

FINE, ſometimes ſignifies a ſum of money paid for entering lands or tenements let by leaſe; and ſometimes a pecuniary mulct for an offence committed againſt the king and his laws, or againſt the lord of the manor.

FINES *for Alienation*, in feodal law; one of the attendants or conſequences of tenure by vaſſalſhip. *Knight-Service*, according to Blackſtone, was that of fines due to the lord for every alienation, whenever the tenant had occaſion to make over his land to another. This depended on the nature of the feodal connection; it not being reaſonable nor allowed, that a feudatory ſhould transfer his lord's gift to another, and ſubſtitute a new tenant to do the ſervice in his own ſtead, without the conſent of the lord: and, as the feodal obligation was conſidered as reciprocal, the lord alſo could not alienate his ſeignory without the conſent of his tenant, which conſent of his was called an *attornment*. This reſtraint upon the lord ſoon wore away; that upon the tenant continued longer. For, when every thing came in proceſs of time to be bought and ſold, the lords would not grant a licence to their tenants to aliene, without a fine being paid; apprehending that, if it was reaſonable for the heir to pay a fine or relief on the renovation of his paternal eſtate, it was much more reaſonable that a ſtranger ſhould make the ſame acknowledgment on his admiſſion to a newly-purchaſed feud. In England, theſe fines ſeem only to have been exacted from the king's tenants *in capite*, who were never able to aliene without a licence: but as to common perſons, they were at liberty, by *magna charta*, and the ſtatute of *quia emptores* (if not earlier), to aliene the whole of their eſtate, to be holden of the ſame lord as they themſelves held it of before. But the king's tenants *in capite*, not being included under the general words of theſe ſtatutes, could not aliene without a licence: for if they did, it was in ancient ſtrictneſs an abſolute forfeiture of the land; though ſome have imagined otherwiſe. But this ſeverity was mitigated by the ſtatute 1 Edw. III. c. 12. which ordained, that in ſuch caſe the lands ſhould not be forfeited, but a reaſonable fine be paid to the king. Upon which ſtatute it was ſettled, that one-third of the yearly value ſhould be paid for a licence of alienation; but, if the tenant preſumed to aliene without a licence, a full year's value ſhould be paid. The fines were at laſt totally taken away by ſtatute 12 Car. II. c. 24. See KNIGHT-*Service*.

FINE-*Drawing*, or *Rentering*, a dexterous ſewing up or rejoining the parts of any cloth, ſtuff, or the like, torn or rent in the dreſſing, wearing, &c. It is prohibited to *fine-draw* pieces of foreign manufacture upon thoſe of our own, as has formerly been practiſed. See RENTERING.

FINE-*Stiller*, in the diſtillery. That branch of the art which is employed on the diſtilling a ſpirit from treacle, or other preparations or recrements of ſugar, is called *fine-ſtilling*, by way of diſtinction from malt-ſtilling; and the perſon who exerciſes this part of the trade is called *a fine-ſtiller*. The operation in procuring the ſpirit from ſugar is the ſame with that uſed in making the malt-ſpirit; a waſh of the ſaccharine matter being made with water from treacle, &c. and fermented with yeaſt. It is uſual to add in this caſe, however, a conſiderable portion of malt, and ſometimes powdered jalap, to the fermenting backs. The malt accelerates the fermentation, and makes the ſpirit come out the cheaper, and the jalap prevents the riſe of any muſty head on the ſurface of the fermenting liquor, ſo as to leave a greater opportunity for the free acceſs of the air, and thus to ſhorten the work, by turning the foamy into a hiſſing fermentation.

FINERS *of* GOLD *and* SILVER, are thoſe who purify and part thoſe metals from other coarſer ones by fire and acids. They are alſo called *parters* in our old law-books, and ſometimes *departers*.

FINERY, in the iron-works, is one of the two forges at which they hammer the ſow or pig iron. Into the finery they firſt put the pigs of iron, placing three or four of them together behind the fire, with a little of one end thruſt into it; where, ſoftening by degrees, they ſtir and work them with long bars of iron, and expoſe at different times different parts to the blaſt of the bellows, in order to refine it as equally as poſſible, till the metal runs together with a round maſs or lump, which they call a *half bloom*. They then take this out, and give it a few ſtrokes with their ſledges; afterwards they carry it to a great heavy hammer, raiſed by the motion of a water wheel; where applying it dexterouſly to the blows, they preſently beat it out into a thick ſhort ſquare. This they put into the finery again, and heating it red-hot, they work it under the ſame hammer till it comes to be in the ſhape of a bar in the middle, but with two ſquare knobs at the ends, which they call an *ancony*. It is then carried into the other forge called the *chaffry*.

FINEERING See VENEERING.

FINESSE, a French term, of late current in Engliſh. Literally, it is of no farther import than our Engliſh *fineneſs*; but among us it is chiefly uſed to denote that peculiar delicacy or ſubtility perceived in works of the mind, and the niceſt and moſt ſecret and ſublime parts of any ſcience or art. It is ſometimes uſed to expreſs that kind of ſubtility made uſe of for the purpoſes of deception.

FINGAL, king of Morven, in ancient Caledonia. He flouriſhed in the third century; and, according to the Iriſh hiſtories, died in the year 283, although there is ſome reaſon, from Oſſian's poems, for placing his death a few years later. Fingal was deſcended in all probability from thoſe Celtic tribes who were the firſt inhabitants of Britain. Tradition, and the poems of Oſſian, give him a long line of royal anceſtors, ſuch as Combal, Trenmor, Trathal, &c. who had all reigned over the ſame territory. Whether this territory was bounded by the Caledonian foreſt, or extended ſomewhat farther to the ſouth, towards the Roman province, is uncertain; but there is no doubt of its having extended over all the north and weſt Highlands, comprehending the Hebrides, whoſe petty chiefs were all ſubject to the king of Morven. His principal place of reſidence was Selma, which was probably in the neighbourhood of Glenco, ſuppoſed to be the Cona of Oſſian; though ſome imagine it to have been in Strath-Conan in Moray. The truth ſeems to be, that as Fingal and his people lived by hunting, they often ſhifted their habitation. Hence, in all parts of the Highlands we find, in the names of places, buildings, &c. ſuch monuments as juſtify their ſeveral claims for the honour of Fingal's reſidence. Fingal acquired great fame by his prowеſs in arms. He made many ſucceſsful incurſions into the Roman province, from whence he carried away thoſe ſpoils which his ſon ſo often mentions under the names of the *wine of the ſtranger*, and the *wax of the ſtranger*. By ſea we find him frequently making voyages to Scandinavia, the Orkneys, and Ireland; called by Oſſian *Lochlin*, *Inniſtore*, and *Ullin*. Several of theſe expeditions were celebrated by his ſon in epic poems, of which two only remain, Fingal and Temora. In the laſt of theſe poems, we find Fingal fighting together with his grandſon Oſcar. How long he lived afterwards is uncertain. He is ſaid to have died a natural death; and therefore none of his ſon's poems relate to this event, though it is occaſionally mentioned in many of them. "Did thy beauty laſt, O Ryno? Stood the ſtrength of carborne Oſcar? Fingal himſelf paſſed away; and the halls of his fathers have forgot his ſteps. The blaſt of the north opens thy gates, O king, and I behold thee ſitting on miſt, dimly gleaming in all thine arms. Thy form now is not the terror of the valiant: but like a watery cloud, when we ſee the ſtars behind it, with their weeping eyes. Thy ſhield is like the aged moon; thy ſword vapour half kindled with fire. Dim and feeble is

the chief who travelled in brightnefs before—But thy fteps are on the winds of the defert, and the ftorms darken in thy hand. Thou takeft the fun in thy wrath, and hideft him in thy clouds. The fons of little men are afraid, and a thoufand fhowers defcend."—*Berrathon*.

"The character of Fingal (Dr. Blair obferves) is perhaps the moft perfect that was ever drawn by a poet, for we may boldly defy all the writers of antiquity to fhow us any hero equal to Fingal. Throughout the whole of Offian's works, he is prefented to us in all that variety of lights which give the full difplay of a character. In him concur almoft all the qualities that can ennoble human nature; that can either make us admire the hero, or love the man. He is not only unconquerable in war, but he makes his people happy by his wifdom in the days of peace. He is truly the father of his people. He is known by the epithet of 'Fingal of the mildeft look,' and diftinguifhed on every occafion by humanity and generofity. He is merciful to his foes, full of affection to his children, full of concern about his friends, and never mentions Agandecca, his firft love, without the utmoft tendernefs. He is the univerfal protector of the diftreffed; none ever went fad from Fingal.—'O Ofcar! bend the ftrong in arms, but fpare the feeble hand. Be thou a ftream of many tides againft the foes of thy people; but like the gale that moves the grafs to thofe who afk thine aid: fo Trenmor lived; fuch Trathal was; and fuch has Fingal been. My arm was the fupport of the injured: the weak refted behind the lightning of my fteel.' Thefe were the maxims of true heroifm, to which he formed his grandfon. His fame is reprefented as every where fpread; the greateft heroes acknowledge his fuperiority; his enemies tremble at his name; and the higheft encomiums that can be beftowed on one whom the poet would moft exalt, is to fay, that his foul was like the foul of Fingal. Wherever he appears, we behold the hero. The objects he purfues are always great; to bend the proud, to protect the injured, to defend his friends, to overcome his enemies by generofity more than by force. Some ftrokes of human imperfection and frailty are what ufually give us the moft clear view and the moft fenfible impreffion of a character, becaufe they prefent to us a man fuch as we have feen; they recall known features of human nature. When poets go beyond this range, and attempt to defcribe a faultlefs hero, they, for the moft part, fet before us a fort of vague undiftinguifhable character, fuch as the imagination cannot lay hold of, or realife to itfelf as the object of affection. But Fingal, though exhibited without any of the common human failings, is neverthelefs a real man; a character which touches and interefts every reader."

We may obferve, that Fingal appears to have been no lefs a poet than a warrior; at leaft, in all thofe paffages afcribed to him in the poems of his fon, there is a grandeur and loftinefs that elevates them above the common ftyle even of Offian. The following paffage from the poem of *Carthon* may be taken as a fpecimen of Fingal's poetry. "—'Raife, ye bards,' faid the mighty Fingal, 'the praife of unhappy Moina. Call her ghoft, with your fongs, to our hills; that fhe may reft with the fair of Morven, the funbeams of other days, and the delight of heroes of old.—I have feen the walls of Balclutha, but they were defolate. The fire had refounded in the halls; and the voice of the people is heard no more. The ftream of Clutha was removed from its place by the fall of the walls. The thiftle fhook, there, its lonely head: the mofs whiftled to the wind. The fox looked out from the windows; the rank grafs of the wall waved round his head. Defolate is the dwelling of Moina: filence is in the houfe of her fathers. Raife the fong of mourning, O bards, over the land of ftrangers. They have but fallen before us; for, one day we muft fall.—Why doft thou build the hall, fon of the winged days? Thou lookeft from thy towers to-day; yet a few years, and the blaft of the defert comes; it howls in thy empty court, and whiftles round thy half-worn fhield.—And let the blaft of the defert come! We fhall be renowned in our day. The mark of my arm fhall be in the battle, and my name in the fong of bards. Raife the fong; fend round the fhell: and let joy be heard in my hall. When thou, fun of heaven, fhalt fail! if thou fhalt fail, thou mighty light! if thy brightnefs is for a feafon, like Fingal; our fame fhall furvive thy beams.'—Such was the joy of Fingal in the day of his joy. His thoufand bards leaned forward from their feats, to hear the voice of the king. It was like the mufic of the harp on the gale of the fpring. Lovely were thy thoughts, O Fingal! Why had not Offian the ftrength of thy foul? But thou ftandeft alone, my father; and who can equal the king of Morven?"

FINGERS, in anatomy, the extreme part of the hand divided into five members. See ANATOMY, p. 167.

FINING *of* LIQUORS. See CLARIFICATION.

FINISTERRE, the moft wefterly cape or promontory of Spain, in 10. 15. W. long. and 43° N. lat. This cape is likewife the moft wefterly part of the continent of Europe.

FINISTERRE, a department of France, which includes part of the late province of Bretagne. Its name correfponds to our word, the Land's End, it being the moft wefterly part of France. Quimper is the epifcopal town.

FINITE, fomething bounded or limited, in contradiftinction to INFINITE.

FINLAND (the duchy of), is bounded on the weft by the gulph of Bothnia, on the eaft by Mufcovy, on the fouth by the gulph of Finland and Ingria, and on the north by Bothnia and Lapland. It is about 200 miles in length, and almoft as much in breadth. It contains many lakes; in which are feveral iflands, which are generally rocks or inacceffible mountains. The inhabitants are fmall of ftature, capable of enduring hardfhips, and good foldiers. The Ruffians have for fome time rendered themfelves mafters of a good part of this province; the reft belongs to Sweden. It is divided into feven provinces: 1. Finland; 2. Cajana; 3. Thavafthia; 4. Nyeland; 5. Savolaxia; 6. Carelia; and, 7. Kexholmia. *Finland Proper* is an agreeable country, and lies over-againft the city of Stockholm, near the place where the gulphs of Bothnia and Finland meet. It is divided into South and North Finland. It is diverfified with mountains, forefts, lakes, meadows, and pleafant fields. The inhabitants falt the fifh they do not confume themfelves, and fend it into foreign countries.

FIR-TREE, in botany. See PINUS.

FIRE, in phyfiology, fignifies that fubtle invifible caufe by which bodies are expanded or enlarged in bulk, and become hot to the touch; fluids are rarefied into vapour; folid bodies become fluid, and in like manner are at laft diffipated, or, if incapable of being carried off in vapour, are at length melted into glafs. It feems likewife to be the chief agent in nature on which animal and vegetable life have an immediate dependence, and without which it does not appear that nature itfelf could fubfift a fingle moment.

The difputes concerning fire, which for a long time divided philofophers, have now in a great meafure, though not wholly, fubfided. The celebrated philofophers of the laft century, Bacon, Boyle, and Newton, were of opinion, that fire was no diftinct fubftance from other bodies, but that it confifted entirely in the violent motion of the parts of any body. As no motion, however, can be produced without a caufe, they were obliged to have recourfe to a mechanical force or impulfe as the ultimate caufe of fire in all cafes. Thus Boyle tells us, that when a piece of iron becomes hot by hammering, "there is *nothing* to make it fo, except the forcible motion of the hammer impreffing a vehement and varioufly-determined agitation on the fmall parts of the iron." Bacon defines *heat*, which he makes fynonymous

with fire, to be "an expanfive undulatory motion in the minute particles of a body, whereby they tend with fome rapidity from a centre towards a circumference, and at the fame time a little upwards." Sir Ifaac Newton faid nothing pofitive upon the fubject; but conjectured that grofs bodies and light might be convertible into one another; and that great bodies of the fize of our earth, when violently heated, might continue and increafe their heat by the mutual action and reaction of their parts.

But while the mechanical philofophers thus endeavoured to account for the phenomena of fire, upon the fame principles which they judged fufficient to explain thofe of the univerfe in general, the chemifts as ftrenuoufly afferted that fire was a fluid of a certain kind, diftinct from all others, and univerfally prefent throughout the whole globe. Boerhaave particularly maintained this doctrine; and in fupport of it brought the following argument: that fteel and flint would ftrike fire, and produce the very fame degree of heat in Nova Zembla which they would do under the equator. Other arguments were drawn from the increafed weight of metalline calces, which they fuppofed to proceed from the fixing of the element of fire in the fubftance whofe weight was thus increafed. By thefe experiments, Mr. Boyle himfelf feems to have been ftaggered; as he publifhed a treatife on the poffibility of making fire and flame ponderable; though this was directly contrary to his own principles already quoted. For a long time, however, the matter was moft violently difputed; and the mechanical philofophers, though their arguments were equally inconclufive with thofe of their adverfaries, at laft prevailed through the prejudice in favour of Sir Ifaac Newton, who indeed had fcarce taken any active part in the conteft.

That the caufe of fire cannot be any mechanical motion which we can imprefs, is very evident; becaufe on mechanical principles an effect muft always be proportionable to the caufe. In the cafe of fire, however, the effect is beyond all calculation greater than the caufe, fuppofing the latter to be only a mechanical percuffion, as in the cafe of hammering iron till it be red hot. By a few ftrokes of an hammer, the particles of a piece of iron, we fhall allow, may be fet in a violent motion, and thus produce fire. If, however, we direct the motion of thefe particles upon another body whofe parts are at reft, and in fome degree coherent, it is plain that the latter will refift and diminifh the motion of the particles already moved, in proportion to their *vis inertiæ*, as well as the cohefion of the parts of the fecond body, if indeed we can fuppofe the *vis inertiæ* of matter to be different from the effect of gravitation, cohefion, or fome other power acting upon it. By no argumentation whatever, then, can we fhow upon mechanical principles, why fire fhould have fuch a tendency to increafe and multiply itfelf without end, as we fee it has, even abftracting from all confideration of the neceffity of air for continuing the action of fire.

The action of the air, in augmenting and continuing the power of fire, feems fcarce at all to have been confidered by thofe who firft undertook an inveftigation of the fubject. It evidently gave rife to the Hutchinfonian hypothefis, that fire, light, and air, were convertible into one another. This, however, is equally untenable with the mechanical hypothefis: for later difcoveries have fhown, that our atmofphere is compofed of two diftinct fluids, only one of which is fit for fupporting flame: and if we fhould fuppofe this to be the only proper air, it is in like manner demonftrated, that this pure fluid is not homogeneous, but compofed of a gravitating and non-gravitating fubftance; the latter of which only has the properties of fire: fo that this element is ftill as invifible as ever; nor can it be fhown by any experiment that fire *per fe* has ever been changed into a palpable or gravitating fubftance.

The experiments which firft feemed to bring this difpute to a decifion were thofe of Dr. Black, concerning what he called *latent heat*; on which fome other names, fuch as *abfolute heat*, *fpecific fire*, &c. have been beftowed, very little to the advancement of fcience in general. From thefe difcoveries it appears, that fire may exift in bodies, in fuch a manner as not to difcover itfelf in any other way than by its action upon the minute parts of the body; but that fuddenly this action may be changed in fuch a manner as no longer to be directed upon the particles of the body itfelf, but upon external objects: in which cafe we then perceive its action by our fenfe of feeling, or difcover it by the thermometer, and call it *fenfible heat*. This expreffion, it muft be owned, is improper; and the ufe of the word *heat*, inftead of *fire*, has produced fome confufion, which it is not now eafy to avoid in fpeaking on thefe fubjects. By the word *heat*, we ought always to underftand the effect of fire, or the fluid acting in a certain manner, rather than the mere element itfelf; which, it is certain, from the experiments juft mentioned, may exift in fubftances actually *cold* to the touch.

From this difcovery made by Dr. Black, along with many others in electricity, and recorded at length in various articles of this work, it is now almoft univerfally allowed, that fire is a diftinct fluid, capable of being transferred from one body to another. But when this was difcovered, another queftion no lefs perplexing occurred, viz. what kind of a fluid it was; or whether it bears any analogy to thofe with which we are better acquainted? Here we find two fluids, viz. the folar light and the electric matter, both of which occafionally act as fire, and which therefore feem likely to be all the fame at bottom. By the vulgar, indeed, the matter has long ago been determined; and the rays of the fun as well as the electrical fluid have been promifcuoufly denominated *elementary fire*. Philofophers, indeed, have withheld their affent; though their reafons for fo doing are by no means apparent. The moft ftrange fuppofitions, however, have been made concerning the nature of both thefe fluids; and on the moft flender grounds imaginable, or rather on no grounds at all, they have been fuppofed to be phlogifton itfelf, or to contain a large proportion of it. Mr. Scheele went fo far in this way as to form an hypothefis, which he endeavoured to fupport by fome experiments, that fire is compofed of dephlogifticated air and phlogifton. But it is now afcertained beyond all poffibility of difpute, that the refult of fuch a combination is not fire, but fixed air: fo that we need not take any farther notice of this hypothefis than juft to obferve, that it would have been altogether untenable, even though this difcovery had not been made; becaufe the dephlogifticated air itfelf is not a fimple but a compound fubftance, as has already been obferved; and that in all cafes of combuftion the one part of the air is feparated from the other.

It was long ago obferved by Sir Ifaac Newton, that heat was certainly conveyed by a medium more fubtle than the common air; becaufe two thermometers, one included in the vacuum of an air-pump, the other placed in the open air, at an equal diftance from the fire, would grow equally hot in nearly the fame time. The confequence of this, had he purfued the thought, was, that fire itfelf was equally prefent in all places, and as active where there was no terreftrial matter as where there was. New improvements in the air-pump have enabled fucceeding philofophers to make more perfect vacuums, fuch as it has been fuppofed even the electric matter cannot pafs through. It is not to be doubted, however, that, even there, the thermometer would be heated by a fire as well as in the open air. Fire, therefore, exifts and acts where there is no other matter, and of confequence is a fluid *per fe*, independent of every terreftrial fubftance, without being generated or compounded of any thing we are yet acquainted with. To determine the nature of the fluid, we have only to confider whether any other can be difcovered which will pafs through the perfect vacuum juft mentioned, and act there as fire. Such a fluid we find in the folar

light, which is well known to act even *in vacuo* as the moſt violent fire. The ſolar light will likewiſe act in the very ſame manner in the moſt intenſe cold; for M. de Sauſſure has found, that on the cold mountain top the ſun-beams are equally, nay more powerful than on the plain below. It appears, therefore, that the ſolar light will produce heat independent of any other ſubſtance whatever; that is, where no other body is preſent, at leaſt as far as we can judge, except the light itſelf, and the body to be acted upon. We cannot therefore avoid concluding, that a certain modification of the light of the ſun is the cauſe which produces heat, expanſion, vapour, &c. and anſwers to the reſt of the characters given in our definition of fire, and that independent of any other ſubſtance whatever.

Under the article ELECTRICITY, ſect. xxii. we have endeavoured to ſhow, that the electric matter is no other than the light of the ſun abſorbed by the earth, and thus becoming ſubject to new laws, and aſſuming many properties apparently different from what it has when it acts as light. Even in this caſe it manifeſts its identity with fire or light, *viz.* by producing a moſt intenſe heat where a large quantity of it paſſes through a ſmall ſpace. *In vacuo*, indeed, we cannot manage it in ſuch a manner as to make the proof deciſive. But though this muſt be accounted a defect, it never can amount to any poſitive proof that electricity and fire are different. We ſee that in ſome caſes they produce the very ſame effects; and if they do not ſo in all, we ought rather to account for the difference from the variation of circumſtances, and our want of knowledge or abilities to make proper experiments, than to multiply elements without any neceſſity, when one is evidently capable of anſwering all the purpoſes of nature. At any rate, the experiments which have already been made, and the proofs adduced from the phenomena of nature, ſhow ſuch a ſtrong affinity between the elements of fire, light, and electricity, that we may not only aſſert their identity upon the moſt probable grounds, but lay it down as a poſition againſt which no argument of any weight has an exiſtence at preſent. For a further diſcuſſion of this ſubject, ſee CHEMISTRY, p. 372. ELECTRICITY, ſect. xxii. HEAT, FLAME, FLUIDITY, &c.

Wild FIRE, a kind of artificial or factitious fire, which burns even under water. It is compoſed of ſulphur, pitch, nitre, and various other combuſtible materials; and is very hard to extinguiſh. Chemiſtry, however, has ſupplied a ſtill more deſtructive kind of wild fire, in the union of nitrous acid with oil of turpentine. Theſe two liquids ſeparately are perfectly cold; but, when ſuddenly mixed, produce a flame not eaſily extinguiſhed. This, with great appearance of reaſon, is ſuppoſed to be the wild-fire of the ancients, who, incloſing the two liquids in a glaſs ball which had a partition to keep them aſunder, threw the ball into ſome ſhip of the enemy's; and the globe being thus broken, the liquids united and ſet the veſſel in flames. The French call it *Greek fire*, or *feu Gregeois*, becauſe firſt uſed by the Greeks, about the year 660; as is obſerved by the Jeſuit Petavius, on the authority of Nicetas, Theophanes, Cedrenus, &c.

The inventor, according to the ſame Jeſuit, was an engineer of Heliopolis in Syria, named *Callinicus*, who firſt applied it in the ſea-fight commanded by Conſtantine Pogonates againſt the Saracens, near Cyzicus, in the Helleſpont; and with ſuch effect, that he burnt the whole fleet therewith, wherein were 30,000 men. But others will have it of a much older date; and hold Marcus Gracchus the inventor: which opinion is ſupported by ſeveral paſſages both in the Greek and Roman writers, which ſhows it to have been anciently uſed by both theſe nations in their wars.

Conſtantine's ſucceſſors uſed it on many occaſions with equal advantage as himſelf; and what is remarkable enough is, that they were ſo happy as to keep the ſecret of the compoſition to themſelves, ſo that in the year 960 no other nation knew it. Hugh king of Burgundy, demanding ſhips of the emperor Leo for the ſiege of Freſne, deſired likewiſe the Greek fire.

F. Daniel gives us a good deſcription of the Greek fire in his account of the ſiege of Damietta under St. Louis. Every body, ſays that author, was aſtoniſhed with the Greek fire, which the Turks then prepared; and the ſecret whereof is now loſt. They threw it out of a kind of mortar; and ſometimes ſhot it with an odd ſort of croſs-bow, which was ſtrongly bent by means of a handle or winch, of much greater force than the mere arm. That thrown with the mortar ſometimes appeared in the air of the ſize of a tun, with a long tail, and a noiſe like that of thunder. The French by degrees got the ſecret of extinguiſhing it; in which they ſucceeded ſeveral times.

Machine for Preſerving from FIRE. This machine conſiſts of a pole, a rope, and a baſket. The pole is of fir, or a common ſcaffold pole, of any convenient length from 36 to 46 feet; the diameter at bottom, or greateſt end, about five inches; and at the top, or ſmalleſt end, about three inches. At three feet from the top is a mortiſe through the pole, and a pully fixed to it of nearly the ſame diameter with the pole in that part. The rope is about three quarters of an inch diameter, and twice the length of the pole, with a ſpring hook at one end, to paſs through the ring in the handle of the baſket when uſed: it is put through the mortiſe over the pulley, and then drawn tight on each ſide to near the bottom of the pole, and made faſt there till wanted. The baſket ſhould be of ſtrong wicker-work, three feet and a half long, two feet and a half wide, rounded off at the corners, and four feet deep, rounding every way at the bottom. To the top of the baſket is fixed a ſtrong iron curve or handle, with an eye or ring in the middle; and to one ſide of the baſket, near the top, is fixed a ſmall cord, or guide-rope, of about the length of the pole. When the pole is raiſed, and ſet againſt a houſe over the window from which any perſons are to eſcape, the manner of uſing it is ſo plain and obvious, that it need not be deſcribed. The moſt convenient diſtance from the houſe for the foot of the pole to ſtand, where practicable, is about 12 or 14 feet. If two ſtrong iron ſtraps, about three feet long, riveted to a bar croſs, and ſpreading about 14 inches at the foot, were fixed at the bottom of the pole, this would prevent its turning round or ſlipping on the pavement. And if a ſtrong iron hoop, or ferule, riveted (or welded) to a ſemicircular piece of iron ſpreading about 12 inches, and pointed at the ends, were fixed on at the top of the pole, it would prevent its ſliding againſt the wall.

When theſe two laſt mentioned irons are fixed on, they give the pole all the ſteadineſs of a ladder; and becauſe it is not eaſy, except to perſons who have been uſed to it, to raiſe and ſet upright a pole of 40 feet or more in length, it will be convenient to have two ſmall poles or ſpars of about two inches diameter, fixed to the ſides of the great pole at about two or three feet above the middle of it, by iron eyes riveted to two plates, ſo as to turn every way; the lower end of theſe ſpars to reach within a foot of the bottom of the great pole, and to have ferules and ſhort ſpikes to prevent ſliding on the pavement, when uſed occaſionally to ſupport the great pole like a tripod. There ſhould be two ſtrong aſh trundles let through the pole, one at four feet and one at five feet from the bottom, to ſtand out about eight inches on each ſide, and to ſerve as handles, or to twiſt the rope round in lowering a very heavy weight. If a block and pulley were fixed at about the middle of the rope, above the other pulley, and the other part of the rope made to run double, it would diminiſh any weight in the baſket nearly one-half, and be very uſeful in drawing any perſon up, to the aſſiſtance of thoſe in the chambers, or for removing any effects out of a chamber, which it might be dangerous to attempt by the ſtairs.

It has been proved, by repeated trials, that ſuch a pole as we have been ſpeaking of can be raiſed from the ground, and

two or three perſons taken out of the upper windows of a houſe, and let down ſafely in the ſtreet, in the ſpace of 35 ſeconds, or a little more than half a minute. Sick and infirm perſons, women, children, and many others, who cannot make uſe of a ladder, may be ſafely and eaſily brought down from any of the windows of a houſe on fire by this machine, and, by putting a ſhort pole through the handles of the baſket, may be removed to any diſtance without being taken out of the baſket. The pole muſt always have the rope ready fixed to it, and may be conveniently laid up upon two or three iron hooks under any ſhade or gateway, and the baſket ſhould be kept at the watch-houſe. When the pole is laid up, the two ſpars ſhould always be turned towards the head of it. The baſket ſhould be made of peeled rods, and the pole and ſpars painted of a light ſtone-colour, to render it more viſible when uſed in the night.

Machines for extinguiſhing Fire. In the year 1734, the ſtate of Sweden offered a premium of 20,000 crowns for the beſt method of ſtopping the progreſs of accidental fires; when one Mr. Fuches, a German phyſician, made a preparation for that end, and the experiment was tried on a houſe built on purpoſe, of dry fir, at Legard iſland. In the building were placed ſeveral tubs of tar and pitch, and a great quantity of chips, all which were ſet on fire; flames iſſuing through the top of the houſe, windows, &c. when he threw in one of the barrels containing the preparation, which immediately quenched the flames; a ſecond barrel entirely cleared the ſmoke away; and the whole was executed to the ſatisfaction of the ſpectators, and to the no ſmall ſatisfaction of the inventor, who was about to return home, when unexpectedly the flames broke out again, ſuppoſed to be occaſioned by a ſmall quantity of combuſtible matter being introduced and ſet on fire ſecretly by ſome malicious perſon. Upon this the wrong-headed mob fell upon Mr. Fuches, and beat him moſt unmercifully, ſo that he narrowly eſcaped with his life. He ſoon after left the country, and never could be prevailed on (though ſtrongly perſuaded by ſome of the moſt eminent citizens) to return. It is ſaid, another experiment of the ſame kind was tried in the year 1761 in Holland; but rendered abortive through the perverſeneſs of the populace.

Attempts of a ſimilar nature have met with a better reception in England. Of theſe the moſt ſucceſsful was that of Mr. Godfrey, whoſe contrivance is thus deſcribed by Mr. Ambroſe Godfrey, grandſon to the inventor. "The machine to be employed conſiſts of a ſmall portion of gunpowder cloſely confined; which, when animated by fire, acts by its elaſtic force upon a proper medium, and not only divideth it into the minuteſt atoms, but diſperſeth it alſo in every direction, ſo as immediately to extinguiſh any fire within a certain diſtance. This medium is a liquor ſtrongly impregnated with a preparation of antiphlogiſtic principles, which by their action upon burning materials extinguiſh the flames, and reduce them in general to the ſtate of a black coal; and, by its oppoſite nature to fire, hinders the remaining ſparks, notwithſtanding the admiſſion of the air, from kindling the flames afreſh. By this means, the great point is obtained, in giving ſufficient time for totally extinguiſhing any remains of fire." From this account, however, nothing can be made out; and the quackery of concealment, in a matter that ſo nearly concerns the welfare of the human race, can only be accounted for on the ſcore of its inſufficiency, or the impoſſibility of making it generally uſeful.

The mode of employing theſe machines, was that of throwing them into the different rooms of the houſe in which the flames began to appear. Uſed in this way, if the invention really poſſeſſed the merit aſcribed to it, it evidently would have been of great uſe in extinguiſhing fires on ſhipboard; and would probably have been conſidered as a no leſs neceſſary part of a ſhip's lading, than her ſtores or ammunition.

The hint of theſe machines is ſaid to have been taken by Dr. Godfrey from the invention of one Zachary Greyl, who exhibited ſimilar machines, but without meeting with encouragement. His, however, were made of wood, and the liquor employed was inferior to Dr. Godfrey's in its power of extinguiſhing fire. The latter is ſaid to have uſed potaſh, alum, ſal ammoniac, or ſome other ſaline matter. Theſe machines, however, only proved ſerviceable in the beginning of a fire. When the roof had fallen in, they had no effect.

Water-Engine for Extinguiſhing Fire. See Hydrostatics. In uſing this machine we have the following improvement by Dr. Hoffman, which promiſes to be of great efficacy. As ſoon as the engine is in readineſs to work, ſtir into the water that immediately is to be diſcharged, ſeven or eight pounds of pearl-aſhes in powder, and continue to add it in this manner as occaſion requires; taking care that it be directed againſt the timber or wainſcot, &c. juſt beginning to burn, and not waſted againſt the brickwork; or, where time will admit, diſſolve any quantity of pearl-aſhes in a copper with water, and as faſt as it diſſolves, which will be in a few minutes, mix a pail full with the water in the engine, pretty often; and whatever burning wood it is played upon will be extinguiſhed as if it was dipped in water, and will not burn afreſh in the part extinguiſhed.

Method of Extinguiſhing Fire *in Chimneys*. It is well known, that the inner parts of chimneys eaſily take fire; the ſoot that kindles therein emits a greater flame, according as the tunnel is more elevated, becauſe the current of air feeds the fire. If this current could therefore be ſuppreſſed, the fire would ſoon be extinguiſhed. In order to this, ſome diſcharge a piſtol into the chimney, which produces no effect. Water thrown into the chimney at top is equally uſeleſs, becauſe it comes down through the middle of the tunnel, and not along the ſides. It would be more adviſable to ſtop, with a wet blanket, the upper orifice of the tunnel: but the ſureſt and readieſt method is, to apply the blanket either to the throat of the chimney, or over the whole front of the fire-place. If there happens to be a chimney board or a regiſter, nothing can be ſo effectual as to apply them immediately; and having by that means ſtopped the draught of air from below, the burning ſoot will be put out as readily and as completely as a candle is put out by an extinguiſher, which acts exactly upon the ſame principle.

Securing Buildings againſt Fire. Dr. Hales propoſes to check the progreſs of fires by covering the floors of the adjoining rooms with earth. The propoſal is founded on an experiment which he made with a fir-board half an inch thick, part of which he covered with an inch depth of damp garden mould, and then lighted a fire on the ſurface of the mould; though the fire was kept up by blowing, it was two hours before the board was burnt through, and the earth prevented it from flaming. The thicker the earth is laid on the floors, the better: however, Dr. Hales apprehends that the depth of an inch will generally be ſufficient: and he recommends to lay a deeper covering on the ſtairs, becauſe the fire commonly aſcends by them with the greateſt velocity.

Mr. Hartley made ſeveral trials in they ears 1775 and 1776, in order to evince the efficacy of a method which he had invented for reſtraining the ſpread of fire in buildings. For this purpoſe, thin iron plates were well nailed to the tops of the joiſts, &c. the edges of the ſides and ends being lapped over, folded together, and hammered cloſe. Partitions, ſtairs, and floors, may be defended in the ſame manner; and plates applied to one ſide have been found ſufficient. The plates are ſo thin as not to prevent the floor from being nailed on the joiſts, in the ſame manner as if this preventative were not uſed: they are kept from ruſt by being painted or varniſhed with oil and turpentine. The expence of this addition, when extending through a whole

building, is reckoned at about 5 *per cent.* Mr. Hartley has a patent for this invention, and parliament has voted a ſum of money towards defraying the expence of his numerous experiments. The ſame preſervative may alſo be applied to ſhips, furniture, &c.

The Earl of Stanhope alſo diſcovered and publiſhed a very ſimple and effectual method of ſecuring every kind of building againſt fire. This method he has divided into three parts, viz. under-flooring, extra-lathing, and inter-ſecuring. The method of *under-flooring* is either ſingle or double. In ſingle under-flooring, a common ſtrong lath of oak or fir, about one-fourth of an inch thick, ſhould be nailed againſt each ſide of every joiſt, and of every main timber, ſupporting the floor which is to be ſecured. Other ſimilar laths are then to be nailed along the whole length of the joiſts, with their ends butting againſt each other. The top of each of theſe laths or fillets ought to be at $1\frac{1}{2}$ inch below the top of the joiſts or timbers againſt which they are nailed; and they will thus form a ſort of ſmall ledge on each ſide of all the joiſts. Theſe fillets are to be well bedded in a rough plaſter hereafter mentioned, when they are nailed on, ſo that there may be no interval between them and the joiſts; and the ſame plaſter ought to be ſpread with a trowel upon the tops of all the fillets, and along the ſides of that part of the joiſts which is between the top of the fillets and the upper edge of the joiſts. In order to fill up the intervals between the joiſts that ſupport the floor, ſhort pieces of common laths, whoſe length is equal to the width of theſe intervals, ſhould be laid in the contrary direction to the joiſts, and cloſe together in a row, ſo as to touch one another: their ends muſt reſt upon the fillets, and they ought to be well bedded in the rough plaſter, but are not to be faſtened with nails. They muſt then be covered with one thick coat of the rough plaſter, which is to be ſpread over them to the level of the tops of the joiſts: and in a day or two this plaſter ſhould be trowelled over cloſe to the ſides of the joiſts, without covering the tops of the joiſts with it.

In the method of double-flooring, the fillets and ſhort pieces of laths are applied in the manner already deſcribed; but the coat of rough plaſter ought to be little more than half as thick as that in the former method. Whilſt this rough plaſter is laid on, ſome more of the ſhort pieces of laths above mentioned muſt be laid in the intervals between the joiſts upon the firſt coat, and be dipped deep in it. They ſhould be laid as cloſe as poſſible to each other, and in the ſame direction with the firſt layer of ſhort laths. Over this ſecond layer of ſhort laths there muſt be ſpread another coat of rough plaſter, which ſhould be trowelled level with the tops of the joiſts without riſing above them. The rough plaſter may be made of coarſe lime and hair; or, inſtead of hair, hay chopped to about three inches in length may be ſubſtituted with advantage. One meaſure of common rough ſand, two meaſures of ſlaked lime, and three meaſures of chopped hay, will form in general a very good proportion, when ſufficiently beat up together in the manner of common mortar. The hay ſhould be put in after the two other ingredients are well beat up together with water. This plaſter ſhould be made ſtiff; and when the flooring boards are required to be laid down very ſoon, a fourth or fifth part of quicklime in powder, formed by dropping a ſmall quantity of water on the limeſtone a little while before it is uſed, and well mixed with this rough plaſter, will cauſe it to dry very faſt. If any cracks appear in the rough plaſter-work near the joiſts when it is thoroughly dry, they ought to be cloſed by waſhing them over with a bruſh wet with mortar-waſh: this waſh may be prepared by putting two meaſures of quicklime and one of common ſand in a pail, and ſtirring the mixture with water till the water becomes of the conſiſtence of a thin jelly.

Before the flooring boards are laid, a ſmall quantity of very dry common ſand ſhould be ſtrewed over the plaſter-work, and ſtruck ſmooth with an hollow rule, moved in the direction of the joiſts, ſo that it may lie rounding between each pair of joiſts. The plaſter-work and ſand ſhould be perfectly dry before the boards are laid, for fear of the dry rot. The method of under-flooring may be ſucceſsfully applied to a wooden ſtair caſe; but no ſand is to be laid upon the rough plaſter-work. The method of extra-lathing may be applied to ceiling joiſts, to ſloping roofs, and to wooden partitions.

The third method, which is that of *inter ſecuring*, is very ſimilar to that of under-flooring; but no ſand is afterwards to be laid upon it. Inter-ſecuring is applicable to the ſame parts of a building as the method of extra-lathing, but it is ſeldom neceſſary.

The author of this invention made ſeveral experiments, in order to demonſtrate the efficacy of theſe methods. In moſt houſes it is only neceſſary to ſecure the floors; and the extra-expence of under-flooring, including all materials, is only about nine-pence per ſquare yard, and with the uſe of quick-lime a little more. The extra expence of extra-lathing is no more than ſix-pence per ſquare yard for the timber ſide-walls and partitions; but for the ceiling about nine-pence per ſquare yard. But in moſt houſes no extra-lathing is neceſſary.

Fire-*Eater*. We have a great number of mountebanks who have procured the attention and wonder of the public by eating of fire, walking on fire, waſhing their hands in melted lead, and the like tricks. The moſt celebrated of theſe was our countryman Richardſon, much talked of abroad. His ſecret, as related in the *Journal des Sçavans*, of the year 1680, conſiſted in a pure ſpirit of ſulphur, wherewith he rubbed his hands, and the parts that were to touch the fire; which burning and cauteriſing the epidermis, hardened and enabled the ſkin to reſiſt the fire. This Ambroſe Paré aſſures us he had tried on himſelf; and that after waſhing the hands in urine, and with unguentum aureum, one may ſafely waſh them in melted lead. He adds alſo, that by waſhing his hands in the juice of onions, he could bear a hot ſhovel on them while it melted lead. Notwithſtanding theſe aſſertions, we ſhould be ſorry to recommend a repetition of theſe experiments to any of our readers.

Fire, in theology. See Hell. We read of the ſacred fire in the firſt temple of Jeruſalem, which came down from heaven; it was kept with the utmoſt care, and they were forbidden to carry any ſtrange fire into the temple. This fire is one of the five things which the Jews confeſs were wanting in the ſecond temple. The pagans had their ſacred fires, which they kept in their temples with the moſt religious care, and which were never to be extinguiſhed. Numa was the firſt who built a temple to Fire as a goddeſs, at Rome, and inſtituted an order of prieſteſſes for the preſervation of it. See Vestals. Fire was the ſupreme god of the Chaldeans; the Magi were worſhippers of fire; and the Greeks and Armenians ſtill keep up a ceremony called the *holy fire*, upon a perſuaſion that every Eaſter-day a miraculous fire deſcends from heaven into the holy ſepulchre, and kindles all the lamps and candles there.

Fire-*Barrel*. See *Fire* Barrel.

Fire-*Bavins*. Ibid.

Fire-*Arrow*, in naval artillery, is a ſmall iron dart furniſhed with ſprings and bars, together with a match impregnated with ſulphur and powder, which is wound about its ſhaft. It is intended to fire the ſails of the enemy, and is for this purpoſe diſcharged from a muſquetoon or ſwivel-gun. The match, being kindled by the exploſion, communicates the flame to the ſail againſt which it is directed, where the arrow is faſtened by means of its bars and ſprings. This weapon is peculiar to hot climates, particularly the Weſt Indies, where the ſails being extremely dry by reaſon of the great heats, they inſtantly take

fire, and of courſe ſet fire to the maſts and rigging, and laſtly to the veſſel itſelf.

Fire-*Ball*, in artillery, a compoſition of meal-powder, ſulphur, ſalt-petre, pitch, &c. about the bigneſs of a hand-grenade, coated over with flax, and primed with the flow compoſition of a fuze. This is to be thrown into the enemy's works in the night-time, to diſcover where they are, or to fire houſes, galleries, or blinds of the beſiegers; but they are then armed with ſpikes or hooks of iron, that they may not roll off, but ſtick or hang where they are deſired to have an effect. See *Fire-*Balls, and *Light-*Balls.

Balls of Fire, in meteorology. See Balls *of Fire*.

Fire-*Cocks*. Churchwardens in London and within the bills of mortality are to fix fire-cocks at proper diſtances in ſtreets, and keep a large engine and hand-engine for extinguiſhing fires, under the penalty of 10l. ſtat. 6 Ann. c. 31. On the breaking out of any fire in London or Weſtminſter, the conſtables and beadles of pariſhes ſhall repair to the place with their ſtaves, and aſſiſt in extinguiſhing it, and cauſe the people to work for that end, &c.

Fire-*Engine*. See Steam-*Engine*.

Fire-*Flair*, in icthyology. See Raja.

Fire-*Flies*, a ſpecies of flies common in Guiana, of which there are two ſpecies. The largeſt is more than an inch in length, having a very large head connected with the body by a joint of a particular ſtructure, with which at ſome times it makes a loud knock, particularly when laid on its back. The fly has two feelers or horns, two wings, and ſix legs. Under its belly is a circular patch, which, in the dark, ſhines like a candle; and on each ſide of the head near the eyes is a prominent, globular, luminous body, in ſize about one-third larger than a muſtard-ſeed. Each of theſe bodies is like a living ſtar, emitting a bright, and not ſmall, light; ſince two or three of theſe animals, put into a glaſs-veſſel, afford a light ſufficient to read without difficulty, if placed cloſe to the book. When the fly is dead, theſe bodies will ſtill afford conſiderable light, though it is leſs vivid than before; and if bruiſed, and rubbed over the hands or face, they become luminous in the dark, like a board ſmeared over with Engliſh phoſphorus. They have a reddiſh-brown or cheſnut colour; and live in rotten trees in the day, but are always abroad in the night. The other kind is not more than half as large as the former: their light proceeds from under their wings, and is ſeen only when they are elevated, like ſparks of fire appearing or diſappearing at every ſecond. Of theſe the air is full in the night, though they are never ſeen in the day. They are common not only in the ſouthern, but in the northern parts of America, during the ſummer.

Fire-*Lock*, or *Fuſil*, a ſmall gun which fires with a flint. It is diſtinguiſhed from an old muſket, or match-lock, which was fired with a match. The fire-lock is now in common uſe in the European armies.

Fire-*Philoſophers*, or *Philoſophi per ignem*, a fanatical ſect of philoſophers who appeared towards the cloſe of the 16th century, and made a figure in almoſt all the countries of Europe. The diſtinguiſhing tenet from which they derived this appellation was, that the intimate eſſences of natural things were only to be known by the trying efforts of fire, directed in a chemical proceſs. They were alſo called *Theoſophiſts*, from their declaring againſt human reaſon as a dangerous and deceitful guide, and repreſenting a divine and ſupernatural illumination as the only means of arriving at truth; they were likewiſe denominated *Paracelſiſts*, from the name of Paracelſus, the eminent phyſician and chemiſt, who was the chief ornament and leader of this extraordinary ſect. It was patroniſed in England by Robert Flood or Fludd, who endeavoured to illuſtrate the philoſophy of Paracelſus in a great number of treatiſes; in France, it was zealouſly propagated by Rivier; in Denmark, by Severinus; in Germany, by Kunrath, an eminent phyſician of Dreſden; and in other countries by warm and ſucceſsful votaries, who aſſumed a ſtriking air of piety and devotion, and propoſed to themſelves no other end than the advancement of the divine glory, and the reſtoration of peace and concord in a divided church: accordingly they were joined by ſeveral perſons eminent for their piety, and diſtinguiſhed by their zeal for the advancement of true religion. One of the moſt celebrated of theſe was Daniel Hoffman, profeſſor of divinity in the univerſity of Helmſtadt, who, availing himſelf of ſome unguarded paſſages in the writings of Luther, extravagantly maintained, that philoſophy was the mortal enemy of religion; that truth was diviſible into two branches, the philoſophical and theological; and that what was true in philoſophy was falſe in theology. Hoffman was afterwards obliged, by the interpoſition of Henry Julius, duke of Brunſwick, to retract his invectives againſt philoſophy, and to acknowledge in the moſt open manner, the harmony and union of ſound philoſophy with true and genuine theology.

Fire-*Places*, are contrivances for communicating heat to rooms, and alſo for anſwering various purpoſes of art and manufacture. See Chimney, Furnace, and Stove. The late ingenious Dr. Franklin, having recounted the inconveniencies and advantages of the fire-places in common uſe, propoſed a new contrivance for this purpoſe, called the *Pennſylvania fire-place*. 1. This machine conſiſts of a bottom-place or hearth-piece (ſee plate 25. fig. 1.) with a riſing moulding before for a fender, two perforated ears *F*, *G*, for receiving two ſcrew-rods; a long air-hole *a a*, through which the outward air paſſes into an air-box; and three ſmoke-holes repreſented by dark ſquares in *BC*, through which the ſmoke deſcends and paſſes away; beſides, double ledges for receiving between them the lower edges of the other plates. 2. A black plate without holes, and furniſhed with a pair of ledges to receive, 3. The two ſide-plates, each of which has a pair of ledges to receive the ſide-edges of the front plate, with a ſhoulder on which it reſts; two pair of ledges to receive the ſide-edges of the two middle plates which form the air box, and an oblong air-hole near the top, through which the air warmed in the box is diſcharged into the room, and a wing or bracket as *H*, and a ſmall hole as *R*, for the axis of the regiſter to turn in. See fig. 2. which repreſents one of theſe plates. 4. An air-box compoſed of the two middle plates *D E* and *F G*, fig. 3. and 4. The firſt has five thin ledges or partitions caſt on it, the edges of which are received into ſo many pair of ledges caſt in the other: the tops of all the cavities formed by theſe thin deep ledges are alſo covered by a ledge of the ſame form and depth caſt with them; ſo that when the plates are put together, and the joints luted, there is no communication between the air-box and the ſmoke. In the winding paſſages of this box, freſh air is warmed as it paſſes into the room. 5. A front-plate, which is arched on the under ſide, and ornamented with foliages, &c. 6. A top-plate, with a pair of ears *M*, *N*, (fig. 5.) anſwerable to thoſe in the bottom plate, and perforated for the ſame purpoſe. It has alſo a pair of ledges running round the under ſide to receive the top edges of the front, back, and ſide plates. The air-box does not reach up to the top-plate by $2\frac{1}{2}$ inches.

All theſe plates are of caſt iron; and when they are all in their proper places, they are bound firmly together by a pair of ſlender rods of wrought iron with ſcrews, and the machine appears as in fig. 5. There are alſo two thin plates of wrought iron, viz. 7. The ſhutter, which is of ſuch a length and breadth as to cloſe well the opening of the fire-place, and ſerving to blow up the fire, and to ſecure it in the night. It is raiſed or depreſſed by means of two braſs knobs, and ſlides in a groove left between the foremoſt ledge of the ſide plates and the face of

the front plate. 8. The regifter, which is placed between the back plate and air-box, and furnifhed with a key; fo that it may be turned on its axis, and made to lie in any pofition between level and upright. The operation of this machine, and the method of fixing it, may be underftood by obferving the profile of the chimney and fire-places in fig 6. *M* is the mantle-piece or breaft of the chimney; *C* the funnel; *B* the falfe back, made of brick-work in the chimney, four inches or more from the true back, from the top of which a clofing is to be made over to the breaft of the chimney, that no air may pafs into the chimney except that which goes under the falfe back, and up behind it; *E* the true back of the chimney; *T* the top of the fire-place: *F* the front of it; *A* the place where the fire is made; *D* the air-box; *K* the hole in the fide plate, through which the warmed air is difcharged out of the air-box into the room; *H* the hollow, formed by removing fome bricks from the hearth under the bottom plate filled with frefh air, entering at the paffage *I*, and afcending into the air-box through the air-hole in the bottom plate near *G*, the partition in the hollow, defigned to keep the air and fmoke apart; *P* the paffage under the falfe back, and part of the hearth for the fmoke; and the arrows in the figure fhow the courfe of the fmoke. The fire being made at *A*, the flame and fmoke will afcend, ftrike the top *T*, and give it a confiderable heat; the fmoke will turn over the air-box, and defcend between it and the back plate to the holes near *G* in the bottom plate, heating in its paffage all the plates of the machine; it will then proceed under and behind the falfe back, and rife into the chimney. The air of the room contiguous to the feveral plates, and warmed by them, becomes fpecifically lighter than the other air in the room, and is obliged to rife; but being prevented by the clofure over the fire-place from going up the chimney, is forced out into the room, and rifing by the mantle piece to the ceiling, is again driven down gradually by the ftream of newly-warmed air that follows; and thus the whole room becomes in a little time equally warmed. The air alfo, warmed under the bottom plate and in the air-box, rifes and comes out of the holes in the fide plates, and thus warming and continually changing the air of the room. In the clofing of the chimney, a fquare opening for a trap-door fhould be left for the fweeper to go up: the door may be made of flate or tin, and fo placed, that by turning up againft the back of the chimney when open, it clofes the vacancy behind the falfe back, and fhoots the foot that falls in fweeping out upon the hearth. It will alfo be convenient to have a fmall hole, about five or fix inches fquare, cut near the ceiling through into the funnel, and provided with a fhutter; by occafionally opening which, the heated air of the room and fmoke of tobacco, &c. may be carried off without incommoding the company. For a farther account of the manner of ufing this fire-place, the advantages attending it, anfwers to objections, and directions to the brick-layer in fixing it, the curious reader may confult Franklin's Letters and Papers on Philofophical Subjects, p. 284—318. edit. 1769.

On the fubject of the moft beneficial form in which common fire-places may be conftructed, the public have been lately inftructed, in a valuable effay by the ingenious Count Rumford.

" All chimney-fire-places (fays the author) without exception, whether they are defigned for burning wood or coals, and even thofe which do not fmoke, as well as thofe which do, may be greatly improved by making the alterations in them here recommended; for it is by no means *merely* to prevent chimneys from fmoking that thefe improvements are recommended, but it is alfo to make them better in all other refpects as fire-places; and when the alterations propofed are properly executed, which may very eafily be done with the affiftance of the following plain and fimple directions, the chimneys will never fail to anfwer, I will venture to fay, even beyond expectation. The room will be heated much more equally and more pleafantly, with *lefs than half the fuel* ufed before; the fire will be more cheerful and more agreeable; and the general appearance of the fire-place more neat and elegant, and the chimney *will never fmoke*."

The author having ftated, that thefe advantages will be derived merely from diminifhing the capacity of the *throat* of the chimney, or that part juft above the fire-place, proceeds to give the following explanation of the technical terms which he finds it neceffary to ufe.

" By the *throat* of a chimney (fays he) I mean the lower extremity of its canal, where it unites with the upper part of its open fire-place. This throat is commonly found about a foot above the level of the lower part of the mantle, and it is fometimes contracted to a fmaller fize than the reft of the canal of the chimney, and fometimes not. In plate 26. fig. 5 fhows the fection of a chimney on the common conftruction, in which *d e* is the throat. Fig. 6. fhows the fection of the fame chimney altered and improved, in which *d i* is the reduced throat.

" The *breaft* of a chimney is that part of it which is immediately behind the mantle. It is the wall which forms the entrance from below into the throat of the chimney in front, or towards the room. It is oppofite to the upper extremity of the back of the open fire-place, and parallel to it; in fhort, it may be faid to be the back part of the mantle itfelf. In the figures 5 and 6, it is marked by the letter *d*. The *width* of the throat of chimney *d e* fig. 5, and *d i* fig. 6, is taken from the breaft of the chimney to the back, and its *length* is taken at right angles to its width, or in a line parallel to the mantle *a* fig. 5 and 6.

" The bringing forward of the fire into the room, or rather bringing it nearer to the front of the opening of the fire-place, and the diminifhing of the throat of the chimney, being two objects principally had in view in the alterations in fire-places here recommended, it is evident that both thefe may be attained merely by bringing forward the back of the chimney. The only queftion therefore is, how far it fhould be brought forward? The anfwer is fhort, and eafy to be underftood; bring it forward as far as poffible, without diminifhing *too much* the paffage which muft be left for the fmoke. Now as this paffage, which, in its narroweft part, I have called the *throat of the chimney*, ought, for reafons which are fully explained in the foregoing chapter, to be immediately, or perpendicularly over the fire, it is evident that the back of the chimney muft always be built perfectly upright. To determine therefore the place for the new back, or how far precifely it ought to be brought forward, nothing more is neceffary than to afcertain how wide the throat of the chimney ought to be left, or what fpace muft be left between the top of the breaft of the chimney, where the upright canal of the chimney begins, and the new back of the fire-place carried up perpendicularly to that height.

" In the courfe of my numerous experiments upon chimneys, I have taken much pains to determine the width proper to be given to this paffage, and I have found, that, when the back of the fire-place is of a proper width, the beft width for the throat of a chimney, when the chimney and the fire-place are of the ufual form and fize, is *four inches*. Three inches indeed might fometimes anfwer, efpecially where the fire-place is very fmall, and the chimney good, and well fituated.

" It may perhaps appear extraordinary, upon the firft view of the matter, that fire-places of fuch different fizes fhould all require the throat of the chimney to be of the fame width; but when it is confidered, that the *capacity* of the throat of a chimney does not depend on its width alone, but on its width and *length* taken together; and that in large fire-places, the width

of the back, and confequently the length of the throat of the chimney, is greater than in thofe which are fmaller, this difficulty vanifhes.

"And this leads us to confider another important point refpecting open fire-places, and that is, the width which it will in each cafe be proper to give to the back. In fire-places as they are now commonly conftructed, the back is of equal width with the opening of the fire-place in front; but this conftruction is faulty on two accounts. Firft, in a fire-place fo conftructed, the fides of the fire-place, or covings, as they are called, are parallel to each other, and confequently ill-contrived to throw out into the room the heat they receive from the fire in the form of rays; and fecondly, the large open corners which are formed by making the back as wide as the opening of the fire-place in front, occafion eddies of wind, which frequently difturb the fire, and embarrafs the fmoke in its afcent in fuch a manner as often to bring it into the room. Both thefe defects may be entirely remedied by diminifhing the width of the back of the fire-place. The width which, in moft cafes, it will be beft to give it, is *one third* of the width of the opening of the fire-place in front. But it is not abfolutely neceffary to conform rigoroufly to this decifion, nor will it always be poffible. It will frequently happen that the back of a chimney muft be made wider than, according to the rule here given, it ought to be. This may be, either to accommodate the fire-place to a ftove, which being already on hand muft, to avoid the expence of purchafing a new one, be employed; or for other reafons; and any fmall deviation from the general rule will be attended with no confiderable inconvenience. It will always be beft, however, to conform to it as far as circumftances will allow.

"Where a chimney is defigned for warming a room of a middling fize, and where the thicknefs of the wall of the chimney in front, meafured from the front of the mantle to the breaft of the chimney, is nine inches, I fhould fet off four inches more for the width of the throat of the chimney, which fuppofing the back of the chimney to be built upright, as it always ought to be, will give thirteen inches for the depth of the fire-place, meafured upon the hearth, from the opening of the fire-place in front to the back. In this cafe thirteen inches would be a good fize for the width of the back; and three times thirteen inches, or thirty-nine inches, for the width of the opening of the fire-place in front; and the angle made by the back of the fire-place and the fides of it, or covings, would be juft 135 degrees, which is the beft pofition they can have for throwing heat into the room.

"But I will fuppofe that in altering fuch a chimney it is found neceffary, in order to accommodate the fire-place to a grate or ftove already on hand, to make the fire place fixteen inches wide. In that cafe, I fhould merely increafe the width of the back to the dimenfions required, without altering the depth of the chimney, or increafing the width of the opening of the chimney in front. The covings, it is true, would be fomewhat reduced in their width, by this alteration; and their pofition with refpect to the plane of the back of the chimney would be a little changed; but thefe alterations would produce no bad effects of any confiderable confequence, and would be much lefs likely to injure the fire-place, than an attempt to bring the proportions of its parts nearer to the ftandard, by increafing the depth of the chimney, and the width of its opening in front; or than an attempt to preferve that particular obliquity of the covings which is recommended as the beft (135 degrees), by increafing the width of the opening of the fire-place, without increafing its depth."

The provifion made for the paffage of the chimney-fweeper up the chimney is thus defcribed: "In building up the new back of the fire-place; when this wall (which need never be more than the width of a fingle brick in thicknefs) is brought up fo high that there remains no more than about ten or eleven inches between what is then the top of it, and the infide of the mantle, or lower extremity of the breaft of the chimney, an opening, or door-way, eleven or twelve inches wide, muft be begun in the middle of the back, and continued quite to the top of it, which, according to the height to which it will commonly be neceffary to carry up the back, will make the opening about twelve or fourteen inches high; which will be quite fufficient to allow the chimney-fweeper to pafs. When the fire-place is finifhed, this door-way is to be clofed by a tile, or a fit piece of ftone, placed in it, dry, or without mortar, and confined in its place by means of a rabbet made for that purpofe in the brick work. As often as the chimney is fwept, the chimney-fweeper takes down this tile, which is very eafily done, and when he has finifhed his work he puts it again into its place. The drawing fig. 6. will give a clear idea of this contrivance; and the experience I have had of it has proved that it anfwers perfectly well the purpofe for which it is defigned.

"I obferved above that the new back, which it will always be found neceffary to build in order to bring the fire fufficiently forward, in altering a chimney conftructed on the common principles, need never be thicker than the width of a common brick. I may fay the fame of the thicknefs neceffary to be given to the new fides, or covings, of the chimney; or if the new back and covings are conftructed of ftone, one inch and three quarters, or two inches in thicknefs will be fufficient. Care fhould be taken, in building up thefe new walls, to unite the back to the covings in a folid manner.

"Whether the new back and covings are conftructed of ftone, or built of bricks, the fpace between them and the old back and covings of the chimney ought to be filled up, to give greater folidity to the ftructure. This may be done with loofe rubbifh, or pieces of broken bricks or ftones, provided the work be ftrengthened by a few layers or courfes of bricks laid in mortar; but it will be indifpenfably neceffary to finifh the work, where thefe new walls end, that is to fay, at the top of the throat of the chimney, where it ends abruptly in the open canal of the chimney, by a horizontal courfe of bricks well fecured with mortar. This courfe of bricks will be upon a level with the top of the door-way left for the chimney-fweeper.

"From thefe defcriptions it is clear, that where the throat of the chimney has an end, that is to fay, where it enters into the lower part of the open canal of the chimney, *there* the three walls which form the two covings and the back of the fire-place all end abruptly. It is of much importance that they fhould end in this manner; for were they to be floped outward, and raifed in fuch a manner as to fwell out the upper extremity of the throat of the chimney in the form of a trumpet, and increafe it by degrees to the fize of the canal of the chimney, this manner of uniting the lower extremity of the canal of the chimney with the throat would tend to affift the winds which may attempt to blow down the chimney, in forcing their way through the throat, and throwing the fmoke backward into the room; but when the throat of the chimney ends abruptly, and the ends of the new walls form a flat horizontal furface, it will be much more difficult for any wind from above, to find and force its way through the narrow paffage of the throat of the chimney.

"As the two walls which form the new covings of the chimney are not parallel to each other, but inclined, prefenting an oblique furface towards the front of the chimney; and as they are built perfectly upright and quite flat, from the hearth to the top of the throat, where they end, it is evident that an horizontal fection of the throat will not be an oblong fquare; but its deviation from that form is a matter of no confequence; and no attempts fhould ever be made, by twifting the covings above,

where they approach the breaſt of the chimney, to bring it to that form. All twiſts, bends, prominences, excavations, and other irregularities of form, in the covings of a chimney, never fail to produce eddies in the current of air which is continually paſſing into, and through an open fire-place in which a fire is burning; and all ſuch eddies diſturb, either the fire, or the aſcending current of ſmoke, or both; and not unfrequently cauſe the ſmoke to be thrown back into the room. Hence it appears, that the covings of chimneys ſhould never be made circular, or in the form of any other curve; but always quite flat.

"For the ſame reaſon, that is to ſay, to prevent eddies, the breaſt of the chimney, which forms that ſide of the throat that is in front, or neareſt to the room, ſhould be neatly cleaned off, and its ſurface made quite regular and ſmooth.

"This may eaſily be done by covering it with a coat of plaſter, which may be made thicker or thinner in different parts as may be neceſſary, in order to bring the breaſt of the chimney to be of the proper form.

"With regard to the form of the breaſt of a chimney, this is a matter of very great importance, and which ought always to be particularly attended to.

"I have hitherto given no preciſe directions, in regard to the height to which the new back and covings ought to be carried. This will depend not only on the height of the mantle, but alſo, and more eſpecially, on the height of the breaſt of the chimney, or of that part of the chimney where the breaſt ends and the upright canal begins. The back and covings muſt riſe a few inches, five or ſix for inſtance, higher than this part, otherwiſe the throat of the chimney will not be properly formed; but I know of no advantages that would be gained by carrying them up ſtill higher.

"In forming the door-way for the chimney-ſweeper, the beſt method of proceeding is to place the tile or flat piece of ſtone deſtined for cloſing it, in its proper place; and to build round it, or rather by the ſides of it: taking care not to bring any mortar near it, in order that it may be eaſily removed when the door-way is finiſhed. With regard to the rabbet, which ſhould be made in the door-way to receive it and fix it more firmly in its place, this may either be formed at the ſame time when the door-way is built, or it may be made after it is finiſhed, by attaching to its bottom and ſides, with ſtrong mortar, pieces of thin roof tiles; ſuch as are about half an inch in thickneſs will be the beſt for this uſe; if they are thicker, they will diminiſh too much the opening of the door-way, and will likewiſe be more liable to be torn away by the chimney-ſweeper in paſſing up and down the chimney."

From the foregoing extracts, it is probable, ſufficient information may be drawn, to enable the reader to judge accurately of the mode of conſtructing theſe improved fire-places. We ſhall nevertheleſs proceed to deſcribe the different delineations in plate 26. from which the ſubject cannot fail of being clearly underſtood.

Fig. 1. ſhows the plan of a fire-place on the common conſtruction. A B, the opening of the fire-place in front. C D, the back of the fire-place. A C and B D, the covings.

Fig. 2. ſhows the elevation, or front view of a fire-place on the common conſtruction.

Fig. 3. ſhows how the fire-place repreſented by the fig. 1. is to be altered in order to its being improved. A B is the opening in front—C D, the back, and A C and B D, the covings of the fire-place in its original ſtate. *a b*, Its opening in front—*i k*, its back—and *a i* and *b k*, its covings after it has been altered; *e* is a point upon the hearth, upon which a plumb ſuſpended from the middle of the upper part of the breaſt of the chimney falls. The ſituation for the new back is aſcertained by taking the line *e f* equal to four inches. The new back and covings are repreſented as being built of bricks; and the ſpace between theſe and the old back and covings as being filled up with rubbiſh.

Fig. 4. repreſents the elevation or front view of the fire-place fig. 3. after it has been altered. The lower part of the door-way left for the chimney-ſweeper is ſhown in this figure by dotted lines.

Fig. 5. ſhows the ſection of a chimney fire-place, and of a part of the canal of the chimney, on the common conſtruction. *a b* Is the opening in front; *b c*, the depth of the fire-place at the hearth; *d*, the breaſt of the chimney. *d c*, The throat of the chimney, and *d f*, *g e*, a part of the open canal of the chimney.

Fig. 6. ſhows a ſection of the ſame chimney after it has been altered. *k l* is the new back of the fire-place; *l i*, the tile or ſtone which cloſes the door-way for the chimney-ſweeper; *d i*, the throat of the chimney, narrow to four inches; *a*, the mantle, and *b*, the new wall made under the mantle to diminiſh the height of the opening of the fire place in front. N. B. Theſe two figures are ſections of the ſame chimney which is repreſented in each of the four preceding figures.

Fig. 7. ſhows how the covings are to be placed, when the front of the covings (*a* and *b*) does not come ſo far forward as the front of the opening of the fire-place, or the jambs (A and B).

Fig. 8. ſhows how the width and obliquity of the covings are to be accommodated to the width of the back of a fire-place, in caſes where it is neceſſary to make the back very wide.

Fig. 9. ſhows how an inſtrument called a bevel (*m n*), uſeful in laying out the work, in altering chimney fire-places, may be conſtructed.

Fig. 10. ſhows how, when the breaſt of a chimney (*d*) is too high, it may be brought down by means of a wall (*b*) placed under the mantle, and a coating of plaſter, which in this figure is repreſented by the part marked with dots.

Fig. 11. ſhows how the breaſt of a chimney may be brought down merely by a coating of plaſter.

Fire-*Pots*, in the military art, ſmall earthen pots, into which is put a charged grenade, and over that, powder enough till the grenade is covered; then the pot is covered with a piece of parchment, and two pieces of match acroſs lighted: this pot being thrown by a handle of matches where it is deſigned, it breaks and fires the powder, and burns all that is near it, and likewiſe fires the powder in the grenade, which ought to have no fuſe, to the end its operations may be the quicker.

Fire-*Reeds*. See the Note under *Fire*-Barrel.

Fire-*Ship*, an old veſſel filled with combuſtible ſubſtances intended to be ſet fire to in order to burn the ſhips of an enemy. For a deſcription of this, ſee the article *Fire* Barrel.

Lambent Fires, as the ſhining of meat at certain ſeaſons, the luminouſneſs of the ſea, of inſects, vapours, &c. See the articles Light, Pholas Medusa, Nereis, Fire-*Flies*, Glow-*Worm*, &c.

Port-Fire. See Port-*Fire*.

Spur-Fire. See Spur-*Fire*.

Fire-*Works*, are preparations made of gunpowder, ſulphur, and other inflammable and combuſtible ingredients, uſed on occaſion of public rejoicings and other ſolemnities. The invention of fire-works is by M. Mahudel attributed to the Florentines and people of Sienna; who found out likewiſe the method of adding decorations to them of ſtatues, with fire iſſuing from their eyes and mouths. The art of preparing and managing theſe is called *pyrotechny*. See Pyrotechny.

FIRING, in the military art, denotes the diſcharge of the fire-arms; and its object is to do the utmoſt execution to the enemy. The preſent method of firing by platoons is ſaid to have been invented by Guſtavus Adolphus, and firſt uſed about

the year 1618: the reaſon commonly given for this method is, that a conſtant fire may be always kept up. There are three different ways of platoon-firing; viz. ſtanding, advancing, and retreating. But, previous to every kind of firing, each regiment or battalion muſt be told off in grand diviſions, ſubdiviſions, and platoons, excluſively of the grenadiers, which form two ſubdiviſions or four platoons of themſelves. In firing ſtanding, either by diviſions or platoons, the firſt fire is from the diviſion or platoon on the right; the ſecond fire from the left; the third from the right again; and ſo on alternately, till the firing comes to the centre platoon, which is generally called the *colour platoon*, and does not fire, remaining as a reſerve for the colours. Firing advancing is performed in the ſame manner, with this addition, that before either diviſion or platoon fires, it advances three paces forward. Firing retreating varies from either of the former methods; for before either diviſion or platoon fires, if they are marching from the enemy, it muſt go to the right about, and, after firing, to the left about again, and continue the retreat as ſlow and orderly as poſſible.

In hedge-firing the men are drawn up two deep, and in that order both ranks are to fire ſtanding. Oblique firing is either to the right and left, or from the right and left to the centre, according to the ſituation of the object. The Pruſſians have a particular contrivance for this purpoſe; if they are to level to the right, the rear ranks of every platoon make two quick but ſmall paces to the left, and the body of each ſoldier turns one-eighth of a circle, and *vice verſa*. Parapet-firing depends on the nature of the parapet over which the men are to fire, and alſo upon that of the attack made to poſſeſs it. This method of firing is ſometimes performed by ſingle ranks ſtepping on the banquette and firing; each man inſtantly handing his arms to the centre rank of the ſame file, and taking his back in the room of it; and the centre rank giving it to the rear to load, and forwarding the arms of the rear to the front rank; by which means the front rank men can fire ſix or ſeven rounds in a minute with exactneſs. Parapet-firing may alſo be executed two deep, when the banquette is three feet broad, or in field works, where no banquettes are made. Square firing is performed by a regiment or body of men drawn up in a hollow ſquare, in which caſe each front is generally divided into four diviſions or firings, and the flanks of the ſquare, being the weakeſt part, are covered by four platoons of grenadiers. The firſt fire is from the right diviſion of each face; the ſecond from the left diviſion of each face, &c. and the grenadiers make the laſt fire. Street-firing is practiſed in two ways; either by making the diviſion or platoon that has fired to wheel by half-rank to the right and left outwards from the centre, and to march in that order by half diviſions down the flanks on each ſide of the column, and to draw up in the rear, and go on with their priming and loading; or, to make the diviſion or platoon, after firing, to face to the right and left outwards from the centre, and one half rank to follow the other; and in that order to march in one centre file down on each ſide of the column into the rear, and there draw up as before.

Firing-*Iron*, in farriery, an inſtrument not unlike the blade of a knife; which, being made red hot, is applied to thoſe parts that ſtand in need of it, the hair being firſt taken off.

FIRKIN, an Engliſh meaſure of capacity for things liquid, being the fourth part of the barrel: it contains eight gallons of ale, ſoap, or herrings; and nine gallons of beer.

FIRLOT, a dry meaſure uſed in Scotland. The oat-firlot contains $21\frac{1}{4}$th pints of that country; the wheat firlot contains about 2211 cubical inches; and the barley-firlot, 31 ſtandard-pints. Hence it appears that the Scotch wheat-firlot exceeds the Engliſh buſhel by 33 cubical inches.

FIRMAMENT, in the ancient aſtronomy, the eighth heaven or ſphere; being that wherein the fixed ſtars were ſuppoſed to be placed. It is called the *eighth*, with reſpect to the ſeven heavens or ſpheres of the planets which it ſurrounds. It is ſuppoſed to have two motions; a diurnal motion, given it by the *primum mobile*, from eaſt to weſt, about the poles of the ecliptic; and another oppoſite motion from weſt to eaſt; which laſt it finiſhes according to Tycho, in 25,412 years; according to Ptolemy, in 36,000; and, according to Copernicus, in 258,000; in which time the fixed ſtars return to the ſame preciſe points wherein they were at the beginning. This period is commonly called Plato's year, or the great year. In various places of Scripture, the word *firmament* is uſed for the middle region of the air. Many of the ancients allowed, with the moderns, that the firmament is a fluid matter; though they who gave it the denomination of *firmament* muſt have taken it for a ſolid one.

FIRMAN, is a paſſport or permit granted by the Great Mogul to foreign veſſels, to trade within the territories of his juriſdiction.

FIRMICUS MATERNUS (Julius), a famous writer, who compoſed in Latin, about the year 345, an excellent book in defence of Chriſtianity, intitled, *De errore profanarum religionum*, which is printed with the notes of John Wouver. There are alſo attributed to him eight books of aſtronomy, printed by Aldus Manutius in 1501; but this laſt work appears to have been written by another Julius Firmicus, who lived at the ſame time.

FIRST-BORN. See PRIMOGENITURE, for the literal meaning of the term. In Scripture, it is alſo uſed often in a figurative ſenſe for that which is firſt, moſt excellent, moſt diſtinguiſhed in any thing. Thus it is ſaid of Chriſt (Col. i. 5.), that he is "the firſt-born of every creature;" and in Revelations (i. 5.) he is called "the firſt-begotten of the dead;" that is, according to the commentators, Begotten of the Father before any creature was produced; and the firſt who roſe from the dead by his own power. "The firſt-born of the poor," (Iſa. xiv. 30.) ſignifies, the moſt miſerable of all the poor; and in Job (xviii. 13.) "The firſt-born of death;" that is, the moſt terrible of all deaths.

First-*Fruits*, *primitiæ*, among the Hebrews, were oblations of part of the fruits of the harveſt, offered to God as an acknowledgment of his ſovereign dominion. The firſt of theſe fruits was offered in the name of the whole nation, being either two loaves of bread, or a ſheaf of barley which was threſhed in the court of the temple. Every private perſon was obliged to bring his firſt-fruits to the temple; and theſe conſiſted of wheat, barley, grapes, figs, apricots, olives, and dates. There was another ſort of firſt-fruits which were paid to God. When bread was kneaded in a family, a portion of it was ſet apart, and given to the prieſt or Levite who dwelt in the place: if there was no prieſt or Levite there, it was caſt into the oven, and conſumed by the fire. Theſe offerings made a conſiderable part of the revenues of the Hebrew prieſthood. *Firſt-fruits* are frequently mentioned in ancient Chriſtian writers, as one part of the church-revenue. One of the councils of Carthage enjoins, that they ſhould conſiſt only of grapes and corn; which ſhows, that this was the practice of the African church.

First-*Fruits*, in the church of England, are the profits of every ſpiritual benefice for the firſt year, according to the valuation thereof in the king's books.

FISC, FISCUS, in the civil law, the treaſury of a prince or ſtate; or that to which all things due to the public do fall. The word is derived from the Greek φισκος "a great baſket," uſed when they went to market. By the civil law, none but a ſovereign prince has a right to have a fiſc or public treaſury. At Rome, under the emperors, the term *ærarium* was uſed for the revenues deſtined for ſupport of the charges of the empire: and *fiſcus* for thoſe of the emperor's own family. The treaſury, in effect, belonged to the people, and the fiſcus to the

prince. Hence the goods of condemned persons, if appropriated to the use of the public, were said *publicari*; if to the support of the emperor or prince, *confiscari*.

FISCAL, in the civil law, something relating to the pecuniary interest of the prince or people. The officers appointed for the management of the fisc were called *procuratores fisci*; and *advocati fisci*; and among the cases enumerated in the constitutions of the empire where it was their business to plead, one is against those who have been condemned to pay a fine to the fisc on account of their litigiousness or frivolous appeals.

FISCUS. See Fisc.

FISH, in natural history, an animal that lives in the waters as the natural place of its abode. Fishes form the fourth class of animals in the Linnæan system. Their most general or popular division is into *fresh* and *salt* water ones. Some, however, are of opinion, that all fishes naturally inhabit the salt-waters, and that they have mounted up into rivers only by accident. A few species only swim up into the rivers to deposit their spawn; but by far the greatest number keep in the sea, and would soon expire in fresh water. There are about 400 species of fishes (according to Linnæus) of which we know something: but the unknown ones are supposed to be many more; and, as they are thought to lie in great depths of the sea remote from land, it is probable that many species will remain for ever unknown. For the subdivisions, characters, and natural history of this class of animals, see the articles Ichthyology and Zoology.

Castration of Fish, was a method first practised by Mr. Tull, in order to prevent the excessive increase of fish in some of his ponds, where the numbers did not permit any of them to grow to an advantageous size. But he afterwards found, that the castrated fish grew much larger than their usual size, were more fat, and always in season. This operation may be performed both on male and female fish; and the most eligible time for it is when the ovaries of the female have their ova in them, and when the vessels of the male, analogous to these, have their seminal matter in them; because, at this time, these vessels are more easily distinguished from the ureters, which convey the urine from the kidneys into the bladder, and are situated near the seminal vessels on each side of the spine; which, without sufficient attention, may be mistaken for the ovaries, especially when these last are empty. The time least proper for this operation is just after they have spawned, because the fish are then too weak and languid to bear, with success, so severe an operation; however, with skill and care, it may be performed almost at any time. When a fish is to be castrated, it must be held in a wet cloth, with its belly upwards; then with a sharp pen-knife, having its point bent backwards, the operator cuts through the integuments of the rim of the belly, taking care not to wound any of the intestines. As soon as a small aperture is made, he carefully inserts a hooked pen-knife, and with this dilates the aperture from between the two fore fins almost to the anus. He then, with two small blunt silver-hooks, five or six inches long, and of this form P, by the help of an assistant, holds open the belly of the fish; and, with a spoon or spatula, removes carefully the intestines from one side. When these are removed, you see the ureter, a small vessel, nearly in the direction of the spine, and also the ovary, a larger vessel, lying before it, nearer the integuments of the belly. This last vessel is taken up with a hook of the same kind with those before mentioned, and, after detaching it from the side far enough for the purpose, divided transversely with a pair of sharp scissars, care being taken that the intestines are not wounded or injured. After one of the ovaries has been divided, the operator proceeds to divide the other in the same manner; and then the divided integuments of the belly are sewed with silk, the stitches being inserted at a small distance from one another. Mr. Tull observes farther, that the spawning time is very various; that trouts are full about Christmas; perch in February; pikes in March, and carp and tench in May; and that allowance must be made for climate and situation, with regard to the spawning of fish. When the fish are castrated they are put into the water where they are intended to continue; and they take their chance in common with other fish, as though they were not castrated. With tolerable care, few die of the operation. *Phil. Trans.* vol. xlviii. part 2. art. 106. Although we could not properly avoid inserting the above detail, it is presumed that few will be pleased with the invention. The operation is peculiarly cruel, and the purpose of it only a detestable piece of Apician refinement.

Feeding of Fishes. When fish are fed in large pools or ponds, either malt boiled, or fresh grains, is the best food; thus carps may be raised and fed like capons, and tenches will feed as well. The care of feeding them is best committed to a gardener or servant, who should be always at hand. When fed in a stew, any sort of grain boiled, especially peas, and malt coarsely ground, are proper food; also the grains after brewing, while fresh and sweet; but one bushel of malt not brewed, will go as far as two of grains.

Stealing of Fish, by persons armed and disguised, is felony without benefit of clergy, by 9 Geo. I. cap. 22. See Black *act*. And by 5 Geo. III. cap. 14. the penalty of transportation for seven years is inflicted on persons stealing or taking fish in any water, within a park, paddock, orchard, or yard; and on the receivers, aiders, and abettors; and a forfeiture of five pounds to the owner of the fishery is made payable by persons taking or destroying (or attempting so to do) any fish in any river or other water within any inclosed ground, being private property.

Preserving of Fish *for Cabinets*. Linnæus's method is, to expose them to the air; and when they acquire such a degree of putrefaction that the skin loses its cohesion to the body of the fish, it may be slid off almost like a glove: the two sides of this skin may then be dried upon paper like a plant, or one of the sides may be filled with plaster of Paris to give the subject a due plumpness. A fish may be prepared, after it has acquired this degree of putrefaction, by making a longitudinal incision on the belly, and carefully dissecting the fleshy part from the skin, which is but slightly attached to it in consequence of the putrescency. The skin is then to be filled with cotton and some antiseptic powder, as directed for birds; and, lastly, to be sewed up where the incision was made. See *Methods of Preserving* Birds.

Gold-Fish. See Barbel.

Fish, in a ship, a plank or piece of timber, fastened to a ship's mast or yard, to strengthen it; which is done by nailing it on with iron spikes, and winding ropes hard about them.

Fishes, in heraldry, are the emblems of silence and watchfulness; and are borne either upright, imbowed, extended, endorsed respecting each other, surmounting one another, fretted, &c. In blazoning fishes, those borne feeding should be termed *devouring*; all fishes borne upright and having fins, should be blazoned *hauriant*; and those borne transverse the escutcheon, must be termed *naiant*.

Fish-*Ponds*, those made for the breeding or feeding of fish. Fish-ponds are no small improvement of watery and boggy lands, many of which are fit for no other use. In making of a pond, its head should be at the lowest part of the ground, that the trench of the flood-gate or sluice, having a good fall, may not be too long in emptying. The best way of making the head secure, is to drive in two or three rows of stakes above six feet long, at about four feet distance from each other, the whole length of the pond head, whereof the first row should be rammed at least about four feet deep. If the bottom is false, the foundation may be laid with quick-lime; which slaking, will make it as hard as a stone. Some lay a layer of lime, and another of

earth dug out of the pond, among the piles and ſtakes; and when theſe are well covered, drive in others as they ſee occaſion, ramming in the earth as before, till the pond-head be of the height deſigned. The dam ſhould be made ſloping on each ſide, leaving a waſte to carry off the over-abundance of water in times of floods or rains; and as to the depth of the pond, the deepeſt part need not exceed ſix feet, riſing gradually in ſhoals towards the ſides, for the fiſh to ſun themſelves, and lay their ſpawn. Gravelly and ſandy bottoms, eſpecially the latter, are beſt for breeding; and a fat ſoil with a white fat water, as the waſhings of hills, commons, ſtreets, ſinks, &c. is beſt for fattening all ſorts of fiſh. For ſtoring a pond, carp is to be preferred for its goodneſs, quick growth, and great increaſe, as breeding five or ſix times a-year. A pond of an acre, if it be a feeding and not breeding one, will every year feed 200 carps of three years old, 300 of two years old, and 400 of a year old. Carps delight in ponds that have marle or clay bottoms, with plenty of weeds and graſs, whereon they feed in the hot months. Ponds ſhould be drained every three or four years, and the fiſh ſorted. In breeding ones, the ſmaller ones are to be taken out, to ſtore other ponds with; leaving a good ſtock of females, at leaſt eight or nine years old, as they never breed before that age. In feeding-ponds, it is beſt to keep them pretty near of a ſize. See Breeding *of Fiſh*.

FISHER (John), biſhop of Rocheſter, was born at Beverley in Yorkſhire, in the year 1459, and educated in the collegiate church of that place. In 1484 he removed to Michael-houſe in Cambridge, of which college he was elected maſter in the year 1495. Having applied himſelf to the ſtudy of divinity, he took orders; and, becoming eminent as a divine, attracted the notice of Margaret counteſs of Richmond, mother of Henry VII. who made him her chaplain and confeſſor. In 1501 he took the degree of doctor of divinity, and the ſame year was elected chancellor of the univerſity. In the year following he was appointed Lady Margaret's firſt divinity-profeſſor; and in 1504 conſecrated biſhop of Rocheſter; which ſmall biſhopric he would never reſign, though he was offered both Ely and Lincoln. It is generally allowed, that the foundation of the two colleges of Chriſt-church and St. John's in Cambridge was entirely owing to biſhop Fiſher's perſuaſion, and influence with the counteſs of Richmond: he not only formed the deſign, but ſuperintended the execution. On the promulgation of Martin Luther's doctrine, our biſhop was the firſt to enter the liſts againſt him. On this occaſion he exerted all his influence, and is generally ſuppoſed to have written the famous book by which Henry VIII. obtained the title of *Defender of the Faith*. Hitherto he continued in favour with the king; but in 1527, oppoſing his divorce, and denying his ſupremacy, the implacable Harry determined, and finally effected, his deſtruction. In 1534 the parliament found him guilty of miſpriſion of treaſon, for concealing certain prophetic ſpeeches of a fanatical impoſtor, called the *Holy Maid of Kent*, relative to the king's death; and condemned him, with five others, in loſs of goods, and impriſonment during his majeſty's pleaſure; but he was releaſed, on paying 300l. for the king's uſe.

King Henry being now married to Anne Boleyn, his obſequious parliament took an oath of allegiance proper for the occaſion. This oath the biſhop of Rocheſter ſteadily refuſed, alleging, that his conſcience could not be convinced that the king's firſt marriage was againſt the law of God. For refuſing this oath of ſucceſſion, he was attainted by the parliament of 1534; and committed to the Tower, where he was cruelly treated, and where he would probably have died a natural death, had not the pope created him a cardinal. The king, now poſitively determined on his deſtruction, ſent Rich, the ſolicitor-general, under a pretence of conſulting the biſhop on a caſe of conſcience, but really with a deſign to draw him into a converſation concerning the ſupremacy. The honeſt old biſhop ſpoke his mind without ſuſpicion or reſerve, and an indictment and conviction of high-treaſon was the conſequence. He was beheaded on Tower-hill, on the 22d of June 1535, in the 77th year of his age. Thus died this good old prelate; who, notwithſtanding his inflexible enmity to the reformation, was undoubtedly a learned, pious, and honeſt man. He wrote ſeveral treatiſes againſt Luther, and other works, which were printed at Wurtzburgh, in 1597, in one volume folio.

FISHERY, a place where great numbers of fiſh are caught.

The principal fiſheries for ſalmon, herring, mackrel, pilchards, &c. are along the coaſts of England, Scotland, and Ireland; for cod, on the banks of Newfoundland; for whales, about Greenland; and for pearls, in the Eaſt and Weſt Indies.

Free Fishery, in law, or an excluſive right of fiſhing in a public river, is a royal franchiſe; and is conſidered as ſuch in all countries where the feodal polity has prevailed: though the making ſuch grants, and by that means appropriating, what it ſeems unnatural to reſtrain, the uſe of running water, was prohibited for the future by Magna Charta; and the rivers that were fenced in king John's time were directed to be laid open, as well as the foreſts to be disforeſted. This opening was extended by the ſecond and third charters of Henry III. to thoſe alſo that were fenced under Richard I.; ſo that a franchiſe of free fiſhery ought now to be as old at leaſt as the reign of Henry II. This differs, as judge Blackſtone obſerves, from a *ſeveral of piſcary*, becauſe he that has a ſeveral fiſhery muſt alſo be the owner of the ſoil, which in a free-fiſhery is not requiſite. It differs alſo from a *common* fiſhery, in that the free fiſhery is an excluſive right, the common is not ſo; and therefore, in a free fiſhery, a man has a property in the fiſh before they are caught; in a common piſcary, not till afterwards. Some indeed have conſidered a *free* fiſhery not as a royal franchiſe; but merely as a private grant of a liberty to fiſh in the *ſeveral* fiſhery of the granter. But the conſidering ſuch right as originally a flower of the prerogative, till reſtrained by Magna Charta, and derived by royal grant (previous to the reign of Richard I.) to ſuch as now claim it by preſcription, may remove ſome difficulties in reſpect to this matter with which our law-books are embarraſſed.

Fishery, denotes alſo the commerce of fiſh, more particularly the catching them for ſale. Were we to enter into a very minute conſideration of the fiſheries eſtabliſhed in this kingdom, this article would ſwell beyond its proper bounds; however, ſince fiſheries, if ſucceſsful, are not only objects of great commercial importance, but alſo contribute materially to our naval ſtrength, by becoming permanent nurſeries for ſeamen, we ſhall take notice of ſome of the moſt conſiderable of the Britiſh fiſheries, and the inſtitutions ſet on foot for their ſupport.

The ſituation of the Britiſh coaſts is the moſt advantageous in the world for catching fiſh: the Scottiſh iſlands, particularly thoſe to the north and weſt, lie moſt commodious for carrying on the fiſhing trade to perfection; for no country in Europe can pretend to come up to Scotland in the abundance of the fineſt fiſh, with which its various creeks, bays, rivers, lakes, and coaſts are repleniſhed. Of theſe advantages, the Scots ſeem indeed to have been abundantly ſenſible; for their traffic in herrings is even noticed in hiſtory ſo early as the ninth century. The frequent laws which were enacted in the reigns of James III. IV. and V. diſcover a ſteady determined zeal for the benefit of the country, and the full reſtoration of theſe fiſheries, which the Dutch had found means to engroſs.

The Scottiſh fiſheries were, however, more particularly indebted to the zealous encouragement of James V. and VI.; the former having planned, and the latter carried into execution,

various projects for their extension. The well-meant efforts of James VI. indeed were greatly impeded, and at last wholly suspended, by the disputes which prevailed in the kingdom at that period concerning the succession. Nevertheless the plan was resumed by Charles I. who "ordained an association of the three kingdoms, for a general fishing within the haill seas and coasts of his majesty's said kingdoms; and, for the government of the said association, ordained, that there should be a standing committee chosen and nominated by his majesty, and his successors, from time to time," &c. &c. Several persons of distinction embarked in the design, which the king honoured with his patronage, and encouraged by his bounty. He also ordered lent to be more strictly observed; prohibited the importation of fish taken by foreigners; and agreed to purchase from the company his naval stores and the fish for his fleets. Thus the scheme of establishing a fishery in the Hebrides began to assume a favourable aspect; but all the hopes of the adventurers were frustrated by the breaking out of the civil wars, and the very tragical death of their benefactor.

In 1661, Charles II. the duke of York, lord Clarendon, and other persons of rank and fortune, resumed the business of the fisheries with greater vigour than any of their predecessors. For this purpose, the most salutary laws were enacted by the parliaments of England and Scotland; in virtue of which, all materials used in, or depending upon, the fisheries, were exempted from all duties, excises, or imposts whatever. In England, the company were authorised to set up a lottery, and to have a voluntary collection in all parish churches. Houses of entertainment, as taverns, inns, ale-houses, were to take one or more barrels of herrings, at the stated price of 30s. per barrel; also 2s. 6d. per barrel was to be paid to the stock of this company on all imported fish taken by foreigners. Some Dutch families were also invited, or permitted, to settle at Stornaway: the herrings cured by the royal English company gave general satisfaction, and, as mentioned above, brought a high price for those days. Every circumstance attending this new establishment seemed to be the result of a judicious plan and thorough knowledge of the business, when the necessities of the king obliged him to withdraw his subscription or bounty; which gave such umbrage to the parties concerned, that they soon after dissolved.

In 1677, a new royal company was established in England, at the head of which was the duke of York, the earl of Derby, &c. Besides all the privileges which former companies had enjoyed, the king granted this new company a perpetuity, with power to purchase lands; and also 20l. to be paid them annually, out of the customs of the port of London, for every dogger or buss they should build and send out for seven years to come. A stock of 10,980l. was immediately advanced, and afterwards 1600l. more. This small capital was soon exhausted in purchasing and fitting out busses, with other incidental expences. The company made, however, a successful beginning; and one of their busses or doggers actually took and brought home 32,000 cod fish; other vessels had also a favourable fishery. Such flattering beginnings might have excited fresh subscriptions, when an unforeseen event ruined the whole design beyond the possibility of recovery. Most of the busses had been built in Holland, and manned with Dutchmen; on which pretence the French, who were then at war with Holland, seized six out of seven vessels, with their cargoes and fishing-tackle; and the company being now in debt, sold, in 1680, the remaining stores, &c. A number of gentlemen and merchants raised a new subscription of 60,000l. under the privileges and immunities of the former charter. This attempt also came to nothing, owing to the death of the king, and the troubles of the subsequent reign.

Soon after the revolution this business was again resumed, and upon a more extensive scale; the proposed capital being 300,000l. of which 100,000l. was to have been raised by the surviving patentees or their successors, and 200,000l. by new subscribers. Copies of the letters patent, the constitution of the company, and terms of subscription, were lodged at sundry places in London and Westminster for the perusal of the public, while the subscription was filling. It is probable, that king William's partiality to the Dutch fisheries, the succeeding war, or both of these circumstances, frustrated this new attempt; of which we have no further account in the annals of that reign or since.

The Scottish parliament had also, during the three last reigns, passed sundry acts for erecting companies and promoting the fisheries; but the intestine commotions of that country, and the great exertions which were made for the Darien establishment, enfeebled all other attempts, whether collectively or by individuals, within that kingdom.

In 1749, his late majesty having, at the opening of the parliament, warmly recommended the improvement of the fisheries, the house of commons appointed a committee to inquire into the state of the herring and white fisheries, and to consider of the most probable means of extending the same. All ranks of men were elevated with an idea of the boundless riches that would flow into the kingdom from this source. A subscription of 500,000l. was immediately filled in the city, by a body of men who were incorporated for 21 years by the name of *The Society of the Free British Fishery*. Every encouragement was held out by government, both to the society and to individuals, who might embark in this national business. A bounty of 36s. *per* ton was to be paid annually out of the customs, for 14 years, to the owners of all decked vessels or busses, from 20 to 80 tons burden, which should be built after the commencement of the act, for the use of, and fitted out and employed in, the said fisheries, whether by the society or any other persons. At the same time numerous pamphlets and newspaper-essays came forth; all pretending to elucidate the subject, and to convince the public with what facility the herring fisheries might be transferred from Dutch to British hands. This proved, however, a more arduous task than had been foreseen by superficial speculators. The Dutch were frugal in their expenditures and living; perfect masters of the arts of fishing and curing, which they had carried to the greatest height and perfection. They were in full possession of the European markets; and their fish, whether deserving or otherwise, had the reputation of superior qualities to all others taken in our seas. With such advantages, the Dutch not only maintained their ground against this formidable company, but had also the pleasure of seeing the capital gradually sinking, without having procured an adequate return to the adventurers; notwithstanding various aids and efforts of government from time to time in their favour, particularly in 1757, when an advance of 20s. *per* ton was added to the bounty.

In 1786 the public attention was again called to the state of the British fisheries, by the suggestions of Mr. Dempster in the house of commons, and by different publications that appeared upon the subject: in consequence of which, the minister suffered a committee to be named, to inquire into this great source of national wealth. To that committee it appeared, that the best way of improving the fisheries was to encourage the inhabitants living nearest to the seat of them to become fishers: And it being found that the north-western coast of the kingdom, though abounding with fish and with fine harbours, was utterly destitute of towns, an act was passed for incorporating certain persons therein named, by the style of "*The British Society*, for extending of the fisheries, and improving the sea coasts of this kingdom;" and to enable them to subscribe a joint stock, and therewith to purchase lands, and build thereon free towns, vil-

lages, and fiſhing ſtations in the Highlands and iſlands in that part of Great Britain called Scotland, and for other purpoſes. The Iſle of Mull, Loch-Broom, the Iſle of Sky and of Canay, have already been pitched upon as proper ſituations for ſome of theſe towns. The progreſs of ſuch an undertaking from its nature muſt be ſlow, but ſtill ſlower when carried on with a limited capital ariſing from the ſubſcriptions of a few public-ſpirited individuals. But it is not to be doubted but that it will ultimately tend to the increaſe of our fiſheries, and to the improvement of the Highland part of this kingdom. Its tendency is alſo to leſſen the emigration of a brave and induſtrious race of inhabitants, too many of whom have already removed with their families to America.

Anchovy-Fishery. The anchovy is caught in the months of May, June, and July, on the coaſts of Catalonia, Provence, &c. at which ſeaſon it conſtantly repairs up the ſtraits of Gibraltar into the Mediterranean. Collins ſays they are alſo found in plenty on the weſtern coaſts of England and Wales.

The fiſhing for them is chiefly in the night-time; when a light being put on the ſtern of their little fiſhing-veſſels, the anchovies flock round, and are caught in the nets. But then it is aſſerted to have been found by experience, that anchovies taken thus by fire, are neither ſo good, ſo firm, nor ſo proper for keeping, as thoſe which are taken without fire.

When the fiſhery is over, they cut off the heads, take out their gall and guts, and then lay them in barrels, and ſalt them. The common way of eating anchovies is with oil, vinegar, &c. in order to which they are firſt boned, and the tails, fins, &c. ſlipped off. Being put on the fire, they diſſolve almoſt in any liquor. Or they are made into ſauce by mincing them with pepper, &c. Some alſo pickle anchovies in ſmall delft or earthen pots, made on purpoſe, of two or three pounds weight, more or leſs, which they cover with plaſter to keep them the better. Anchovies ſhould be choſen ſmall, freſh pickled, white on the outſide and red within. If genuine, they have round backs; for thoſe which are flat or large are often nothing but ſardines. Beſide theſe qualities, the pickle, on opening the pots or barrels, ſhould be of a good taſte, and not have loſt its flavour.

Cod-Fishery. There are two kinds of cod-fiſh; the one green or white cod, and the other dried or cured cod; though it is all the ſame fiſh, differently prepared; the former being ſometimes ſalted and barrelled, then taken out for uſe; and the latter having lain for a competent time in ſalt, and then dried in the ſun or ſmoke.

The chief fiſheries for *green* cod are in the bay of Canada, on the great bank of Newfoundland, and on the iſle of St. Peter, and the iſle of Sable; to which places veſſels reſort from many parts both of Europe and America. They are from 100 to 150 tons burden, and will catch between 30,000 and 40,000 cod each. The moſt eſſential part of the fiſhery is, to have a maſter who knows how to cut up the cod, one who is ſkilled to take off the head properly, and above all a good ſalter, on which the preſerving of them, and conſequently the ſucceſs of the voyage, depends. The beſt ſeaſon is from the beginning of February to the end of April; the fiſh, which in the winter retire to the deepeſt water, coming then on the banks, and fattening extremely. What are caught from March to June keep well; but thoſe taken in July, Auguſt, and September, when it is warm on the banks, are apt to ſpoil ſoon. Each fiſher takes but one at a time, yet the moſt expert will take from 350 to 400 in a day; but that is the moſt, the weight of the fiſh and the great coldneſs on the bank fatiguing very much. As ſoon as the cod are caught, the heads are taken off; they are opened, gutted, and ſalted; and the ſalter ſtows them in the bottom of the hold, head to tail, in beds a fathom or two ſquare; putting layers of ſalt and fiſh alternately, but never mixing fiſh caught on different days. When they have lain thus three or four days to drain off the water, they are placed in another part of the ſhip, and ſalted again; where they remain till the veſſel is loaded. Sometimes they are cut in thick pieces, and put in barrels for the greater convenience of carriage.

The principal fiſhery for dry cod is, from Cape Roſe to the Bay des Exports, along the coaſt of Placentia, in which compaſs there are ſeveral commodious ports for the fiſh to be dried in. Theſe, though of the ſame kind with the freſh cod, are much ſmaller, and therefore fitter to keep, as the ſalt penetrates more eaſily into them. The fiſhery of both is much alike; only this latter is moſt expenſive, as it takes up more time, and employs more hands, and yet ſcarce half ſo much ſalt is ſpent in this as in the other. The bait is herring, of which great quantities are taken on the coaſt of Placentia. When ſeveral veſſels meet and intend to fiſh in the ſame port, he whoſe ſhallop firſt touches ground, becomes intitled to the quality and privileges of admiral: he has the choice of his ſtation, and the refuſal of all the wood on the coaſt at his arrival. As faſt as the maſters arrive, they unrig all their veſſels, leaving nothing but the ſhrouds to ſuſtain the maſts; and in the mean time the mates provide a tent on ſhore, covered with branches of trees, and ſails over them, with a ſcaffold of great trunks of pines, 12, 15, 16, and often 20 feet high, commonly from 40 to 60 feet, and about one-third as much in breadth. While the ſcaffold is preparing, the crew are a-fiſhing; and as faſt as they catch, they bring their fiſh aſhore, and open and ſalt them upon moveable benches; but the main ſalting is performed on the ſcaffold. When the fiſh have taken ſalt, they waſh and hang them to drain on rails; when drained, they are laid on a ſort of ſtages, which are ſmall pieces of wood laid acroſs, and covered with branches of trees, having the leaves ſtripped off for the paſſage of the air. On theſe ſtages, they are diſpoſed, a fiſh thick, head againſt tail, with the back uppermoſt, and are turned carefully four times every 24 hours. When they begin to dry, they are laid in heaps 10 or 12 thick, in order to retain their warmth; and every day the heaps are enlarged, till they become double their firſt bulk; then two heaps are joined together, which they turn every day as before: laſtly, they are ſalted again, beginning with thoſe firſt ſalted; and being laid in huge piles, they remain in that ſituation till they are carried on board the ſhips, where they are laid on the branches of trees diſpoſed for that purpoſe, upon the ballaſt, and round the ſhip, with mats to prevent their contracting any moiſture.

The cod ſupplies four kinds of commodities, viz. the zounds, the tongues, the roes, and the oil, which is extracted from its liver. The firſt is ſalted at the fiſhery, together with the fiſh, and put in barrels of from 600 to 700 pounds. The tongues are cured in like manner, and brought in barrels of from 400 to 500 pounds. The roes are alſo ſalted in barrels, and ſerve to caſt into the ſea to draw fiſh together, and particularly pilchards. The oil comes in barrels of from 400 to 520 pounds, and is uſed in dreſſing leather. In Scotland, they catch a ſmall kind of cod on the coaſts of Buchan, and all along the Murray frith on both ſides; as alſo in the frith of Forth, Clyde, &c. which is much eſteemed. They ſalt and dry them in the ſun upon rocks, and ſometimes in the chimney.

Coral-Fishery. See Coral.

Herring-Fishery. Our great ſtations for this fiſhery are off the Shetland and Weſtern Iſles, and off the coaſt of Norfolk, in which the Dutch alſo ſhare. See the article Clupea. There are two ſeaſons for herring-fiſhing: the firſt from June to the end of Auguſt; and the ſecond in autumn, when the fogs become very favourable for this kind of fiſhing. The Dutch begin their herring-fiſhing on the 24th of June, and employ a vaſt number of veſſels called *buſſes*, between 45 and 60 tons burden each, and carrying three or four ſmall guns. They never ſtir out of port without a convoy, unleſs there be enough toge-

ther to make about 18 or 20 cannon among them, in which caſe they are allowed to go in company. Before they go out, they make a verbal agreement, which has the ſame force as if it were in writing. The regulations of the admiralty of Holland have been partly followed by the French and other nations, and partly improved and augmented with new ones; as, that no fiſher ſhall caſt his net within 100 fathoms of another boat: that while the nets are caſt, a light ſhall be kept on the hind part of the veſſel: that when a boat is by any accident obliged to leave off fiſhing, the light ſhall be caſt into the ſea: that when the greater part of a fleet leaves off fiſhing, and caſts anchor, the reſt ſhall do the ſame, &c.

In the late king's reign, very vigorous efforts were made, and bounties allowed, for the encouragement of the Britiſh herring-fiſheries: the firſt was, of 30s. *per* ton to every buſs of 70 tons and upwards. This bounty was afterwards raiſed to 50s. *per* ton, to be paid to ſuch adventurers as were entitled to it by claiming it at the places of rendezvous. The buſſes are from 20 to 90 tons burden, but the beſt ſize is 80. A veſſel of 80 tons ought to take ten laſts, or 120 barrels of herrings, to clear expences, the price of the fiſh to be admitted to be a guinea a barrel. A ſhip of this ſize ought to have 18 men, and three boats: one of 20 tons ſhould have ſix men; and every five tons above require an additional hand. To every ton are 280 yards of net; ſo a veſſel of 80 tons carries 20,000 ſquare yards: each net is 12 yards long, and 10 deep; and every boat takes out from 20 to 30 nets, and puts them together, ſo as to form a long train; they are ſunk at each end of the train by a ſtone, which weighs it down to the full extent: the top is ſupported by buoys, made of ſheep ſkin, with a hollow ſtick at the mouth, faſtened tight; through this the ſkin is blown up, and then ſtopped with a peg, to prevent the eſcape of the air. Sometimes theſe buoys are placed at the top of the nets; at other times the nets are ſuffered to ſink deeper, by the lengthening the cords faſtened to them, every cord being for that purpoſe 10 or 12 fathoms long. But the beſt fiſheries are generally in more ſhallow water.

Of the Scots fiſhery in the Weſtern Iſles, the following account is given by Mr. Pennant. "The fiſhing is always performed in the night, unleſs by accident. The buſſes remain at anchor, and ſend out their boats a little before ſun-ſet; which continue out, in winter and ſummer, till day-light; often taking up and emptying their nets, which they do 10 or 12 times in a night, in caſe of good ſucceſs. During winter it is a moſt dangerous and fatiguing employ, by reaſon of the greatneſs and frequency of the gales in theſe ſeas, and in ſuch gales are the moſt ſucceſsful captures: but, by the providence of Heaven, the fiſhers are ſeldom loſt; and, what is wonderful, few are viſited with illneſs. They go out well prepared, with a warm great coat, boots, and ſkin aprons, and a good proviſion of beef and ſpirits. The ſame good fortune attends the buſſes, which, in the tempeſtuous ſeaſon, and in the darkeſt nights, are continually ſhifting, in theſe narrow ſeas, from harbour to harbour. Sometimes 80 barrels of herrings are taken in a night by the boats of a ſingle veſſel. It once happened, in Loch-Slappan, in Skie, that a buſs of 80 tons might have taken 200 barrels in one night, with 10,000 ſquare yards of net; but the maſter was obliged to deſiſt, for want of a ſufficient number of hands to preſerve the capture. The herrings are preſerved by ſalting, after the entrails are taken out. This laſt is an operation performed by the country-people, who get three-halfpence per barrel for their trouble; and ſometimes, even in the winter, can gain fifteen pence a-day. This employs both women and children; but the ſalting is only entruſted to the crew of the buſſes. The fiſh are laid on their backs in the barrels, and layers of ſalt between them. The entrails are not loſt, for they are boiled into an oil; 8000 fiſh will yield ten gallons, valued at one ſhilling the gallon. A veſſel of 80 tons takes out 144 barrels of ſalt; a drawback of 2s. 8d. is allowed for each barrel uſed by the foreign or Iriſh exportation of the fiſh; but there is a duty of 1s. per barrel for the home-conſumption, and the ſame for thoſe ſent to Ireland. The barrels are made of oak ſtaves, chiefly from Virginia; the hoops from ſeveral parts of our own iſland, and are either of oak, birch, hazel, or willow: the laſt from Holland, liable to a duty. The barrels coſt about 3s. each; they hold from 500 to 800 fiſh, according to the ſize of the fiſh; and are made to contain 32 gallons. The barrels are inſpected by proper officers: a cooper examines if they are ſtatutable and good; if faulty, he deſtroys them, and obliges the maker to ſtand to the loſs."

Herrings are cured either *white*, i. e. pickled, or *red*. Of the *firſt*, thoſe done by the Dutch are the moſt eſteemed, being diſtinguiſhed into four ſorts, according to their ſizes; and the beſt are thoſe that are fat, fleſhy, firm, and white, ſalted the ſame day they are taken, with good ſalt, and well barrelled. The Britiſh cured herrings are little inferior, if not equal, to the Dutch; for, in ſpite of all their endeavours to conceal the ſecret, their method of curing, laſting, or caſking the herrings, has been diſcovered, and is as follows. After they have hauled in their nets, which they drag in the ſtern of their veſſel backwards and forwards in traverſing the coaſt, they throw them upon the ſhip's deck, which is cleared of every thing for that purpoſe: the crew is ſeparated into ſundry diviſions, and each diviſion has a peculiar taſk; one part opens and guts the herrings, leaving the melts and roes; another cures and ſalts them, by lining or rubbing their inſide with ſalt; the next packs them, and between each row and diviſion they ſprinkle handfuls of ſalt; laſtly, the cooper puts the finiſhing hand to all, by heading the caſks very tight, and ſtowing them in the hold. *Red* herrings muſt lie 24 hours in the brine, in as much as they are to take all their ſalt there; and when they are taken out, they are ſpitted, that is, ſtrung by the head on little wooden ſpits, and then hung in a chimney made for that purpoſe. After which, a fire of bruſh wood, which yields a deal of ſmoke but no flame, being made under them, they remain there till ſufficiently ſmoked and dried, and are afterwards barrelled up for keeping.

Lobſter-Fishery. Lobſters are taken along the Britiſh channel, and on the coaſt of Norway, whence they are brought to London for ſale; and alſo in the frith of Edinburgh, and on the coaſt of Northumberland. See the article Cancer. By 10 and 11 W. III. cap. 24. no lobſter is to be taken under eight inches in length, from the peak of the noſe to the end of the middle fin of the tail; and by 9 G. II. cap. 33. no lobſters are to be taken on the coaſt of Scotland from the firſt of June to the firſt of September.

Mackrel-Fishery. The mackrel is a ſummer fiſh of paſſage, found in large ſhoals, in different parts of the ocean, not far north; but eſpecially on the French and Engliſh coaſts. The fiſhing is uſually in the months of April, May and June, and even July, according to the place. See Scomber. They enter the Engliſh channel in April, and proceed up to the ſtraits of Dover as the ſummer advances; ſo that by June they are on the coaſts of Cornwall, Suſſex, Normandy, Picardy, &c. where the fiſhery is moſt conſiderable. They are an excellent food freſh; and not to be deſpiſed, when well prepared, pickled, and put up in barrels; a method of preſerving them chiefly uſed in Cornwall. The fiſh is taken in two ways; either with a line or nets: the latter is the more conſiderable, and is uſually performed in the night-time. The rules obſerved in the fiſhing for mackrel are much the ſame as thoſe already mentioned in the fiſhery of herrings.

There are two ways of pickling them: the firſt is, by opening and gutting them, and filling the belly with ſalt, crammed in as hard as poſſible with a ſtick; which done, they range them in ſtrata or rows, at the bottom of the veſſel, ſtrewing ſalt between the layers. In the ſecond way, they put them immediately into tubs full of brine, made of freſh water and ſalt; and leave them to ſteep, till they have imbibed ſalt enough to make them keep; after which they are taken out, and barrelled up, taking care to preſs them cloſe down. Mackrel are not cured or exported as merchandize, except a few by the Yarmouth and Leoſtoff merchants, but are generally conſumed at home; eſpecially in the city of London, and the ſea-ports between the Thames and Yarmouth, eaſt, and the Land's-end of Cornwall weſt.

Oyſter-Fishery. This fiſhery is principally carried on at Colcheſter in Eſſex; Feverſham and Milton in Kent; the Iſle of Wight; the Swales of the Medway; and Tenby on the coaſt of Wales. From Feverſham, and adjacent parts, the Dutch have ſometimes loaded a hundred large hoys with oyſters in a year. They are alſo taken in great quantities near Portſmouth, and in all the creeks and rivers between Southampton and Chicheſter: many of which are carried about by ſea to London and to Colcheſter, to be fed in the pits about Wavenhoe and other places. See Ostrea.

Pearl-Fishery. See the article Pearl.

Pilchard Fishery. The chief pilchard-fiſheries are along the coaſts of Dalmatia, on the coaſt of Bretagne, and along the coaſts of Cornwall and Devonſhire. That of Dalmatia is very plentiful: that on the coaſts of Bretagne employs annually about 300 ſhips. Of the pilchard-fiſhery on the coaſt of Cornwall, the following account is given by Dr. Borlaſe: "It employs a great number of men on the ſea, training them thereby to naval affairs; employs men, women, and children, at land, in ſalting, preſſing, waſhing, and cleaning; in making boats, nets, ropes, caſks, and all the trades depending on their conſtruction and ſale. The poor are fed with the offals of the captures, the land with the refuſe of the fiſh and ſalt; the merchant finds the gains of commiſſion and honeſt commerce, the fiſherman the gains of the fiſh. Ships are often freighted hither with ſalt, and into foreign countries with the fiſh, carrying off at the ſame time part of our tin. Of the uſual produce of the great number of hogſheads exported each year for ten years from 1747 to 1756 incluſive, from the four ports of Fowy, Falmouth, Penzance, and St. Ives, it appears that Fowy has exported yearly 1732 hogſheads; Falmouth, 14,631 hogſheads and two-thirds: Penzance and Mounts-Bay 12,149 hogſheads and one-third; St. Ives, 1282 hogſheads; in all amounting to 29,795 hogſheads. Every hogſhead for ten years laſt paſt, together with the bounty allowed for each hogſhead exported, and the oil made out of each hogſhead, has amounted, one year with another at an average, to the price of 1l. 13s. 3d.; ſo that the caſh paid for pilchards exported has, at a medium, annually amounted to the ſum of 49,532l. 10s." The numbers that are taken at one ſhooting out of the nets are amazingly great. Mr. Pennant ſays, that Dr. Borlaſe aſſured him, that on the 5th of October 1767, there were at one time incloſed in St. Ives's Bay 7000 hogſheads, each hogſhead containing 35,000 fiſh, in all 245 millions.

The pilchards naturally follow the light, which contributes much to the facility of the fiſhery: the ſeaſon is from June to September. On the coaſts of France they make uſe of the roes of the cod-fiſh as a bait; which, thrown into the ſea, makes them riſe from the bottom, and run into the nets. On our coaſts there are perſons poſted aſhore, who, ſpying by the colour of the water where the ſhoals are, make ſigns to the boats to go among them to caſt their nets. When taken, they are brought on ſhore to a warehouſe, where they are laid up in broad piles, ſupported with backs and ſides; and as they are piled, they ſalt them with bay-ſalt; in which lying to ſoak for 30 or 40 days, they run out a deal of blood, with dirty pickle and bittern: then they waſh them clean in ſea-water; and, when dry, barrel and preſs them hard down to ſqueeze out the oil, which iſſues out at a hole in the bottom of the caſk.

Salmon-Fishery. For a deſcription of this fiſh, ſee the article Salmo. The chief ſalmon fiſheries in Europe are in England, Scotland, and Ireland, in the rivers, and ſea-coaſts adjoining to the river-mouths. The moſt diſtinguiſhed for ſalmon in Scotland are, the river Tweed, the Clyde, the Tay, the Dee, the Don, the Spey, the Neſs, the Bewly, &c. in moſt of which it is very common, about the height of ſummer, eſpecially if the weather happens to be very hot, to catch four or five ſcore ſalmon at a draught. The chief rivers in England for ſalmon are, the Tyne, the Trent, the Severn, and the Thames. The fiſhing is performed with nets, and ſometimes with a kind of locks or weirs made on purpoſe, which in certain places have iron or wooden grates ſo diſpoſed, in an angle, that being impelled by any force in a contrary direction to the courſe of the river, they may give way and open a little at the point of contact, and immediately ſhut again, cloſing the angle. The ſalmon, therefore, coming up into the rivers, are admitted into theſe grates, which open, and ſuffer them to paſs through, but ſhut again, and prevent their return. The ſalmon is alſo caught with a ſpear, which they dart into him when they ſee him ſwimming near the ſurface of the water. It is cuſtomary likewiſe to catch them with a candle and lanthorn, or wiſp of ſtraw ſet on fire; for the fiſh naturally following the light, are ſtruck with the ſpear, or taken in a net ſpread for that purpoſe, and lifted with a ſudden jerk from the bottom.

"The capture of ſalmon in the Tweed, about the month of July (ſays Mr. Pennant) is prodigious. In a good fiſhery, often a boat-load, and ſometimes near two, are taken in a tide: ſome few years ago there were above 700 fiſh taken at one haul, but from 50 to 100 is very frequent. The coopers in Berwick then begin to ſalt the ſalmon thoroughly in pipes and other large veſſels, and afterwards barrel them to ſend abroad, having then far more than the London markets can take off their hands.

"Moſt of the ſalmon taken before April, or to the ſetting in of the warm weather, is ſent freſh to London in baſkets; unleſs now and then the veſſel is diſappointed by contrary winds of ſailing immediately; in which caſe the fiſh is brought aſhore again to the coopers' offices, and boiled, pickled, and kitted, and ſent to the London markets by the ſame ſhip, and freſh ſalmon put in the baſkets in lieu of the ſtale ones. At the beginning of the ſeaſon, when a ſhip is on the point of ſailing, a freſh clean ſalmon will ſell from a ſhilling to eighteen pence a pound; and moſt of the time that this part of the trade is carried on, the prices are from five to nine ſhillings per ſtone; the value riſing and falling according to the plenty of fiſh, or the proſpect of a fair or foul wind. Some fiſh are ſent in this manner to London the latter end of September, when the weather grows cool; but then the fiſh are full of large roes, grow very thin-bellied, and are not eſteemed ſo palatable.

"The ſeaſon for fiſhing in the Tweed begins November 30th, but the fiſhermen work very little till after Chriſtmas: it ends on Michaelmas-day; yet the corporation of Berwick (who are conſervators of the river) indulge the fiſhermen with a fortnight paſt that time, on account of the change of the ſtyle.

"There are on the river 41 conſiderable fiſheries, extending upwards, about 14 miles from the mouth (the others above being of no great value), which are rented for near 5400l. *per annum*: the expence attending the ſervants' wages, nets, boats, &c. amounts to 5000l. more; which together makes up the ſum

10,400l. Now, in confequence, the produce muft defray all, and no lefs than 20 times that fum of fifh will effect it; fo that 208,000 falmon muft be caught there one year with another.

"Scotland poffeffes great numbers of fine fifheries on both fides of that kindgom. The Scotch in early times had moft fevere laws againft the killing of this fifh: for the third offence was made capital, by a law of James IV. Before that, the offender had power to redeem his life. They were thought in the time of Henry VI. a prefent worthy of a crowned head: for in that reign the queen of Scotland fent to the duchefs of Clarence 10 cafks of falted falmon; which Henry directed to pafs duty-free. The falmon are cured in the fame manner as at Berwick, and a great quantity is fent to London in the fpring; but after that time, the adventurers begin to barrel and export them to foreign countries: but we believe that commerce is far lefs lucrative than it was in former times, partly owing to the great increafe of the Newfoundland fifhery, and partly to the general relaxation of the difcipline of abftinence in the Romifh church.

"Ireland (particularly the north) abounds with this fifh: the moft confiderable fifhery is at Cranna, on the river Ban, about a mile and an half from Coleraine. When I made the tour of that hofpitable kingdom in 1754, it was rented by a neighbouring gentleman for 620l. a-year; who affured me, that the tenant, his predeceffor, gave 1600l. *per annum*, and was a much greater gainer by the bargain, for the reafons before mentioned, and on account of the number of poachers who deftroy the fifh in the fence-months.

"The mouth of this river faces the north; and is finely fituated to receive the fifh that roam along the coaft in fearch of an inlet into fome frefh water, as they do all along that end of the kingdom which oppofes itfelf to the northern ocean. We have feen near Ballicaftle, nets placed in the fea at the foot of the promontories that jut into it, which the falmon ftrike into as they are wandering clofe to fhore; and numbers are taken by that method.

"In the Ban they fifh with nets 18 fcore yards long, and are continually drawing night and day the whole feafon, which we think lafts about four months, two fets of 16 men each alternately relieving one another. The beft drawing is when the tide is coming in: we were told, that at a fingle draught there were once 840 fifh taken.

"A few miles higher up the river is a weir, where a confiderable number of fifh that efcape the nets are taken. We were lately informed, that, in the year 1760, about 320 tons were taken in the Cranna fifhery."

With regard to the manner of *curing Salmon*, when the fifh are taken, they are opened along the back, the guts and gills, and the greateft part of the bones removed, fo as to make the infide as fmooth as poffible. They then falt the fifh in large tubs for the purpofe, where they lie a confiderable time foaking in brine; and about October, they pack them clofe up in barrels, and fend them to London, or up the Mediterranean. They have alfo in Scotland a great deal of falmon falted in the common way, which after foaking in brine a competent time, is well preffed, and then dried in fmoke: this is called *kipper*, and is chiefly made for home confumption; and if properly cured and prepared, is reckoned very delicious.

Sturgeon FISHERY. See ACCIPENSER. The greateft fturgeon-fifhery is in the mouth of the Volga, on the Cafpian fea; where the Mufcovites employ a great number of hands, and catch them in a kind of inclofure formed by huge ftakes reprefenting the letter Z repeated feveral times. Thefe fifheries are open on the fide next the fea, and clofe on the other; by which means the fifh afcending in its feafon up the river, is embarraffed in thefe narrow angular retreats, and fo is eafily killed with a harping-iron. Sturgeons, when frefh, eat delicioufly; and in order to make them keep, they are falted or pickled in large pieces, and put up in cags from 30 to 50 pounds. But the great object of this fifhery is the roe, of which the Mufcovites are extremely fond, and of which is made the cavear, or kavia, fo much efteemed by the Italians. See CAVEAR.

Tunny-FISHERY. The tunny (a fpecies of SCOMBER, which fee) was a fifh well-known to the ancients, and made a great article of commerce: and there are ftill very confiderable tunny-fifheries on the coafts of Sicily, as well as feveral other parts of the Mediterranean. The nets are fpread over a large fpace of fea by means of cables faftened to anchors, and are divided into feveral compartments. The entrance is always directed, according to the feafon, towards that part of the fea from which the fifh are known to come. A man placed upon the fummit of a rock high above the water, gives the fignal of the fifh being arrived; for he can difcern from that elevation what paffes under the waters infinitely better than any perfon nearer the furface. As foon as notice is given that the fhoal of fifh has penetrated as far as the inner compartment, or the chamber of death, the paffage is drawn clofe, and the flaughter begins. The undertakers of thefe fifheries pay an acknowledgment to the king, or the lord upon whofe land they fix the main ftay or foot of the tonnara; they make the beft bargain they can: and, till fuccefs has crowned their endeavours, obtain this leave for a fmall confideration; but the rent is afterwards raifed in proportion to their capture.

The tunny enters the Mediterranean about the vernal equinox, travelling in a triangular phalanx, fo as to cut the waters with its point, and to prefent an extenfive bafe for the tides and currents to act againft, and impel forwards. Thefe fifh repair to the warm feas of Greece to fpawn, fleering their courfe thither along the European fhores, but as they return, approach the African coaft; the young fry is placed in the van of the fquadron as they travel. They come back from the eaft in May, and abound on the coaft of Sicily and Calabria about that time. In autumn they fteer northward, and frequent the neighbourhood of Amalfi and Naples; but during the whole feafon ftragglers are occafionally caught. When taken in May, the ufual time of their appearance in the Calabrian bays, they are full of fpawn, and their flefh is then efteemed unwholefome, apt to occafion headachs and vapours; the milts and roes are particularly fo at that feafon. To prevent thefe bad effects, the natives fry them in oil, and afterwards falt them. The quantity of this fifh confumed annually in the two Sicilies almoft exceeds the bounds of calculation. From the beginning of May to the end of October it is eaten frefh, and all the reft of the year it is in ufe falted. The moft delicate part is the muzzle. The belly falted was called *tarantallum*, and accounted a great delicacy by the Romans; its prefent name is *Surra*. The reft of the body is cut into flices, and put into tubs.

Turbot-FISHERY. Turbots grow to a large fize, fome weighing from 23 to 30 pounds. They are taken chiefly off the north coaft of England, and others off the Dutch coaft. The large turbot (as well as feveral other kinds of flat fifh) are taken by the hook and line, for they lie in deep water; the method of taking them in weirs or ftaked nets being very precarious. When the fifhermen go out to fifh, each perfon is provided with three lines, which are coiled on a flat oblong piece of wickerwork; the hooks being baited, and placed regularly in the centre of the coil. Each line is furnifhed with 14 fcore of hooks, at the diftance of fix feet two inches from each other. The hooks are faftened to the lines upon fneads of twifted horfe-hair 27 inches in length. When fifhing, there are always three men in each coble, and confequently nine of thefe lines are faftened

together, and ufed as one line, extending in length near three miles, and furnifhed with 2520 hooks. An anchor and a buoy are fixed at the firft end of the line, and one more of each at the end of each man's lines; in all four anchors, which are common perforated ftones, and four buoys made of leather or cork. The line is always laid acrofs the current. The tides of flood and ebb continue an equal time upon our coaft, and, when undifturbed by winds, run each way about fix hours; they are fo rapid that the fifhermen can only fhoot and haul their lines at the turn of tide, and therefore the lines always remain upon the ground about fix hours; during which time the *myxine glutinofa* of Linnæus will frequently penetrate the fifh that are on the hooks, and entirely devour them, leaving only the fkin and bones. The fame rapidity of tides prevents their ufing hand-lines; and therefore two of the people commonly wrap themfelves in the fail, and fleep while the other keeps a ftrict look-out, for fear of being run down by fhips, and to obferve the weather. For ftorms often rife fo fuddenly, that it is with extreme difficulty they can fometimes efcape to the fhore, leaving their lines behind.

Befides the coble, the fifhermen have alfo a five-men boat, which is 40 feet long and 15 broad, and 25 tons burden; it is fo called, though navigated by fix men and a boy, becaufe one of the men is commonly hired to cook, &c. and does not fhare in the profits with the other five. This boat is decked at each end, but open in the middle, and has two large lug-fails. All our able fifhermen go in thefe boats to the herring-fifhery at Yarmouth in the latter end of September, and return about the middle of November. The boats are then laid up till the beginning of Lent, at which time they go off in them to the edge of the Dogger, and other places, to fifh for turbot, cod, ling, fkates, &c. They always take two cobles on board; and when they come upon their ground, anchor the boat, throw out the cobles, and fifh in the fame manner as thofe do who go from the fhore in a coble; with this difference only, that here each man is provided with double the quantity of lines, and inftead of waiting the return of the tide in the coble, they return to their boat and bait their other lines; thus hawling one fet and fhooting another every turn of tide. They commonly run into harbour twice a-week to deliver their fifh.

The beft bait is frefh herring cut in pieces of a proper fize; the five-men boats are always furnifhed with nets for taking them. Next to herrings are the leffer lampreys. The next baits in efteem are fmall haddocks cut in pieces, fand-worms, and limpets, here called *flidders*; and when none of thefe can be had, they ufe bullock's liver. The hooks are two inches and a half long in the fhank, and near an inch wide between the fhank and the point. The line is made of fmall cording, and is always tanned before it is ufed. Turbots are extremely delicate in their choice of baits; for if a piece of herring or haddock has been 12 hours out of the fea, and then ufed as bait, they will not touch it.

Whale-Fishery. For the natural hiftory of the whale, the importance of the whale-fifhery to Britain, and other particulars, fee the article Balæna.

We fhall here only remark, that the legiflature, juftly confidering that trade as of great national importance, beftowed upon it at different periods very confiderable encouragements. In particular, every Britifh veffel of 200 tons or upwards, bound to the Greenland feas on the whale-fifhery, if found to be duly qualified according to the act, obtained a licence from the commiffioners of the cuftoms to proceed on fuch voyage: and on the fhip's return, the mafter and mate making oath that they proceeded on fuch voyage and no other, and ufed all their endeavours to take whales, &c. and that all the whale-fins, blubber, oil, &c. imported in their fhip, were taken by their crew in thofe feas, there was allowed 40s. for every ton according to the admeafurement of the fhip.

It was afterwards found, however, that fo great a bounty was neither neceffary to the fuccefs of the trade, nor expedient with regard to the public. In 1786, therefore, the acts conferring the faid emoluments being upon the point of expiring, the fubject was brought under the confideration of parliament; and it was propofed to continue the former meafures, but with a reduction of the bounty from 40s. to 30s. In propofing this alteration, it was ftated, "that the fums which this country had paid in bounties for the Greenland fifhery amounted to 1,265,461l.; that in the laft year we had paid 94,858l.; and that, from the confequent deduction of the price of the fifh, the public at prefent paid 60 *per cent.* upon every cargo. In the Greenland fifhery there were employed 6000 feamen, and thefe feamen coft government 13l. 10s. per man *per annum*, though we were never able to obtain more than 500 of that number to ferve on board our fhips of war. Befides, the vaft encouragement given to the trade had occafioned fuch a glut in the market, that it was found neceffary to export confiderable quantities; and thus we paid a large fhare of the purchafe-money for foreign nations, as well as for our own people, befides fupplying them with the materials of feveral important manufactures." This propofition was oppofed by feveral members, but was finally carried; and the propriety of the meafure became very foon apparent. At that time (1786) the number of fhips employed from England in the whale-fifhery to Davis's Straits and the Greenland feas amounted to 139, befides 15 from Scotland. The propofed alteration took place the next year (1787); and notwithftanding the diminution of the bounty, the trade increafed; the number of fhips employed the fame year from England amounting to 217, and the next year (1788) to 222.

The whale fifhery has of late years been confiderably indebted to the introduction of a new kind of harpoon, called the *Gun* Harpoon, which the Society for the Encouragement of Arts have exerted themfelves to bring into general ufe. For an account of this, fee the article Harpoon.

FISHING, in general, the art of catching fifh, whether by means of nets, of fpears, or of the line and hook. That which is performed by the net, fpear, or harpoon, for fifh that go in fhoals, has been explained in the preceding articles. That performed by the rod, line, and hook, for folitary fifh, is ufually termed Angling: See that article; and for the particular manner of angling for the different kinds of fifh, fee their refpective names, as Dace, Eel, Perch, &c. The following, however, require to be mentioned here.

1. The *Barbel*, fo called on account of the bark or beard that is under his chops (fee Barbel), though a coarfe fifh, gives confiderable exercife to the angler's ingenuity. They fwim together in great fhoals, and are at their worft in April, at which time they fpawn, but come foon in feafon: the places whither they chiefly refort, are fuch as are weedy and gravelly rifing grounds, in which this fifh is faid to dig and root with his nofe like a fwine. In the fummer he frequents the ftrongeft and fwifteft currents of water; as deep bridges, weirs, &c. and is apt to fettle himfelf amongft the piles, hollow places, and mofs, weeds; and will remain there immoveable: but in the winter he retires into deep waters, and helps the female to make a hole in the fands to hide her fpawn in, to hinder its being devoured by other fifh. He is a very curious and cunning fifh; for if his baits be not fweet, clean, well fcoured, and kept in fweet mofs, he will not bite; but, well-ordered and curioufly kept, he will bite with great eagernefs. The beft bait for him is the fpawn of a falmon, trout, or any other fifh; and if you would have good fport with him, bait the places where you intend to fifh

with it a night or two before, or with large worms cut in pieces; and the earlier in the morning or the later in the evening that you fiſh, the better it will be. Your rod and line muſt be both ſtrong and long, with a running plummet on the line; and let a little bit of lead be placed a foot or more above the hook, to keep the bullet from falling on it: ſo the worm will be at the bottom, where they always bite; and when the fiſh takes the bait, your plummet will lie and not choke him. By the bending of your rod you may know when he bites, as alſo with your hand you will feel him make a ſtrong ſnatch; then ſtrike, and you will rarely fail, if you play him well; but if you manage him not dexterouſly, he will break your line. The beſt time for fiſhing is about nine in the morning, and the moſt proper ſeaſon is the latter end of May, June, July, and the beginning of Auguſt.

2. The *Bleak*, is an eager fiſh, caught with all ſorts of worms bred on trees or plants; as alſo with flies, paſte, ſheep's blood, &c. See the article BARBEL. Bleak may be angled for with half a ſcore of hooks at once, if they can be all faſtened on: he will alſo in the evening take a natural or artificial fly. If the day be warm and clear, there is no fly ſo good for him as the ſmall fly at the top of the water, which he will take at any time of the day, eſpecially in the evening: but if the day is cold and cloudy, gentles and caddis are the beſt: about two feet under water. No fiſh yields better ſport to a young angler than the bleak. He is ſo eager, that he will leap out of the water for a bait. There is another way of taking bleak, which is by whipping them in a boat, or on a bank ſide in freſh water in a ſummer's evening, with a hazel top about five or ſix feet long and a line twice the length of the rod. But the beſt method is with a drabble, thus: tie eight or ten ſmall hooks acroſs a line, two inches above one another; the biggeſt hook the lowermoſt, (whereby you may ſometimes take a better fiſh), and bait them with gentles, flies, or ſome ſmall red worms, by which means you may take half a dozen or more at a time.

3. For the *Bream*, (ſee BARBEL) obſerve the following directions, which will alſo be of uſe in *Carp*-fiſhing. Procure about a quart of large red worms; put them into freſh moſs well waſhed and dried every three or four days, feeding them with fat mould and chopped fennel, and they will be thoroughly ſcoured in about three weeks.

Let your lines be ſilk and hair, but all ſilk is the beſt: let the floats be either ſwan-quills or gooſe-quills. Let your plumb be a piece of lead in the ſhape of a pear, with a ſmall ring at the point of it: faſten the lead to the line, and the line-hook to the lead; about ten or twelve inches ſpace between lead and hook will be enough; and take care the lead be heavy enough to ſink the float. Having baited your hook well with a ſtrong worm, the worm will draw the hook up and down in the bottom, which will provoke the bream to bite the more eagerly. It will be beſt to fit up three or four rods and lines in this manner, and ſet them as will be directed, and this will afford you much the better ſport. Find the exact depth of the water if poſſible, that your float may ſwim on its ſurface directly over the lead; then provide the following ground bait: Take about a peck of ſweet groſs-ground-malt; and having boiled it a very little, ſtrain it hard through a bag, and carry it to the waterſide where you have ſounded; and into the place where you ſuppoſe the fiſh reſort, there throw in the malt by handfuls ſqueezed hard together, that the ſtream may not ſeparate it before it comes to the bottom; and be ſure to throw it in at leaſt a yard above the place where you intend the hook ſhall lie, otherwiſe the ſtream will carry it down too far. Do this about nine o'clock at night, keeping ſome of the malt in the bag; and go to the place about three the next morning; but approach very warily, leſt you ſhould be ſeen by the fiſh; for it is certain that they have their ſentinels watching on the top of the water, while the reſt are feeding below. Having baited your hook ſo that the worm may crawl to and fro, the better to allure the fiſh to bite, caſt it in at the place where you find the fiſh to ſtay moſt, which is generally in the broadeſt and deepeſt part of the river, and ſo that it may reſt about the midſt of your bait that is on the ground. Caſt in your ſecond line ſo that it may reſt a yard above that, and a third about a yard below it. Let your rods lie on the bank with ſome ſtones to keep them down at the great ends; and then withdraw yourſelf, yet not ſo far but that you can have your eye upon all the floats: and when you ſee one bitten and carried away, do not be too haſty to run in, but give time to the fiſh to tire himſelf, and then touch him gently. When you perceive the float ſink, creep to the waterſide, and give it as much line as you can. If it is a bream or carp, he will run to the other ſide. Strike him gently, and hold your rod at a bend a little while; but do not pull, for then you will ſpoil all; but you muſt firſt tire them before they can be landed, for they are very ſhy. If there are any carp in the river, it is an even wager that you take one or more of them: but if there are any pike or perch, they will be ſure to viſit the ground-bait, though they will not touch it, being drawn thither by the great reſort of the ſmall fiſh; and until you remove them, it is in vain to think of taking the bream or carp. In this caſe, bait one of your hooks with a ſmall bleak, roach, or gudgeon, about two feet deep from your float, with a little red worm at the point of your hook; and if a pike be there, he will be ſure to ſnap at it. This ſport is good till nine o'clock in the morning; and, in a gloomy day, till night: but do not frequent the place too much, leſt the fiſh grow ſhy.

4. The *Carp*. See CARP, and alſo the article BARBEL. A perſon who angles for carp muſt arm himſelf with abundance of patience, becauſe of its extraordinary ſubtilty and ſhyneſs: they always chooſe to lie in the deepeſt places, either of ponds or rivers, where there is but a ſmall running ſtream. Further, obſerve, that they will ſeldom bite in cold weather; and you cannot be too early or too late at the ſport in hot weather: yet if he bite, you need not fear his hold; for he is one of thoſe leather-mouthed fiſh that have their teeth in the throat. Neither muſt you forget, in angling for him, to have a ſtrong rod and line; and ſince he is ſo very wary, it will be proper to entice him, by baiting the ground with a coarſe paſte.

He ſeldom refuſes the red worm in March, the caddis in June, nor the graſhopper in July, April, and September. This fiſh does not only delight in worms, but alſo in ſweet paſte; of which there is great variety; the beſt is made of honey and ſugar, mixed up with flour, ſome veal minced fine, and a little cotton or white wool to make it adhere to the hook. It ought to be thrown into the water ſome hours before you begin to angle; neither will ſmall pellets thrown into the water two or three days before be worſe for this purpoſe, eſpecially if chickens guts, garbage, or blood mixed with bran and cow-dung, be alſo thrown in. If you fiſh with gentles, anoint them with honey, and put them on your hook, with a deep ſcarlet dipped in the like, which is a good way to deceive the fiſh. Honey and crumbs of wheat-bread, mixed together, make alſo a very good paſte.

In taking a carp either in pond or river, if the angler intends to add profit to his pleaſure, he muſt take a peck of ale-grains, and a good quantity of any blood to mix with the grains, baiting the ground with it where he intends to angle. This food will wonderfully attract the ſcale-fiſh, as carp, tench, roach, dace, and bream. Let him angle in a morning, plumbing his ground, and angling for carp with a ſtrong line: the bait muſt be either paſte or a knotted red worm; and by this means he will have ſport enough.

An Epitome of the whole art of FISHING, *wherein are ſhown, at one view, the harbours, ſeaſons, and depths, for catching all ſorts of fiſh uſual[ly] angled for; alſo the various baits for each, ſo digeſted as to contain the eſſence of all the treatiſes ever written on the ſubject, exempt from t[he] ſuperfluities, which tend more to perplex than inſtruct.*

Names.	Where found.	Seaſon.	Time to ang.	Depth from ground.	Proper Baits.			
					Flies. N°	Paſtes. N°	Worms N°	Fiſh an[d] Inſect[s] N° 8.
Bream	rough-ſtr. river or mid. pond	April to Mich.	Sun riſe to 9 3 to Sun-ſet	touch ground	——	1 3	1 to 7	N° 8.
Barbel	gravel-banks in currents under bridges	April to Aug.	very early or late	ditto	——	2	2 6 7	——
Bleak	ſandy bottom, deep rivers, ſhips ſterns	May to Oct.	all day	6 inches from bottom	1 2	2	2 3 8	——
Carp	ſtill deep mud-bottom, pond or river	May to Aug.	Sun-riſe to 9 3 to Sun-ſet	3 inches from bottom hot weather, mid-water	——	1 3 4	1 2 3 4 7	——
Chub or Chevin	ditto	May to Dec.	ditto	ditto	1 to 5	2	1 2 4 5	7 8
Dace	ſandy bottom, deep rivers, ſhips ſterns	May to Oct.	all day	6 to 12 inches from bottom	ditto	3 4	1 to 5 & 8	——
Gudgeon	gravel ſhoals	May to Oct.	ditto	near or on ground	——	ditto	2 8	——
Pike	near clay-banks	All the year	ditto	mid water	wh. ſtro. and ſnap	line float hook fixt	on ſhore	1 2 3 5 6 [7]
Pearch	river in ſtream } gravel or weedy bottom pond deepeſt part }	May to Aug. Aug. to May	S. riſe to 10 2 to Sun-ſet mid-day	ditto 6 inches from bottom	2	1	3 5 7 8	1 6
Pope	deep holes in rivers	May to Oct.	all day	ditto	5	——	all	——
Roach	ſandy bottom, deep rivers, ſhips ſterns	May to Oct.	ditto	6 to 12 inches	1 2 4 5	3 4	ditto	8
Salmon	deep rivers	Mar. to Sept.	8 to 9, 3 to 6	mid-way to the bottom	all large	——	1 5 6 7	1
Smelts	ſhips ſterns and docks	Apr. to Oct.	all day	mid-way to the bottom variable	all ſmall	——	1 2 5	bits o[f] ſmelt
Trout	purling ſtream and eddies of ſtony bottom river	Mar. to Mich.	ditto	cold weather, 6 inches to 9 hot weath. top to mid-wat.	1 to 5	——	1 2 5 to 8	1 8
Tench	mud-bottom river or pond	All the year	Sun-riſe to 9 3 to Sun-ſet	cold wea. 3 inch. from bot. hot weather mid-water	——	1 3 4	1 3 4 to 7	——
Umber or Grayling	clay bottom, ſwift ſtream	All the year	all day	cold weather, 6 to 9 inch. hot weath. top to mid-wat.	1 to 5	——	all	1 8

Deſcription of proper Baits for the ſeveral ſorts of FISH *referred to in the foregoing Table.*

Flies. 1. Stone-fly, found under hollow ſtones at the ſide of rivers, is of a brown colour, with yellow ſtreaks on the back and belly, has large wings, and is in ſeaſon from April to July. 2. Green drake, found among ſtones by river-ſides, has a yellow body ribbed with green, is long and ſlender, with wings like a butterfly, his tail turns on his back, and from May to Midſummer is very uſeful. 3. Oak-fly, found in the body of an old oak or aſh, with its head downwards, is of a brown colour, and excellent from May to September. 4. Palmer-fly or worm, found on leaves of plants, is commonly called a *caterpillar*, and when it comes to a fly is excellent for trout. 5. Ant-fly, found in ant-hills from June to September. 6. The May fly is to be found playing by the river-ſide, eſpecially againſt rain. 7. The black-fly is to be found upon every hawthorn after the buds are fallen off.

Paſtes. 1. Take the blood of a ſheep, and mix it with honey and flour to a proper conſiſtence. 2. Take old cheeſe grated, a little butter ſufficient to work it, and colour it with ſaffron; in winter uſe ruſty bacon inſtead of butter. 3. Crumbs of bread chewed or worked with honey or ſugar, moiſtened with gum water. 4. Bread chewed, and worked in the hand till it becomes ſtiff.

Worms. 1. The earth-bob, found in ſandy ground after ploughing; it is white, with a red head; and bigger than a gentle; another is found in heathy ground, with a blue head. Keep them in an earthen veſſel well covered, and a ſufficient quantity of the mould they harbour in. They are excellent from April to November. 2. Gentles, to be had from putrid fleſh: let them lie in wheat-bran a few days before uſed. 3. Flag-worms, found in the roots of flags; they are of a pale yellow colour, are longer and thinner than a gentle, and muſt be ſcoured like them. 4. Cow-turd-bob, or clap-bait, found under cow-turd from May to Michaelmas; it is like a gentle, but larger. Keep it in its native earth like the earth-bob. 5. Cadis worm, or cod-bait, found under looſe ſtones in ſhallow rivers; they are yellow, bigger than a gentle, with a black or blue head, and are in ſeaſon from April to July. Keep them in flannel bags. 6. Lob worm, found in gardens; it is very large, and has a red head, a ſtreak down the back, and a flat

broad tail. 7. Marſh-worms, found in marſhy ground; keep them in moſs ten days before you uſe them: their colour is a blueiſh red: they are a good bait from March to Michaelmas. 8. Brandling red-worms, or blood worms. found in rotten dunghills and tanners' bark; they are ſmall red worms, very good for all ſmall fiſh, have ſometimes a yellow tail, and are called *tag-tails*.

Fiſh and Inſects. 1. Minnow. 2. Gudgeon. 3. Roach. 4. Dace. 5. Smelt. 6. Yellow frog. 7. Snail ſlit. 8. Graſhopper.

Fishing-*Fly*, a bait uſed in angling for various kinds of fiſh. See Fishing. The fly is either *natural* or *artificial*.

I. *Natural* flies are innumerable. The moſt uſual for this purpoſe are mentioned in the preceding page. There are two ways to fiſh with natural flies; either on the ſurface of the water or a little underneath it. In angling for chevin, roach, or dace, move not your natural fly ſwiftly, when you ſee the fiſh make at it; but rather let it glide freely towards him with the ſtream: but if it be in a ſtill and ſlow water, draw the fly ſlowly ſidewiſe by him, which will make him eagerly purſue it.

II. The *artificial* fly is ſeldom uſed but in bluſtering weather, when the waters are ſo troubled by the winds, that the natural fly cannot be ſeen, nor reſt upon them. Of artificial flies there are reckoned no leſs than 12 ſorts, of which the following are the principal. 1. For March, the dun-fly; made of dun-wool, and the feathers of the partridge's wing; or the body made of black wool, and the feathers of a black drake. 2. For April, the ſtone-fly; the body made of black wool, dyed yellow under the wings and tail. 3. For the beginning of May, the ruddy fly; made of red wool, and bound about with black ſilk, with the feathers of a black capon hanging dangling on his ſides next his tail. 4. For June, the greeniſh fly; the body made of black wool, with a yellow liſt on either ſide, the wings taken off the wings of a buzzard, bound with black broken hemp. 5. The mooriſh fly, the body made of duſkiſh wool, and the wings of the blackiſh mail of a drake. 6. The tawny fly, good till the middle of June; the body made of tawny wool, the wings made contrary one againſt the other, of the whitiſh mail of a white drake. 7. For July, the waſp fly; the body made of black wool, caſt about with yellow ſilk, and the wings of drakes' feathers. 8. The ſteel-fly, good in the middle of July; the body made with greeniſh wool, caſt about with the feathers of a peacock's tail, and the wings made of thoſe of the buzzard. 9. For Auguſt, the drake-fly; the body made with black wool caſt about with black ſilk; his wings of the mail of a black drake, with a black head.

The beſt *Rules for artificial fly-fiſhing* are, 1. To fiſh in a river ſomewhat diſturbed with rain: or in a cloudy day, when the waters are moved by a gentle breeze: the ſouth wind is beſt; and if the wind blow high, yet not ſo but that you may conveniently guard your tackle, the fiſh will riſe in plain deeps; but if the wind be ſmall, the beſt angling is in ſwift ſtreams. 2. Keep as far from the water-ſide as may be; fiſh down the ſtream with the ſun at your back, and touch not the water with your line. 3. Ever angle in clear rivers, with a ſmall fly and ſlender wings; but in muddy places, uſe a larger. 4. When, after rain, the water becomes browniſh, uſe an orange fly; in a clear day, a light-coloured fly; a dark fly for dark waters, &c. 5. Let the line be twice as long as the rod, unleſs the river be encumbered with trees. 6. For every ſort of fly, have ſeveral of the ſame, differing in colour, to ſuit with the different complexions of ſeveral waters and weathers. 7. Have a nimble eye, and active hand, to ſtrike preſently with the riſing of the fiſh; or elſe he will be apt to throw out the hook. 8. Let the fly fall firſt into the water, and not the line, which will ſcare the fiſh. 9. In ſlow rivers, or ſtill places, caſt the fly acroſs the river, and let it ſink a little in the water, and draw it gently back with the current. *Salmon-flies* ſhould be made with their wings ſtanding one behind the other, whether two or four. This fiſh delights in the gaudieſt colours that can be; chiefly in the wings, which muſt be long, as well as the tail.

Fishing-*Floats*, are little appendages to the line, ſerving to keep the hook and bait ſuſpended at the proper depth, to diſcover when the fiſh have hold of them, &c. Of theſe there are many kinds; ſome made of quills, which are the beſt for ſlow waters; but for ſtrong ſtreams, ſound cork, without flaws or holes, bored through with an hot iron, into which is put a quill of a fit proportion, is preferable: the cork ſhould be ſhaped to a pyramidal form, and made ſmooth.

Fishing-*Hook*, a ſmall inſtrument made of ſteel-wire, of a proper form to catch and retain fiſh. The fiſhing hook, in general, ought to be long in the ſhank, ſomewhat thick in the circumference, the point even and ſtraight: the bend ſhould be in the ſhank. For ſetting the hook on, uſe ſtrong but ſmall ſilk, laying the hair on the inſide of the hook; for if it be on the outſide, the ſilk will fret and cut it aſunder.

There are ſeveral ſizes of theſe fiſhing-hooks, ſome big, ſome little: and of theſe, ſome have peculiar names; as, 1. Single hooks. 2. Double hooks; which have two bendings, one contrary to the other. 3. Snappers, or gorgers, which are the hooks to whip the artificial fly upon, or bait with the natural fly. 4. Springers, or ſpring hooks; a kind of double hook. with a ſpring, which flies open upon being ſtruck into any fiſh, and ſo keep its mouth open.

Fishing-*Line*, is either made of hair twiſted; or ſilk; or the Indian graſs. The beſt colours are the ſorrel, white, and grey; the two laſt for clear waters, the firſt for muddy ones. Nor is the pale watery green deſpiſable; this colour is given artificially, by ſteeping the hair in a liquor made of alum, ſoot, and the juice of walnut-leaves, boiled together.

Fishing-*Rod*, a long ſlender rod or wand, to which the line is faſtened, for angling. Of theſe there are ſeveral ſorts: as, 1. A troller, or trolling rod, which has a ring at the end of the rod, for the line to go through when it runs off a reel. 2. A whipper, or whipping-rod; a top-rod, that is weak in the middle, and top heavy, but all ſlender and fine. 3. A dropper; which is a ſtrong rod and very light. 4. A ſnapper, or ſnap-rod: which is a ſtrong pole, peculiarly uſed for the pike. 5. A bottom rod; being the ſame as the dropper, but ſomewhat more pliable. 6. A ſniggling or procking ſtick; a forked ſtick, having a ſhort ſtrong line, with a needle, baited with a lob-worm: this is only ſuitable for eels in their holes.

Fishing-*Frog*, or *Angler*. See Lophius.

Right of Fishing, and property of fiſh. It has been held, that where the lord of the manor hath the ſoil on both ſides of the river, it is a good evidence that he hath a right of fiſhing; and it puts the proof upon him who claims *liberam piſcariam*: but where a river ebbs and flows, and is an arm of the ſea, there it is common to all, and he who claims a privilege to himſelf muſt prove it; for if the treſpaſs is brought for fiſhing there, the defendant may juſtify, that the place where is *brachium maris, in quo unuſquiſque ſubditus domini regis valet et habere debet liberam piſcariam*. In the Severn the ſoil belongs to the owners of the land on each ſide; and the ſoil of the river Thames is in the king, but the fiſhing is common to all. He who is owner of the ſoil of a private river, hath *ſeparalis piſcaria*; and he that hath *libera piſcaria*, hath a property in the fiſh, and may bring a poſſeſſory action for them; but *communis piſcaria* is like the caſe of all other commons. One that has a cloſe pond in which there are fiſh, may call them *piſces ſuos*, in an indictment, &c. but he cannot call them *bona & catalla*. if they be not in trunks. There needs no privilege to make a fiſh pond, as there doth in the caſe of a warren. See Franchise.

FISKARD, a town in Pembrokeshire, situated on a steep cliff on the sea. It is governed by a mayor, bailiff, &c. and carries on a good trade in herrings. It has a market on Friday, and is 242 miles W. by N. of London.

FISSURES, in the history of the earth, certain interruptions, that in an horizontal or parallel manner divide the several strata of which the body of our terrestrial globe is composed.

Fissure *of the Bones*, in surgery, is when they are divided either transversely or longitudinally, not quite through, but cracked after the manner of glass, by any external force.

FISTULA, in the ancient music, an instrument of the wind-kind, resembling our flute or flageolet. The principal wind-instruments of the ancients were the tibia and the fistula. But how they were constituted, wherein they differed, or how they were played upon, does not appear. All we know is, that the fistula was at first made of reeds, and afterwards of other matters. Some had holes, some none; some again were single pipes; others a combination of several; witness the syringa of Pan.

Fistula, in surgery, a deep, tubular, and callous ulcer, generally arising from an abscess. It differs from a *sinus*, in its being callous, which the latter is not. See Surgery.

Fistula, in farriery. See Farriery, page 436.

FISTULARIA, or Tobacco-pipe Fish; a genus of fishes, belonging to the order of abdominales. See Plate 25. Of this genus Linnæus reckons two species; but we have a description only of one, viz. the tabacaria. It is described by Mr. Catesby, from the only one he ever saw. It was almost a foot in length; the fore-part from the nose to half-way the body of nearly equal bigness; from whence it grew tapering to the tail, which was forked, and from which grew a slender taper whip, four inches long, of the consistence of whalebone; the mouth narrow, from which to the eyes was almost three inches. The whole fish was of a brown colour. They are sometimes taken on the coasts of Jamaica.

FIT. See the article Paroxysm.

FITCHES, in husbandry, a sort of pulse, more generally known by the name of *chick-pea*. See Cicer. Fitches are cultivated either for feeding cattle, or improving the land. They make a wholesome and nourishing food, whether given in the straw or threshed out. When sown only to improve the soil, they are ploughed in just as they begin to blossom, by which means a tough stiff clay-soil is much enriched.

FITCHET, a name used in some places for the weasel, called also the *foumart*. See Mustela.

FITCHY, in heraldry, from the French *fixé*, i. e. *fixed*; a term applied to a cross when the lower branch ends in a sharp point: and the reason of it Mackenzie supposes to be, that the primitive Christians were wont to carry crosses with them wherever they went; and when they stopped on their journey at any place, they fixed those portable crosses in the ground for devotion's sake.

FITZ, makes part of the surname of some of the natural sons of the kings of England, as *Fitz-roy*; which is purely French, and signifies the "king's son."

FITZHERBERT (Sir Anthony), a very learned lawyer in the reign of king Henry VIII. was descended from an ancient family, and born at Norbury in Derbyshire. He was made one of the judges of the court of common-pleas in 1523; and distinguished himself by many valuable works, as well as by such an honourable discharge of the duties of his office, as made him esteemed an oracle of the law. His writings are, *The Grand Abridgment*; *The Office and Authority of Justices of Peace*; *the Office of Sheriffs, Bailiffs of Liberties, Escheators, Constables, Coroners, &c.*; *Of the Diversity of Courts*; *The New Natura Brevium*; *Of the Surveying of Lands*; and *The Book of Husbandry.* He died in 1538.

FITZ-STEPHEN (William), a learned monk of Canterbury, of Norman extraction, but born of respectable parents in the city of London. He lived in the 12th century; and being attached to the service of archbishop Becket, was present at the time of his murder. In the year 1174, he wrote in Latin, *The Life of St. Thomas, archbishop and martyr*; in which, as Becket was a native of the metropolis, he introduces a description of the city of London, with a miscellaneous detail of the manners and usages of the citizens; this is deservedly considered as a great curiosity, being the earliest professed account of London extant. Fitz-Stephen died in 1191.

FIVES, or Vives. See Farriery, p. 421.

FIXATION, in chemistry, the rendering any volatile substance fixed, so as not to fly off upon being exposed to a great heat: hence,

FIXED bodies, are those which bear a considerable degree of heat without evaporating, or losing any of their weight. Among the most fixed bodies are diamonds, gold, &c. See Diamond, Gold, &c.

Fixed, or *Fixable Air*, an invisible and permanently elastic fluid, superior in gravity to the common atmospheric air and most other aerial fluids, exceedingly destructive to animal life; produced in great quantities, naturally from combustible bodies, and artificially by many chemical processes. From its apparently acid properties it has obtained the name of *aerial acid*, *cretaceous acid*, and *carbonic acid*; from its noxious qualities, it has been called *mephitic air*, or *mephitic gas*; and, from the circumstance of being produced in vast quantities during the combustion of charcoal, it first obtained, from Van Helmont, the name of *gas sylvestre*. The term *fixed air* has been given from its property of readily losing its elasticity, and fixing itself in many bodies, particularly those of the calcareous kind; and though some objected to the propriety of the term, the fluid in question is so well known by the name of fixed air, that we choose still to retain it. The nature and properties of fixed air are explained under the article Aerology. The acid which is commonly known by the name of fixed air, abounds in great quantities in nature, and appears to be produced in a variety of circumstances. It composes about one third of the weight of lime-stone, marble, calcareous spar, and other natural specimens of calcareous earth, from which it may be extricated either by the simple application of heat, or by the superior affinity of some other acid; most acids having a stronger action on bodies than this. This last process does not require heat, because fixed air is strongly disposed to assume the elastic state. Water, under the common pressure of the atmosphere, and at a low temperature, absorbs somewhat more than its bulk of fixed air, and then constitutes a weak acid. If the pressure be greater, the absorption is augmented. Heated water absorbs less; and if water impregnated with this acid be exposed on a brisk fire, the rapid escape of the aerial bubbles affords an appearance as if the water were at the point of boiling, when the heat is not greater than the hand can bear. Congelation separates it readily and completely from water; but no degree of cold or pressure has yet exhibited this acid in a dense or concentrated state of fluidity.

Fixed air is nearly twice as heavy as common air, and for that reason occupies the lower parts of such mines or caverns as contain materials which afford it by decomposition. The miners call it choke-damp. The Grotto del Cano, in the kingdom of Naples, has been famous for ages on account of the effects of a stratum of fixed air which covers its bottom. It is a cave or hole in the side of a mountain, near the lake Agnano, measuring not more than eighteen feet from its entrance to the inner extremity; where if a dog or other animal that holds down its head be thrust, it is immediately killed by inhaling this noxious fluid.

Fixed air is emitted in large quantities by bodies in the ſtate of vinous fermentation, (ſee FERMENTATION), and on account of its great weight it occupies the apparently empty ſpace or upper part of the veſſels in which the fermenting proceſs is going on. A variety of ſtriking experiments may be made in this ſtratum of elaſtic fluid. Lighted paper, or a candle dipped into it, is immediately extinguiſhed; and the ſmoke remaining in the fixed air renders its ſurface viſible, which may be thrown into waves by agitation like water. If a diſh of water be immerſed in this air, and briſkly agitated, it ſoon becomes impregnated, and obtains the vivid taſte of Pyrmont water. In conſequence of the weight of the fixed air, it may be taken out in a pitcher or bottle, which, if well corked, may be uſed to convey it to great diſtances. The effects produced by moving this inviſible fluid from one veſſel to another have a very ſingular appearance: if a candle or ſmall animal be placed in a deep veſſel, the former becomes extinct, and the latter expires in a few ſeconds, after the fixed air is communicated to them, though the eye is incapable of diſtinguiſhing any thing that is done.

When vegetable ſubſtances are expoſed to a ſtrong heat in veſſels partly cloſed, the volatile principles fly off; but combuſtion does not take place for want of air. The fixed reſidue is the inflammable ſubſtance called charcoal. For general purpoſes, wood is converted into charcoal by building it up in a pyramidical form, and covering the pile with clay or earth, leaving a few air-holes, which are cloſed when the maſs is perfectly lighted, and by that means the combuſtion is carried on in an imperfect manner. Common charcoal when expoſed to heat in cloſed veſſels gives out a ſmall quantity of inflammable air, which ſeems extraneous to it; and, if it be burned, it leaves a ſmall portion of earth, fixed alkali, and other ſalts. The greater part of charcoal therefore conſiſts of one inflammable ſubſtance: and it is found, that if this be burned in a cloſe veſſel over mercury with vital air, the product is fixed air, and nothing elſe, as is proved by the reſidue after the fixed air has been abſorbed by cauſtic fixed alkali; for there is either no aerial reſidue, or the reſidue conſiſts of vital air as pure as it was at firſt*.

Hence it follows, that fixed air conſiſts of the inflammable matter of charcoal united to vital air. The antiphlogiſtian philoſophers conſider this matter as a peculiar combuſtible and acidifiable baſe, and thence infer the preſence of charcoal in all caſes where fixed air is extricated or produced; but, on the other hand, ſeveral of the phlogiſtians think themſelves juſtifiable in concluding that fixed air is produced by the union of inflammable air with vital air, when either of them is in the naſcent ſtate or ſtate of extrication.

When the electric † ſpark is paſſed through fixed air confined by mercury, the volume of air is augmented about one twenty-fourth part; and of this, three-fifths are abſorbed by a ſolution of cauſtic alkali, and the remainder is inflammable. An eminent philoſopher of the phlogiſtic opinion ſuppoſes this effect to ariſe from the decompoſition of the fixed air, whoſe vital air, combining more intimately with part of the inflammable air, forms water, the reſidue of this laſt air being diſengaged. But the chemiſt who made the experiment, accounts for it as follows, without ſuppoſing the fixed air to be decompoſed. The air of the atmoſphere and other elaſtic fluids are proved by experiment to be capable of retaining mercury in ſolution; ſo likewiſe in all probability does the fixed air; and they all retain much water. Whenever therefore the electric ſpark, by paſſing through this mixture of fixed air, mercury, and water, ignites a minute portion of it, the vital air of the water unites with and calcines the mercury, while the inflammable air of the water is ſet at liberty, and the fixed air, like other acids, unites to the mercurial calx, and falls down with it. He ſuppoſes from analogy, that the water in the fixed air increaſes its volume by rarefying, and that the abſtraction of the water occaſions a contraction, while the diſengagement of the inflammable air produces a ſomewhat greater augmentation of bulks. In this way, ſuppoſing the water and mercury to be preſent in ſufficient quantity, the whole of the fixed air may enter into a ſolid combination, and nothing remains but inflammable air. Additional experiments muſt however be made before either opinion can be eſtabliſhed.

Fixed air does not appear to be ſtrongly diſpoſed to unite with argillaceous earth. Moſt clays however afford a ſmall quantity of this fluid by heat; and the ſnowy white ſubſtance reſembling chalk, and known by the name of lac lunæ, is found to conſiſt of clay ſaturated with fixed air. A ſaline ſubſtance, conſiſting of two ſix-ſided pyramids joined at one common baſe, weighing five or ſix grains, and of a taſte ſomewhat reſembling alum, was produced by leaving an ounce phial of water, impregnated with fixed air and a redundancy of earth of alum, expoſed to ſpontaneous evaporation for ſome months.

Calcareous earth and fixed air have a ſtrong attraction for each other. Moſt of the ſpecimens of calcareous earth abound with this acid; and the immediate precipitation of lime from lime-water is the teſt of the preſence of this acid.

Ponderous earth combines very ſtrongly with fixed air. This compound has been found in England and elſewhere.

Magneſia unites readily to a large proportion of fixed air.

The uſual method of procuring magneſia is by precipitation from a ſolution of Epſom ſalt, by adding an alkali which combines with the acid. When a mild fixed alkali is uſed, it is neceſſary that the ſaline ſolutions ſhould be boiling hot, and the ebullition continued for a ſhort time, in order to diſſipate a portion of fixed air, which would hold part of the magneſia in ſolution. From this cauſe it is, that perfectly mild vegetable alkali affords no precipitate when added to a ſolution ‡ of Epſom ſalt at the temperature of 60°. The mineral alkali, which contains leſs fixed air than the cryſtallized vegetable alkali, likewiſe affords but a ſmall quantity of precipitate, unleſs heat be applied. Mild volatile alkali alſo poſſeſſes the property of affording no precipitate when added to a ſolution of Epſom ſalt in the cold. With a greater heat magneſia is ſeparated, and at a boiling heat it is again taken up, moſt probably forming a triple ſalt compoſed of vitriolic acid united to volatile alkali and magneſia. The ſaline combination of magneſia and fixed air is ſeparated in cryſtals from all theſe cold ſolutions by ſtanding uncovered; during which time the fixed air which held the magneſia in ſolution is no doubt gradually diſſipated. The cryſtals afforded when vegetable alkali is uſed, are contaminated with vitriolated tartar, which ſeparates at the ſame time: thoſe obtained by mineral alkali are finer and purer; but the moſt beau-

* Lavoiſier in Mem. Acad. Part for 1781, p. 449.

† This experiment, firſt performed by Dr. Prieſtley, i. 248, has ſince been repeated by Van Marum and others. The experiment of Mr. Monge, quoted by Kirwan in his Eſſay on Phlogiſton, p. 193, ſecond edition, is that ſpoken of in the text; and the opinions are thoſe of Meſſrs. Kirwan and Monge.

‡ One part Epſom ſalt, diſſolved in ſix parts of water, was mixed with one part of cryſtallized vegetable alkali, diſſolved in five parts water. Conſult Fourcroy in the Annales de Chimie, ii. 282, from whence the whole of this article reſpecting aerated magneſia is taken.

tiful and pureſt are obtained by leaving the ſolution to which volatile alkali has been added, expoſed for ſome days in an oblong veſſel.

This cryſtallized aerated magneſia has uſually the form of ſixſided priſms. It is almoſt taſteleſs; effloreſces in the air; becomes pulverent by heat, by the loſs of its fixed air and water; is ſoluble in about forty times its weight of water, at the temperature of 55°. Half its weight conſiſts of fixed air, one fourth water, and one fourth magneſia; whereas the common aerated magneſia obtained by rapid precipitation contains forty parts magneſia, forty-eight fixed air, and twelve water.

All the earthy combinations of fixed air are nearly inſoluble in water; they are all more ſoluble with an exceſs of that acid than in mere water; and they all give out their fixed air by heat, except the native ſpecimen of aerated ponderous earth. This laſt contains no water; and water ſeems to be eſſentially neceſſary to enable bodies to aſſume the aerial form.

Fixed air has no action upon ſiliceous earth.

The three alkalis form concrete cryſtallizable ſalts when united with fixed air, which, being in fact neutral ſalts, are much leſs active than the cauſtic or pure alkalis themſelves. Theſe ſalts ſtill continue to be called the mild alkalis, becauſe the fixed air, though it forms a large proportion of their weight, is diſplaced by moſt other acids, and therefore does not obviouſly ſeem to impair their alkaline properties: beſides which, as this volatile acid flies off in the elaſtic form, and is loſt in common experiments (exhibiting no other indication of its preſence than the violent ebullition which accompanies its eſcape), it was formerly overlooked, and even at the preſent time is not always ſufficiently attended to.

Alkaline air and fixed air unite, and form the concrete volatile alkali.

The combination of fixed air with inflammable ſubſtances has not been accurately examined. Metallic calces uſually contain more or leſs of this acid. Plumbago or black lead is the moſt remarkable compound into which it enters. This affords much fixed air; but chemiſts are not agreed with reſpect to its combuſtible part, ſome conſidering it as the mere principle of inflammability, and others aſſerting it to be iron. See Plumbago, and alſo Iron.

As fixed air is now an article of the materia medica, a method of obtaining it readily and in large quantity becomes an object of conſiderable conſequence. Mr. Henry, who has ſtated that fixed air is the proper baſe of ferments, and the immediate cauſe of fermentation (ſee Fermentation), deſcribes an apparatus for impregnating wort or other fermentable liquors with it. This apparatus is repreſented in plate 27, where *A A*, fig. 1. repreſents the caſk in which the wort is to be impregnated; *d d*, the ſtrings by which the air-veſſel is to be let down. Fig. 2. *D*, The air-veſſel, ſimilar to the bottom part of Dr. Nooth's glaſs machine, to be made of glaſs or earthen ware. *c c*, A glaſs-ſtopper ground in to fit the mouth of the veſſel, having a number of capillary tubes running from bottom to top in a diverging direction, ſo as to ſpread the air in its paſſage through the liquor. Fig. 3. The ſtopper viewed ſeparately to ſhow the capillary tubes.

The method of uſing this apparatus is obvious from an inſpection of the figure; but at the ſame time it muſt be equally evident, that it cannot be applied where any very large quantity is to be impregnated. Where great quantities of fixed air are required, we muſt alſo uſe great quantities of fermenting materials; and it would be inconvenient in the higheſt degree to immerge theſe in the liquor to be fermented; not to mention, that where large quantities of this kind of materials are mixed, they ought frequently to be ſtirred or ſhaken, leſt they ſhould concrete into hard lumps; while at the ſame time they are often apt to ſwell, and would thus endanger the ſpoiling of the liquor altogether. It muſt alſo be remarked, that any liquid receives an impregnation of fixed air more readily from the ſurface than by blowing it through the maſs of liquid. The apparatus repreſented fig. 4. therefore ſeems preferable to that of Mr. Henry, as capable of being extended indefinitely almoſt without any additional trouble. *ABCD* repreſents a large wooden caſk filled with materials to the height repreſented by *k k*. *E* is a large flat cooler for holding the liquor to be impregnated. This veſſel is to be cloſely covered, and may be conveniently made of wood, having a wooden top, the edges of which are cloſely luted all round with a mixture of ſalad oil and finely powdered chalk. *f*, Repreſents a tin pipe, about an inch in diameter, by which a communication is made between the caſk and cooler for the tranſmiſſion of the fixed air. *g b*, Is a wooden axis paſſing quite through the caſk from top to bottom, and moveable on a centre *b*, having a ſtrong handle at top, to turn it in order to ſtir the mixture. *i i i i*, Are four croſs blades fixed into the axis, which, in conſequence of turning the handle, ſtir and raiſe a great commotion in the liquor contained in the caſk. *m*, Is a large hole ſtopped with a wooden plug, by which the materials may be put in or taken out; and for this laſt purpoſe a kind of ladle with an upright ſtem as *M* may be made uſe of. *l*, Is a plug ſtopping up a hole in the lid of the cooler *E*, by which the liquor to be impregnated may be put in, and let out again by the cock *n*.

In this apparatus it is evident, that when an effervеſcing mixture is put into the caſk, the fixed air muſt paſs through the tube *f* into the cooler, where it will be abſorbed by the liquor as faſt as it is emitted by the materials; but in order to prevent it from eſcaping, all the junctures muſt be luted carefully with the mixture of ſalad oil and chalk already mentioned, which is both ſufficiently adheſive, and, remaining ſoft for a long time, may be inſtantaneouſly repaired where it happens to be broken. When the effervеſcence begins to be languid, it may inſtantly be quickened by turning the handle; but this will diſturb the luting at *o o*, which muſt therefore be preſſed cloſe all round the axis as ſoon as the matter is ſufficiently ſtirred.

Fixed *Stars*, are ſuch as conſtantly retain the ſame poſition and diſtance with reſpect to each other; by which they are contradiſtinguiſhed from *erratic* or *wandering* ſtars, which are continually ſhifting their ſituation and diſtance. The fixed ſtars are what we properly and abſolutely call *ſtars*: the reſt have their peculiar denominations of *planet* and *comet*. See Astronomy, p. 358.

FIXITY, or Fixedness, in chemiſtry, is in a peculiar manner uſed for the affection oppoſite to volatility; *i. e.* the property whereby bodies bear the action of the fire, without being diſſipated in fumes.

FLACCUS (Caius Valerius), an ancient Latin poet, of whom we have very imperfect accounts remaining. He wrote a poem on the Argonautic expedition; of which, however, he did not live to finiſh the eighth book, dying at about 30 years of age. John Baptiſta Pius, an Italian poet, completed the eighth book of the Argonautics; and added two more from the fourth of Apollonius; which ſupplement was firſt added to Aldus's edition in 1523.

FLAGS, in the army, are ſmall banners of diſtinction ſtuck in the baggage-waggons, to diſtinguiſh the baggage of one brigade from another, and of one battalion from another; that they may be marſhalled by the waggon-maſter general according to the rank of their brigades, to avoid the confuſion that might otherwiſe ariſe.

Flag, in the marine, a certain banner or ſtandard, by which an admiral is diſtinguiſhed at ſea from the inferior ſhips of his ſquadron; alſo the colours by which one nation is diſtinguiſhed from another. See plate 28. In the Britiſh navy, flags are either red, white, or blue; and are diſplayed from the top of

the main-maſt, fore-maſt, or mizen-maſt, according to the rank of the admiral. When a flag is diſplayed from the flag-ſtaff on the main-maſt, the officer diſtinguiſhed thereby is known to be an admiral; when from the foremaſt, a vice-admiral; and when from the mizen-maſt, a rear-admiral. The firſt flag in Great Britain is the royal ſtandard, which is only to be hoiſted when the king or queen are on board the veſſel: the ſecond is that of the anchor of hope, which characteriſes the lord high admiral, or lords commiſſioners of the admiralty: and the third is the union-flag, in which the croſſes of St. George and St. Andrew are blended. This laſt is appropriated to the admiral of the fleet, who is the firſt military officer under the lord high admiral. The next flag after the union is that of the white ſquadron, at the main-maſt head; and the laſt, which characteriſes an admiral, is the blue, at the ſame maſt-head. For a vice-admiral, the firſt flag is the red, the ſecond the white, the third the blue, at the flag-ſtaff on the fore-maſt. The ſame order proceeds with regard to the rear-admirals, whoſe flags are hoiſted on the top of the mizen-maſt: the loweſt flag in our navy is accordingly the blue on the mizen maſt.

To Lower or Strike the FLAG, in the marine, is to pull it down upon the cap, or to take it in, out of the reſpect or ſubmiſſion due from all ſhips or fleets inferior to thoſe which are deemed their ſuperiors. To lower or ſtrike the flag in an engagement is a ſign of yielding. The way of leading a ſhip in triumph is to tie her flags to the ſhrouds, or the gallery, in the hind-part of the ſhip, and let them hang down towards the water, and to tow the veſſels by the ſtern. Livy relates, that this was the way the Romans uſed thoſe of Carthage. *To Heave out* the Flag, is to put out or put abroad the flag. *To Hang out the White Flag*, is to aſk quarter; or it ſhows, when a veſſel is arrived on a coaſt, that it has no hoſtile intention, but comes to trade, or the like. The red flag is a ſign of defiance, and battle.

FLAG is alſo uſed for ſedge, a kind of ruſh.

Corn-FLAG. See GLADIOLUS.

Sweet-ſcented FLAG. See ACORUS.

FLAG-*Officers*, thoſe who command the ſeveral ſquadrons of a fleet; ſuch are the admirals, vice-admirals, and rear-admirals. The flag-officers in our pay, are the admiral, vice-admiral, and rear admiral of the white, red, and blue. See ADMIRAL, FLAG, and FLEET.

FLAG-*Ship*, a ſhip commanded by a general or flag-officer, who has a right to carry a flag, in contradiſtinction to the ſecondary veſſels under the command thereof.

FLAG-*Stone*, a genus of argillaceous earths of a grey, yellowiſh, or reddiſh white colour; not giving fire with ſteel, nor effervefcing with acids. Its ſpecific gravity is from 2600 to 2780. Sometimes it is found compact, and ſometimes like the argillaceous grit; in which caſe its gravity is leſs. Its general uſe is for flooring houſes, though ſometimes it is made uſe of for covering them. There is alſo a calcareous flag-ſtone found near Woodſtock in England. It is of a yellowiſh white colour, and moderately hard, containing a little iron. Its ſpecific gravity is 2585.

FLAGELLANTES, a ſect of wild fanatics who chaſtiſed and diſciplined themſelves with whips in public. The ſect of the Flagellantes had its riſe in Italy in the year 1260; its author was one Rainier, a hermit; and it was propagated from hence through almoſt all the countries of Europe. It was in all probability no more than the effect of an indiſcreet zeal. A great number of perſons of all ages and ſexes made proceſſions, walking two by two with their ſhoulders bare, which they whipped till the blood ran down, in order to obtain mercy from God, and appeaſe his indignation againſt the wickedneſs of the age. They were then called the *devout*; and having eſtabliſhed a ſuperior, he was called the *general of the devotion*. Though the primitive Flagellantes were exemplary in point of morals, yet they were joined by a turbulent rabble, who were infected with the moſt ridiculous and impious opinions; ſo that the emperors and pontiffs thought proper to put an end to this religious phrenſy, by declaring all devout whipping contrary to the divine law, and prejudicial to the ſoul's eternal intereſt.

However, this ſect revived in Germany towards the middle of the next century, and rambling through many provinces, occaſioned great diſturbance. They held, among other things, that flagellation was of equal virtue with baptiſm and the other ſacraments; that the forgiveneſs of all ſins was to be obtained by it from God without the merits of Jeſus Chriſt; that the old law of Chriſt was ſoon to be aboliſhed, and that a new law, enjoining the baptiſm of blood to be adminiſtered by whipping, was to be ſubſtituted in its place: upon which Clement VII, by an injudicious as well as unrighteous policy, thundered out anathemas againſt the Flagellantes, who were burnt by the inquiſitors in ſeveral places; but they were not eaſily extirpated. They appeared again in Thuringia and Lower Saxony in the 15th century; and rejected not only the ſacraments, but every branch of external worſhip; and placed their only hopes of ſalvation in faith and flagellation, to which they added other ſtrange doctrines concerning evil ſpirits. Their leader Conrad Schmidt and many others were committed to the flames by German inquiſitors in and after the year 1414.

FLAGEOLET, or FLAJEOLET, a little flute, uſed chiefly by ſhepherds and country-people. It is made of box or other hard wood, and ſometimes of ivory; and has ſix holes, beſides that at the bottom, the mouth-piece, and that behind the neck.

FLAIL, an inſtrument for threſhing corn. It conſiſts of the following parts. 1. The hand-ſtaff, or piece held in the threſher's hand. 2. The ſwiple, or that part which ſtrikes out the corn. 3. The caplins, or ſtrong double leathers, made faſt to the tops of the hand-ſtaff and ſwiple. 4. The middle-band, being the leather thong or fiſh ſkin that ties the caplins together.

FLAIR, in ſea language. The ſeamen ſay that the work doth flair over, when a ſhip ſeems houſed in near the water, ſo that the work hangs over a little too much, and thus is let out broader aloft than the due proportion will allow.

FLAKE, in the cod fiſhery, a ſort of ſcaffold or platform, made of hurdles, and ſupported by ſtanchions, and uſed for drying cod-fiſh in Newfoundland. Theſe flakes are uſually placed near the ſhores of fiſhing-harbours.

FLAKE, in gardening, a name given by the floriſts to a ſort of carnations which are of two colours only, and have very large ſtripes, all of them going quite through the leaves.

FLAKE-*White*, in painting, is lead corroded by means of the vapour of grapes, or a ceruſs prepared by the acid of grapes. It is brought here from Italy; and has been ſaid to ſurpaſs, both with regard to its whiteneſs and durability, all the kinds of white lead made with us. It is uſed in oil and varniſh painting for all purpoſes where a very clean white is required. The flake-white ſhould be procured in lumps as it is brought over, and levigated by thoſe who uſe it; becauſe that which the colourmen ſell in a prepared ſtate is levigated and mixed up with ſtarch, and often with common chalk, and worſe ſophiſtications.

FLAMBEAU, or FLAMBOY, a luminary made of ſeveral thick wicks, covered over with wax, ſerving to burn at nights in the ſtreets; as alſo at funeral proceſſions, illuminations, &c. Flambeaux differ from links, torches, and tapers. They are made ſquare, ſometimes of white wax and ſometimes of yellow. They uſually conſiſt of four wicks or branches near an inch thick, and about three feet long, made of a ſort of coarſe hempen yarn half twiſted. They are made with the ladle

much as torches or tapers are; viz. by firft pouring the melted wax on the top of the feveral fufpended wicks, and letting it run down to the bottom. This they repeat twice. After each wick has thus got its proper cover of wax, they lay them to dry; then roll them on a table, and fo join four of them together by means of a red-hot iron. When joined, they pour on more wax till the flambeau is brought to the fize required, which is ufually from a pound and a half to three pounds. The laft thing is to finifh their form or outfide, which they do with a kind of polifhing inftrument of wood by running it along all the angles formed by the union of the branches. The flambeaux of the ancients were different from ours. They were made of woods dried in furnaces or otherwife. They ufed many kinds of wood for this purpofe; the wood moft ufual was pine. Pliny fays, that in his time they frequently alfo burnt oak, elm, and hazel. In the feventh book of the Æneid, mention is made of a flambeau of pine; and Servius on that paffage remarks, that they alfo made them of the cornel-tree.

FLAMBOROUGH-head, a remarkable promontory of Yorkfhire, whofe lofty fnow-white cliffs are feen far out at fea, and ferve for a direction to fhips. Its rocks are occupied by innumerable multitudes of feafowls, which fill the air and ocean all around. It is five miles E. of Burlington. Lon. 0. 4. E. Lat. 54. 9. N.

FLAME, is a general name for every kind of luminous vapour, provided the light it emits hath any confiderable degree of intenfity. The name *flame*, however, is moft generally applied to fuch as are of a conical figure, like thofe arifing from our common fires; without this, they are commonly called *luminous vapours*, or fimply *lights*.

Newton and others have confidered flame as an ignited vapour, or red hot fmoke. This, in a certain fenfe, may be true, but, no doubt, contains an inaccurate comparifon. Simple ignition never exceeds in intenfity of light the body by contact of which it was produced. But it appears to be well afcertained, that flame always confifts of volatile inflammable matter in the act of combuftion and combination with the vital part of the atmofphere. Many metallic fubftances are volatilized by heat, and burn with a flame by the contact of the air in this rare ftate. Sulphur, phofphorus, and fome other bafes of acids, exhibit the fame phenomenon. But the flames of organized fubftances are in general produced by the extrication and accenfion of inflammable air with more or lefs of charcoal. When the circumftances are not favourable to the perfect combuftion of thefe products, a portion of the coal paffes through the luminous current unburned, and forms fmoke. Soot is the condenfed matter of fmoke.

As the artificial light of lamps and candles is afforded by the flame they exhibit, it feems a matter of confiderable importance to fociety to afcertain how the moft luminous flame may be produced with the leaft confumption of combuftible matter. There does not appear to be any danger of error in concluding that the light emitted will be greateft when the matter is completely confumed in the fhorteft time. It is therefore neceffary that a ftream of volatilized combuftible matter of a proper figure, at a very elevated temperature, fhould pafs into the atmofphere with a certain determinate velocity. If the figure of this ftream fhould not be duly proportioned; that is to fay, if it be too thick, its internal parts will not be completely burned for want of contact with the air. If its temperature be below that of ignition, it will not burn when it comes into the open air. And there is a certain velocity at which the quantity of atmofpherical air which comes in contact with the vapour will be neither too great nor too fmall; for too much air will diminifh the temperature of the ftream of combuftible matter fo much as very confiderably to impede the defired effect, and too little will render the combuftion languid. See Count Rumford's remarks under Light.

We have an example of a flame too large in the mouths of the chimneys of furnaces, where the luminous part is merely fuperficial, or of the thicknefs of about an inch or two, according to circumftances, and the internal part, though hot, will not fet fire to paper paffed into it through an iron tube; the fame defect of air preventing the combuftion of the paper as prevented the interior fluid itfelf from burning. And in the lamp of Argand we fee the advantage of an internal current of air, which renders the combuftion perfect by the application of air on both fides of a thin flame. So likewife a fmall flame is whiter and more luminous than a larger; and a fhort fnuff of a candle giving out lefs combuftible matter in proportion to the circumambient air, the quantity of light becomes increafed to eight or ten times what a long fnuff would have afforded.

Flames are of different colours, according to the fubftances from which they are produced. Thus, the flame of fulphur and fpirit of wine is blue; the flame of nitre and zinc, of a bright white; that of copper, of a greenifh blue, &c. Thefe varieties afford an opportunity of making a number of agreeable reprefentations in fire-works, which could not be done if the flame produced from every different fubftance was of the fame colour. See Pyrotechnics.

FLAMEN, in Roman antiquity, the name of an order of priefts, inftituted by Romulus or Numa; authors not being agreed on this head. They were originally only three, viz. the *Flamen Dialis, Flamen Martialis, and Flamen Quirinalis*. The Flamen Dialis was facred to Jupiter, and a perfon of the higheft confequence and authority in the ftate. He difcharged feveral religious duties which properly belonged to their kings, and was honoured with many eminent privileges beyond all other officers, but was obliged to obferve feveral fuperftitious reftraints. The Flamen Martialis was facred to Mars, and was ordained to infpect the rites of that god. The Flamen Quirinalis was facred to, and fuperintended the rites of Quirinus Romulus. The Flamines laft mentioned, though of high authority, were much inferior to the Flamen Dialis. All three were chofen by the people, and confecrated by the Pontifex Maximus. In latter times feveral priefts of the fame order and name were added to them, but inferior in power. The whole number at laft amounted to 15: the three firft of whom were fenators, and called *Flamines majores*; the other 12, taken from among the people, were denominated *Flamines minores*. Some authors tell us the Romans had a Flamen for every deity they worfhipped. The greater Flamines wore the robe edged with purple, like the great magiftrates; had an ivory chair, and a feat in the fenate. They wore a little band of thread about their heads, whence their name is faid to be derived, *quafi Filamines*.

The wife of the Flamen Dialis was called *Flaminica*, and wore a flame-coloured habit, on which was painted a thunder-bolt, and above her head-drefs fhe had green oak boughs, to indicate that fhe belonged to Jupiter the thunderer, to whom the oak was facred. The Flamines wore each of them a hat or cap called *Flammeum* or *Apex*.

FLAMINGO, in ornithology. See Phoenicopterus.

FLAMINIUS, or Flamininus, (T. Q.) a celebrated Roman raifed to the confulfhip in the year of Rome 554, though under the age of 30. He was trained in the art of war againft Hannibal; and fhowed himfelf capable in every refpect to difcharge with honour the great office with which he was entrufted. He was fent at the head of the Roman troops againft Philip king of Macedonia, and in this expedition he met with uncommon fuccefs. The Greeks gradually declared themfelves his firmeft fupporters; and he totally defeated Philip on the confines of Epirus, and made all Locris, Phocis, and Theffaly, tributary to the Roman power. He granted peace to the conquered monarch, and proclaimed all Greece free and independent, at the Ifthmian games. This celebrated action procured the

name of Patrons of Greece to the Romans, and infenfibly paved their way to univerfal dominion. Flaminius behaved among them with the greateft policy; by his ready compliance to their national cuftoms and prejudices, he gained uncommon popularity, and received the name of father and deliverer of Greece. He was afterwards fent ambaffador to king Prufias, who had given refuge to Hannibal; and there his prudence and artifice haftened out of the world a man who had long been the terror of the Romans. Flaminius was found dead in his bed, after a life fpent in the greateft glory, in which he had imitated with fuccefs the virtues of his model Scipio.

Flaminius, or Flaminio, (Mark Anthony), one of the beft Latin poets in the 16th century, of Imola in Italy, fon and grandfon of very learned men. The pope had chofen him fecretary to the council in 1545; but he refufed that employment, becaufe, favouring the new opinions, he would not employ his pen in an affembly where he knew thefe opinions were to be condemned. He paraphrafed 30 of the pfalms in Latin verfe, and alfo wrote notes on the pfalms; and fome letters and poems which are efteemed. He died at Rome in 1550.

FLAMSTED, a town of Hertfordfhire in England, 5 miles from St. Alban's and Dunftable, ftands on the river Verlam, and was of old called Verlamftede. The land hereabouts is a clay fo thickly mixed with flints, that, after a fhower, nothing appears but a heap of ftones; and yet it bears very good corn even in dry fummers. This fertility is imputed to an effect of the flint, which preferves it from cold in the winter; and to its clofenefs, which keeps it from the fcorching rays of the fun in the fummer. Edward VI. when an infant, was brought hither for his health; and, it is faid, the bedftead he lay on, which is curioufly wrought, is ftill preferved in the manor-houfe juft by.

FLAMSTEED (John), an eminent Englifh aftronomer in the 17th century, born at Derby in 1646. He had early read a great deal of civil and ecclefiaftical hiftory; but happening to fee John de Sacrobofco's book *de Sphæra*, this gave him a turn for aftronomy, which ftudy he afterwards profecuted with great vigour. His father, finding him in correfpondence with feveral learned men, advifed him to go to London, that he might be perfonally acquainted with them. In 1674 he wrote an ephemeris, in which he fhowed the falfity of aftrology; and gave a table of the moon's rifing and fetting, carefully calculated, together with the eclipfes and appulfes of the moon and planets to fixed ftars. This fell into the hands of Sir Jonas More; for whom, at his requeft, he made a table of the moon's true fouthings. In 1674, Sir Jonas having informed him that a true account of the tides would be highly acceptable to his majefty, he compofed a fmall ephemeris for the king's ufe: and when Sir Jonas fhowed the king and duke of York our author's telefcopes and micrometer, and recommended him ftrongly, he procured him a warrant to be king's aftronomer, with the falary of 100l. per annum; on which occafion he was ordained. In 1675 the foundation of the royal obfervatory at Greenwich was laid, and during the building he lodged at Greenwich; his quadrant and telefcopes being kept in the queen's houfe there. His *Doctrine of the Sphere* was publifhed in 1681, in a pofthumous work of Sir Jonas More, intitled *A new Syftem of the Mathematics*. In 1684 he was prefented to the living of Burftow in Surry, which he enjoyed till he died in 1719. His *Hiftoria cæleftis Britannica* was publifhed at London in 1725, in 3 vols. Mr. Flamfteed likewife compofed the Britifh Catalogue of the fixed ftars, which contains twice the number that are in the catalogue of Hevelius; to each of which he annexed its longitude, latitude, right afcenfion, and diftance from the pole, together with the variation of right afcenfion and declination, while the longitude increafes a degree. This catalogue, together with moft of his obfervations, were printed on a fine paper and character, at the expence of the late prince George of Denmark.

FLANDERS, a country of the Netherlands, divided into Dutch, Auftrian, and French Flanders. It is bounded by the German Ocean and the United Provinces on the N. by Brabant on the E. by Hainault and Artois on the S. and by another part of Artois and the German Ocean on the W. being about 60 miles in length, and 50 in breadth. It is a level country, fertile in grain and paftures, and the air is good. The manufactures are fine linen, lace, and tapeftry.

FLANEL, or Flannel, a kind of flight, loofe, woollen ftuff, compofed of a woof and warp, and wove on a loom with two treddles, after the manner of bays. Dr. Black affigns as a reafon why flanel and other fubftances of the kind keep our bodies warm, that they compofe a rare and fpongy mafs, the fibres of which touch each other fo flightly, that the heat moves flowly through the interftices, which being filled only with air, and that in a ftagnant ftate, give little affiftance in conducting the heat. Count Rumford, however, has inquired farther into the matter, and finds that there is a relation betwixt the power which the fubftances ufually worn as clothing have of abforbing moifture, and that of keeping our bodies warm. Having provided a quantity of each of thofe fubftances mentioned below, he expofed them, fpread out upon China plates, for the fpace of 24 hours to the warm and dry air of a room, which had been heated by a German ftove for feveral months, and during the laft fix hours had raifed the thermometer to 85° of Fahrenheit; after which he weighed equal quantities of the different fubftances with a very accurate balance. They were then fpread out upon a China plate, and removed into a very large uninhabited room upon the fecond floor, where they were expofed 48 hours upon a table placed in the middle of the room, the air of which was at 45° of Fahrenheit. At the end of this fpace they were weighed, and then removed into a damp cellar, and placed on a table in the middle of the vault, where the air was at the temperature of 45°, and which by the hygrometer feemed to be fully faturated with moifture. In this fituation they were fuffered to remain three days and three nights; the vault being all the time hung round with wet linen cloths, to render the air as completely damp as poffible. At the end of three days they were weighed, and the weights at the different times were found in the following Table:

	Weight after being dried in the hot room.	Weight after coming out of the cold room.	Weight after remaining 72 h. in the vault.
Sheeps' wool	1000 Parts	1084	1163
Beaver's fur		1072	1125
The fur of a Ruffian hare		1065	1115
Eider down		1067	1112
Silk { Raw fingle thread		1057	1107
Silk { Ravellings of white taffety		1054	1103
Linen { Fine lint		1046	1102
Linen { Ravellings of fine linen		1044	1082
Cotton wool		1043	1089
Ravellings of filver lace		1000	1000

On thefe experiments our author obferves, that though linen, from the apparent eafe with which it receives dampnefs from the atmofphere, feems to have a much greater attraction for water than any other; yet it would appear, from what is related above, that thofe bodies which receive water in its inelaftic form with the greateft eafe, or are moft eafily wet, are not thofe which in all cafes attract the moifture of the atmofphere with the greateft avidity. "Perhaps (fays he), the apparent damp-

nefs of linen to the touch arifes more from the eafe with which that fubftance parts with the water it contains, than from the quantity of water it actually holds: in the fame manner as a body appears hot to the touch, in confequence of its parting freely with its heat; while another body, which is really at the fame temperature, but which withholds its heat with greater obftinacy, affects the fenfe of feeling much lefs violently. It is well known that woollen clothes, fuch as flanels, &c. worn next the fkin, greatly promote infenfible perfpiration. May not this arife principally from the ftrong attraction which fubfifts between wool and the watery vapour which is continually iffuing from the human body? That it does not depend entirely on the warmth of that covering, is clear; for the fame degree of warmth, produced by wearing more clothing of a different kind, does not produce the fame effect. The perfpiration of the human body being abforbed by a covering of flanel, it is immediately diftributed through the whole thicknefs of that fubftance, and by that means expofed, by a very large furface, to be carried off by the atmofphere; and the lofs of this watery vapour, which the flanel fuftains on the one fide by evaporation, being immediately reftored from the other, in confequence of the ftrong attraction between the flanel and this vapour, the pores of the fkin are difencumbered, and they are continually furrounded by a dry and falubrious atmofphere."

Our author expreffes his furprife, that the cuftom of wearing flanel next the fkin fhould not have prevailed more univerfally. He is confident it would prevent a number of difeafes; and he thinks there is no greater luxury than the comfortable fenfation which arifes from wearing it, efpecially after one is a little accuftomed to it. "It is a miftaken notion (fays he), that it is too warm a clothing for fummer. I have worn it in the hotteft climates, and at all feafons of the year; and never found the leaft inconvenience from it. It is the warm bath of a perfpiration confined by a linen fhirt, wet with fweat, which renders the fummer heats of fouthern climates fo infupportable; but flanel promotes perfpiration, and favours its evaporation; and evaporation, as is well known, produces pofitive cold.

It has been obferved that new flanel, after fome time wearing, acquires the property of fhining in the dark, but lofes it on being wafhed. See *Philof Tranf.* n° 483. § 7.

FLANK, in the manege, is a term applied to the fides of a horfe's buttocks, &c. In a ftrict fenfe, the flanks of a horfe are the extremes of the belly, where the ribs are wanting, and are below the loins. The flanks of a horfe fhould be full, having, at the top of each, a feather. The diftance between the laft rib and haunch-bone, which is properly the flank, fhould be fhort, which they term *well coupled*, fuch horfes being moft hardy, and fit to endure labour. A horfe is faid to have no flank if the laft of the fhort ribs be at a confiderable diftance from the haunch-bone; as alfo when his ribs are too much ftraightened in their compafs.

Flank, in war, is ufed by way of analogy for the fide of a battalion, army, &c. in contradiftinction to the *front* and *rear*. To *attack* the enemy *in flank*, is to difcover and fire upon them on one fide. See File.

Flank, in fortification, is a line drawn from the extremity of the face towards the infide of the work. Or, flank is that part of a baftion which reaches from the curtain to the face, and defends the oppofite face, the flank, and the curtain. See Fortification.

FLAT, in fea-language, denotes a level ground lying at a fmall depth under the furface of the fea, and is alfo called a *fhoal* or *fhallow*.

Flat *bottomed Boats*, are fuch as are made to fwim in fhallow water, and to carry a great number of troops, artillery, ammunition, &c. They are conftructed with a 12 pounder, bow-chafe, and an 18 pounder, ftern-chafe; their keel is from 90 to 100 feet, and from 12 to 24 feet beam. They have one maft, a large fquare main-fail, and a jib-fail; are rowed by 18 or 20 oars, and can carry 400 men each. The gun takes up one bow, and a bridge the other, over which the troops are to march. Thofe that carry horfes have the fore-part of the boat made to open when the men are to mount and ride over a bridge.

FLATMAN (Thomas), an Englifh poet of fome repute, born at London about the year 1633. He ftudied at the Inner-Temple, and became a barrifter, but it does not appear that he ever practifed; for having a turn for the fine arts, he gave a loofe to his inclination that way, and acquired reputation both as a poet and a painter. He publifhed, in 1682, a third edition of his poems and fongs, dedicated to the duke of Ormond, with a print of himfelf as a frontifpiece: he alfo publifhed a fatirical romance in profe, on Richard Cromwell, foon after the reftoration; which took greatly during that turn of affairs. He died about 1688.

FLATS, in mufic. See Interval.

FLATUS, flatulence, in medicine; vapours generated in the ftomach and inteftines, chiefly occafioned by a weaknefs of thofe parts. They occafion diftenfion, uneafy fenfations, and ficknefs, and often a confiderable degree of pain. See Medicine.

FLAVEL (John), an eminent nonconformift minifter, was educated at Univerfity college in Oxford; and became minifter of Deptford, and afterwards of Dartmouth in Devonfhire, where he refided the greateft part of his life, and was admired for his preaching. Though he was generally refpected at Dartmouth, yet in 1685 feveral of the aldermen of that town, attended by the rabble, carried about a ridiculous effigy of him, to which were affixed the Bill of Exclufion and the Covenant. Upon this occafion, he thought it prudent to withdraw from the town; not knowing what treatment he might meet with from a riotous mob, headed by magiftrates who were themfelves among the loweft of mankind. Part of his Diary, printed with his Remains, muft give the reader a high idea of his piety. He died in 1691, aged 61; and after his death, his works, which confifted of many pieces of practical divinity, were printed in two volumes folio. Among thefe, the moft famous are his "Navigation Spiritualized, or a New Compafs for Seamen, confifting of 32 points of pleafant obfervations and ferious reflections," of which there have been feveral editions in 8vo; and his "Hufbandry Spiritualized, &c. with occafional meditations upon beafts, birds, trees, flowers, rivers, and feveral other objects," of which alfo there have been many editions in octavo.

FLAX, in botany. See Linum. The following particulars with regard to the manner of raifing flax have been for fome years paft warmly recommended by the truftees for fifheries, manufactures, and improvements in Scotland.

Of the Choice of the Soil, and preparing the Ground for Flax. A fkilful flax-raifer always prefers a free open deep loam, and all grounds that produced the preceding year a good crop of turnip, cabbage, potatoes, barley, or broad clover; or have been formerly laid down rich, and kept for fome years in pafture. A clay foil, the fecond or third crop after being limed, will anfwer well for flax; provided, if the ground be ftill ftiff, that it be brought to a proper mould, by tilling after harveft, to expofe it to the winter frofts. All new grounds produce a ftrong crop of flax, and pretty free of weeds. When a great many mole-heaps appear upon new ground, it anfwers the better for flax after one tilling. Flax-feed ought never to be fown on grounds that are either too wet or dry; but on fuch as retain a natural moifture: and fuch grounds as are inclined to weeds ought to be avoided, unlefs prepared by a careful fummer-fallow.

If the lint-ſeed be ſown early, and the flax not allowed to ſtand for ſeed, a crop of turnip may be got after the flax that very year; the ſecond year a crop of rye or barley may be taken; and the third year, graſs-ſeeds are ſometimes ſown along with the lint-ſeed. This is the method moſtly practiſed in and about the counties of Lincoln and Somerſet, where great quantities of flax and hemp are every year raiſed, and where theſe crops have long been capital articles. There, old ploughed grounds are never ſown with lint-ſeed, unleſs the ſoil be very rich and clean. A certain worm, called in Scotland the *coupworm*, abounds in new-ploughed grounds, which greatly hurts every crop but flax. In ſmall incloſures ſurrounded with trees or high hedges, the flax, for want of free air, is ſubject to fall before it be ripe, and the droppings of rain and dew from the trees prevent the flax within the reach of the trees from growing to any perfection. Of preceding crops, potatoes and hemp are the beſt preparation for flax. In the fens of Lincoln, upon proper ground of old tillage, they ſow hemp, dunging well the firſt year; the ſecond year, hemp without dung; the third year, flax without dung; and that ſame year, a crop of turnip eat on the ground by ſheep; the fourth year, hemp with a large coat of dung; and ſo on ſucceſſively.

If the ground be free and open, it ſhould be but once ploughed, and that as ſhallow as poſſible, not deeper than 2½ inches. It ſhould be laid flat, reduced to a fine garden mould by good harrowing, and all ſtones and ſods ſhould be carried off. Except a little pigeon's dung for cold or ſour ground, no other dung ſhould be uſed preparatory for flax; becauſe it produces too many weeds, and throws up the flax thin and poor upon the ſtalk. Before ſowing, the bulky clods ſhould be broken, or carried off the ground; and ſtones, quickenings, and every other thing that may hinder the growth of the flax, ſhould be carefully taken away.

Choice of Seed. The brighter in colour, and heavier the ſeed is, ſo much the better; that which when bruiſed appears of a light or yellowiſh green, and freſh in the heart, oily and not dry, and ſmells and taſtes ſweet, and not fuſty, may be depended upon. Dutch ſeed of the preceding year's growth, for the moſt part, anſwers beſt; but it ſeldom ſucceeds if kept another year. It ripens ſooner than any other foreign ſeed. Philadelphia ſeed produces fine lint and few bolls, becauſe ſown thick, and anſwers beſt in wet cold ſoils. Riga ſeed produces coarſer lint, and the greateſt quantity of ſeed. Scotch ſeed, when well winned and kept, and changed from one kind of ſoil to another, ſometimes anſwers pretty well; but ſhould be ſown thick, as many of its grains are bad, and fail. It ſprings well, and its flax is ſooner ripe than any other; but its produce afterwards is generally inferior to that from foreign ſeed. A kind has been lately imported, called *Memel ſeed;* which looks well, is ſhort and plump, but ſeldom grows above eight inches, and on that account ought not to be ſown.

Method of Sowing. The quantity of lint-ſeed ſown ſhould be proportioned to the condition of the ſoil; for if the ground be in good heart, and the ſeed ſown thick, the crop will be in danger of falling before it is ready for pulling. In Scotland, from 11 to 12 pecks Linlithgow meaſure of Dutch or Riga ſeed is generally thought ſufficient for one acre; and about 10 pecks of Philadelphia-ſeed, which, being the ſmalleſt grained, goes fartheſt. Riga lint ſeed, and the next year's produce of it, is preferred in Lincolnſhire. The time for ſowing lint ſeed is from the middle of March to the end of April, as the ground and ſeaſon anſwer: but the earlier the ſeed is ſown, the leſs the crop interferes with the corn-harveſt. Late ſown lint-ſeed may grow long, but the flax upon the ſtalk will be thin and poor. After ſowing, the ground ought to be harrowed till the ſeed is well covered, and then (ſuppoſing the ſoil, as before mentioned, to be free and reduced to a fine mould) it ought to be rolled. When a farmer ſows a large quantity of lint-ſeed, he may find it proper to ſow a part earlier and part later, that in the future operations of weeding, pulling, watering, and graſſing, the work may be the eaſier and more conveniently gone about. It ought always to be ſown on a dry bed.

Of Weeding. Flax ought to be weeded when the crop is about four inches long. If longer deferred, the weeders will ſo much break and bend the ſtalks, that they will never perhaps recover their ſtraightneſs again; and when the flax grows crooked, it is more liable to be hurt in the rippling and ſwingling. Quicken-graſs ſhould not be taken up: for, being ſtrongly rooted, the pulling of it always looſens a deal of the lint. If there is an appearance of a ſettled drought, it is better to defer the weeding, than by that operation to expoſe the tender roots of the flax to the drought. So ſoon as the weeds are got out, they ought to be carried off the field, inſtead of being laid in the furrow, where they often take root again, and at any rate obſtruct the growth of the flax in the furrows.

Of Pulling. When the crop grows ſo ſhort and branchy as to appear more valuable for ſeed than flax, it ought not to be pulled before it be thoroughly ripe; but if it grows long and not branchy, the ſeed ſhould be diſregarded, and all the attention given to the flax. In the laſt caſe it ought to be pulled after the bloom has fallen, when the ſtalk begins to turn yellow, and before the leaves fall, and the bolls turn hard and ſharp-pointed. When the ſtalk is ſmall, and carries few bolls, the flax is fine; but the ſtalk of coarſe flax is groſs, rank, branchy, and carries many bolls. When the flax has fallen, and lies, ſuch as lies ought to be immediately pulled, whether it has grown enough or not, as otherwiſe it will rot altogether. When parts of the ſame field grow unequally, ſo that ſome parts are ready for pulling before other parts, only what is ready ſhould be pulled, and the reſt ſhould be ſuffered to ſtand till it ripens.

The flax-raiſer ought to be at pains to pull, and keep by itſelf, each different kind of lint which he finds in his field; what is both long and fine, by itſelf; what is both long and coarſe, by itſelf; what is both ſhort and fine, by itſelf; what is both ſhort and coarſe, by itſelf; and in like manner every other kind by itſelf that is of the ſame ſize and quality. If the different kinds be not thus kept ſeparate, the flax muſt be much damaged in the watering and the other ſucceeding operations. What is commonly called *under-growth* may be neglected as uſeleſs. Few perſons that have ſeen pulled flax are ignorant of the method of laying it in handfuls acroſs each other; which gives the flax ſufficient air, and keeps the handfuls ſeparate and ready for the rippler to work upon.

Of Stacking up for Winter, and Winning the Seed. If the flax be more valuable than the ſeed, it ought by no means to be ſtacked up; for its own natural juice aſſiſts it greatly in the watering; whereas, if kept long unwatered, it loſes that juice, and the harle adheres ſo much to the boon, that it requires longer time to water, and even the quality of the flax becomes thereby harſher and coarſer. Beſides, the flax ſtacked up over year is in great danger from vermin and other accidents; the water in ſpring is not ſo ſoft and warm as in harveſt; and near a year is thereby loſt of the uſe of the lint: but if the flax be ſo ſhort and branchy as to appear moſt valuable for ſeed, it ought, after pulling, to be ſtooked and dried upon the field, as is done with corn; then ſtacked up for winter, rippled in ſpring; and after ſheeling, the ſeed ſhould be well cleaned from bad ſeeds, &c.

Of Rippling. If the flax is to be regarded more than the ſeed, it ſhould, after pulling, be allowed to lie ſome hours upon the ground to dry a little, and ſo gain ſome firmneſs, to prevent the ſkin or harle, which is the flax, from rubbing off in the rippling; an operation which ought by no means to be neglected, as the bolls, if put into the water along with the flax, breed vermin there, and otherwiſe ſpoil the water. The bolls alſo prove

very inconvenient in the graffing and breaking. In Lincolnfhire and Ireland, they think that rippling hurts the flax; and therefore, in place of rippling, they ftrike the bolls againft a ftone. The handfuls for rippling fhould not be great, as that endangers the lint in the rippling comb. After rippling, the flax-raifer will perceive, that he is able to affort each fize and quality of the flax by itfelf more exactly than he could before.

Of Watering. A running ftream waftes the lint, makes it white, and frequently carries it away. Lochs, by the great quantity and motion of the water, alfo wafte and whiten the flax, though not fo much as running ftreams. Both rivers and lochs water the flax quicker than canals. But all flax ought to be watered in canals, which fhould be funk in clay ground if poffible, as that foil retains the water beft: but if a firm retentive foil cannot be got, the bottom or fides of the canal, or both the bottom and fides, may be lined with clay; or inftead of lining the fides with clay, which might fall down, a ditch may be dug without the canal, and filled with clay, which will prevent both extraneous water from entering, and the water within from running off.

A canal of 40 feet long, fix broad, and four deep, will generally water the growth of an acre of flax. It ought to be filled with frefh foft water from a river or brook, if poffible two or three weeks before the flax is put in, and expofed all that time to the heat of the fun. The greater way the river or brook has run, the fofter, and therefore the better, will the water be. Springs, or fhort-runs from hills, are too cold, unlefs the water is allowed to ftand long in the canal. Water from coal or iron is very bad for flax. A little of the powder of galls thrown into a glafs of water will immediately difcover if it comes from minerals of that kind, by turning it into a dark colour, more or lefs tinged in proportion to the quantity of metal it contains. The canal ought not to be under fhade; which, befides keeping the fun from foftening the water, might make one part of the canal cooler than another, and fo water the flax unequally.

The flax-raifer will obferve, when the water is brought to a proper heat, that fmall plants will be rifing quickly in it, numbers of fmall infects and reptiles will be generating there, and bubbles of air rifing on the furface. If no fuch figns appear, the water is fcarcely warm enough, or is otherwife unfit for flax. Mofs-holes, when neither too deep nor too fhallow, frequently anfwer well for watering flax, when the water is proper, as before defcribed. The proper feafon for watering flax is from the end of July to the end of Auguft. The doing this as foon as poffible after pulling is very advantageous. The flax being forted after rippling, as before mentioned, fhould next be put in beets, never larger than a man can grafp with both his hands, and tied very flack with a band of a few ftalks. Dried rufhes anfwer exceedingly well for binding flax, as they do not rot in the water, and may be dried and kept for ufe again. The beets fhould be put into the canals flope-ways, or half ftanding upon end, the root-end uppermoft. Upon the crop-ends, when uppermoft, there frequently breeds a deal of vermin, deftructive of the flax, which are effectually prevented by putting the crop-end downmoft.

The whole flax in the canal ought to be carefully covered from the fun with divots; the graffy fide of which fhould be next the flax, to keep it clean. If it is not thus covered, the fun will difcolour the flax, though quite covered with water. If the divots are not weighty enough to keep the flax entirely under water, a few ftones may be laid above them; but the flax fhould not be preffed to the bottom.

When the flax is fufficiently watered, it feels foft to the gripe, and the *harle* parts eafily with the *boon* or *fhow*, which laft is then become brittle, and looks whitifh. When thefe figns are found, the flax fhould be taken out of the water, beet after beet; each gently rinfed in the water, to cleanfe it of the naftinefs which has gathered about it in the canal; and as the lint is then very tender, and the beet flackly tied, it muft be carefully and gently handled. Great care ought to be taken that no part be overdone; and as the coarfeft waters fooneft, if different kinds be mixed together, a part will be rotted, when the reft is not fufficiently watered. When lint taken out of the canal is not found fufficiently watered, it may be laid in a heap for 12, 18, or 24 hours, which will have an effect like more watering; but this operation is nice, and may prove dangerous in unfkilful hands. After the flax is taken out of the canal, frefh lint fhould not be put a fecond time into it, until the former water be run off, and the canal cleaned, and fupplied with a frefh quantity of water.

Of Graffing. Short heath is the beft field for graffing flax; as, when wet, it faftens to the heath, and is thereby prevented from being blown away by the wind. The heath alfo keeps it a little above the earth, and fo expofes it the more equally to the weather. When fuch heath is not to be got, links or clean old lea-ground is the next beft. Long-grafs grounds fhould be avoided, as the grafs growing through the lint frequently fpots, tenders, or rots it; and grounds expofed to violent winds fhould alfo be avoided.

The flax, when taken out of the water, muft be fpread very thin upon the ground; and being then very tender, it muft be gently handled. The thinner it is fpread the better, as it is then the more equally expofed to the weather. But it ought never to be fpread during a heavy fhower, as that would wafh and wafte the harle too much, which is then exceffively tender, but foon after becomes firm enough to bear the rains, which, with the open air and funfhine, cleans, foftens, and purifies the harle to the degree wanted, and makes it blifter from the boon. In fhort, after the flax has got a little firmnefs by being a few hours fpread in dry weather, the more rain and funfhine it gets the better.

If there be little danger of high winds carrying off the flax, it will be much the better for being turned about once a-week. If it is not to be turned, it ought to be very thin fpread. The fpreading of flax and hemp, which requires a deal of ground, enriches it greatly.

The flax-raifer fhould fpread his firft row of flax at the end of the field oppofite to the point from whence the moft violent wind commonly comes, placing the root-ends foremoft. He makes the root-ends of every other row overlap the crop-ends of the former row three or four inches, and binds down the laft row with a rope; by which means the wind does not eafily get below the lint to blow it away: and as the crop-ends are feldom fo fully watered as the root-ends, the aforefaid overlapping has an effect like giving the crop-ends more watering. Experience only can fully teach a perfon the figns of flax being fufficiently graffed: then it is of a clearer colour than formerly; the harle is bliftered up, and eafily parts with the boon, which is then become very brittle. The whole fhould be fufficiently graffed before any of it is lifted; for if a part be lifted fooner than the reft, that which remains is in great danger from the winds.

A dry day ought to be chofen for taking up the flax; and if there is no appearance of high wind, it fhould be loofed from the heath or grafs, and left loofe for fome hours, to make it thoroughly dry.

As a great quantity of flax can fcarcely be all equally watered and graffed, and as the different qualities will beft appear at lifting the flax off the grafs; therefore at that time each different kind fhould be gathered together, and kept by itfelf; that is, all of the fame colour, length, and quality.

The fmaller the beets lint is made up in, the better for drying, and the more convenient for ftacking, houfing, &c. and in making up thefe beets, as in every other operation upon flax, it

is of great conſequence that the lint be laid together as it grew, the root-ends together, and the crop-ends together.

FLAX-*Dreſſing*. For many ages it was the practice to ſeparate the boon or core from the flax, which is the bark of the plant, by the following ſimple *hand-methods*. Firſt, for breaking the boon, the ſtalks in ſmall parcels were beat with a mallet; or, more dexterouſly, the *break* (Plate 27. fig. 1. and 2.) was uſed thus: The flax being held in the left-hand acroſs the three *under-teeth* or *ſwords* of the break *A*, fig. 1. and *a*, fig. 2, the *upper-teeth*, *B*, fig. 1. and *b*, fig. 2, were with the right-hand quickly and often forced down upon the flax, which was artfully ſhifted and turned with the left hand. Next, for clearing the flax of the broken boon, the workman with his left-hand held the flax over the *ſtock*, fig. 3. and 4. while with his right-hand he ſtruck or threſhed the flax with the *ſcutcher*, fig. 5.

Theſe methods of breaking and ſcutching the flax being ſlow and very laborious, a *water-mill* was invented in Scotland about 40 years ago; which, with ſome late improvements, makes great diſpatch, and in ſkilful and careful hands gives ſatisfaction. It has been generally conſtructed to break the boon by three dented rollers, placed one above the other; the middle one of which, being forced quickly round, takes the other two along with it, and one end of the handfuls of the flax being by the workmen directed in between the upper and middle rollers, the flax is immediately drawn in by the rollers; a curved board or plate of tin behind the rollers directs the flax to return again between the middle and undermoſt rollers; and thus the operation is repeated until the boon be ſufficiently broke. Great weights of timber or ſtone at the ends of levers preſs the upper and under rollers towards the middle one.

The ſcutching is next carried on by the mill in the following manner: Four arms, ſomething like the hand-ſcutchers before deſcribed, project from a perpendicular axle; a box around the axle incloſes theſe projecting ſcutchers; and this box is divided among the workmen, each having ſufficient room to ſtand and handle his flax, which, through ſlits in the upper part and ſides of the box, they hold in to the ſtroke of the ſcutchers; which, moving round horizontally, ſtrike the flax acroſs or at right angles, and ſo threſh out or clear it of the boon.

The breaking of the flax by *rollers* is ſcarcely ſubject to any objection, except that it is dangerous to workmen not ſufficiently on their guard, who ſometimes allow the rollers to take hold of their fingers, and thereby their whole arm is inſtantly drawn in: thus many have loſt their arms. To avoid this danger, a break, upon the general principles of the hand-break before deſcribed, has been lately adapted to water-machinery, and uſed in place of rollers. The horizontal ſtroke of the ſcutchers was long thought too ſevere, and waſteful of the flax; but very careful experiments have diſcovered, that the waſte complained of muſt be charged to the unſkilfulneſs or negligence of the workmen, as in good hands the mill carries away nothing but what, if not ſo ſcutched off, muſt be taken off in the heckling with more loſs both of time and flax. But to obviate this objection of the violence of the *horizontal ſcutchers*, an imitation of hand-ſcutching has been applied to water. The ſcutchers then project from an horizontal axle, and move like the arms of a check-reel, ſtriking the flax neither acroſs nor perpendicularly down, but ſloping in upon the parcel exactly as the flax is ſtruck by the hand-ſcutcher. This ſloping ſtroke is got by raiſing the ſcutching-ſtock ſome inches higher than the centre of the axle; and by raiſing or lowering the ſtock over which the flax is held, or ſcrewing it nearer to or farther from the ſcutchers, the workman can temper or humour the ſtroke almoſt as he pleaſes.

A lint-mill with horizontal ſcutchers upon a perpendicular axle requires a houſe of two ſtories, the rollers or break being placed in the ground ſtory, and the ſcutchers in the loft above; but a mill with vertical ſcutchers on an horizontal axle requires but one ground ſtory for all the machinery.

Another method of breaking and ſcutching flax, more expeditious than the old hand-methods, and more gentle than water-mills, has alſo been lately invented in Scotland. It is much like the break and ſcutcher giving the ſloping ſtroke laſt deſcribed, moved by the foot. The treddle is remarkably long, and the ſcutchers are fixed upon the rim of a fly-wheel. The foot-break is alſo aſſiſted in its motion by a fly. Theſe foot-machines are very uſeful where there are no water-mills, but they are far inferior to the mills in point of expedition.

The next operation that flax undergoes after ſcutching is heckling. The *heckle* (fig. 6.) is firmly fixed to a bench before the workman, who ſtrikes the flax upon the teeth of the heckle, and draws it through the teeth. To perſons unacquainted with that kind of work this may ſeem a very ſimple operation; but, in fact, it requires as much practice to acquire the method of heckling well, and without waſting the flax, as any other operation in the whole manufacture of linen. They uſe coarſer and wider-teethed heckles, or finer, according to the quality of the flax; generally putting the flax through two heckles, a coarſer one firſt, and next a fine one.

Flax for cambric and fine lawn, thread, and lace, is dreſſed in a manner ſomewhat different. It is not ſkutched ſo thoroughly as common flax, which from the ſkutch proceeds to the heckle, and from that to the ſpinner: whereas this fine flax, after a rough ſkutching, is ſcraped and cleanſed with a blunt knife upon the workman's knee covered with his leather-apron; from the knife it proceeds to the ſpinner, who, with a bruſh made for the purpoſe, ſtraights and dreſſes each parcel juſt before ſhe begins to ſpin it.

On the ſubject of dreſſing flax, we refer the reader to ſome obſervations publiſhed in the Gentleman's Magazine for June 1787, which ſeem worthy of very particular attention.

In the Swediſh Tranſactions for the year 1747, a method is given of preparing flax in ſuch a manner as to reſemble *cotton* in whiteneſs and ſoftneſs, as well as in coherence. For this purpoſe, a little ſea-water is to be put into an iron pot or an untinned copper-kettle, and a mixture of equal parts of birch-aſhes and quicklime ſtrewed upon it; a ſmall bundle of flax is to be opened and ſpread upon the ſurface, and covered with more of the mixture, and the ſtratification continued till the veſſel is ſufficiently filled. The whole is then to be boiled with ſea-water for ten hours, freſh quantities of water being occaſionally ſupplied in proportion to the evaporation, that the matter may never become dry. The boiled flax is to be immediately waſhed in the ſea by a little at a time, in a baſket, with a ſmooth ſtick at firſt while hot; and when grown cold enough to be borne by the hands, it muſt be well rubbed, waſhed with ſoap, laid to bleach, and turned and watered every day. Repetitions of the waſhing with ſoap expedite the bleaching; after which the flax is to be beat, and again well waſhed; when dry, it is to be worked and carded in the ſame manner as common cotton, and preſſed betwixt two boards for 48 hours. It is now fully prepared and fit for uſe. It loſes in this proceſs near one-half its weight, which is abundantly compenſated by the improvement made in its quality.

Earth-FLAX. See AMIANTHUS.

New-Zealand FLAX-*Plant*. See PHORMIUM.

Toad-FLAX. See LINARIA.

FLEA, in zoology. See PULEX.

FLEA-*Bane*, in botany. See CONYZA.

FLEA-*Bitten*, that colour of a horſe which is white or grey ſpotted all over with dark reddiſh ſpots.

FLEAM, in ſurgery and farriery, an inſtrument for letting blood of a man or horſe. A caſe of fleams, as it is called by farriers, comprehends ſix ſorts of inſtruments; two hooked ones,

called *drawers*, and uſed for cleaning wounds; a pen-knife; a ſharp-pointed lancet for making inciſions; and two fleams, one ſharp and the other broad-pointed. Theſe laſt are ſomewhat like the point of a lancet, fixed in a flat handle, and no longer than is juſt neceſſary to open the vein.

FLECHIER (Eſprit), biſhop of Niſmes, one of the moſt celebrated preachers of his age, and the publiſher of many panegyrics and funeral orations, was born at Perne in Avignon in 1632. He was nominated to the biſhopric of Lavaur in 1685, and tranſlated to Niſmes in 1687. At this latter place he founded an academy, and took the preſidentſhip upon himſelf: his own palace was indeed a kind of academy, where he applied himſelf to train up orators and writers, who might ſerve the church, and do honour to the nation. He publiſhed, beſides his panegyrics and funeral orations, 1. An Hiſtory of the Emperor Theodoſius, that of Cardinal Ximenes, and that of Cardinal Commendon. 2. Several Sermons. 3. Miſcellaneous Works. 4. Letters, &c. He died in 1710.

FLECKNOE (Richard), an Engliſh poet in the reign of Charles II. more remarkable for Mr. Dryden's ſatire on him than for any works of his own. He is ſaid to have been originally a jeſuit, and to have had good Engliſh connections in the Catholic intereſt. When Dryden loſt the place of poet-laureat on the Revolution, its being conferred on Flecknoe, for whom he had a ſettled averſion, gave occaſion to his poem entitled *Mac Flecknoe*; one of the beſt written ſatires in our language, and from which Pope ſeems to have taken the hint for his Dunciad. Flecknoe wrote ſome plays; but could never get more than one of them acted, and that was damned.

FLEECE, the covering of wool ſhorn off the bodies of ſheep. See Wool.

Golden Fleece. See Argonauts, and Golden *Fleece*.

FLEET, commonly implies a company of ſhips of war, belonging to any prince or ſtate: but ſometimes it denotes any number of trading ſhips employed in a particular branch of commerce. The admirals of his Britannic Majeſty's fleet are divided into three ſquadrons, *viz.* the red, the white, and the blue. When any of theſe officers are inveſted with the command of a ſquadron or detachment of men of war, the particular ſhips are diſtinguiſhed by the colours of their reſpective ſquadrons: that is to ſay, the ſhips of the red ſquadron wear an enſign whoſe union is diſplayed on a red field; the enſigns of the white ſquadron have a white field; and thoſe of the blue ſquadron a blue field; the union being common to all three. The ſhips of war, therefore, are occaſionally annexed to any of the three ſquadrons, or ſhifted from one to another. Of whatſoever number a fleet of ſhips of war is compoſed, it is uſually divided into three ſquadrons; and theſe, if numerous, are again ſeparated into diviſions. The admiral, or principal officer, commands the centre; the vice-admiral, or ſecond in command, ſuperintends the van-guard; and the operations of the rear are directed by the rear-admiral, or the officer next in rank. See the article Division. The diſpoſition of a fleet, while proceeding on a voyage, will in ſome meaſure depend on particular circumſtances; as the difficulty of the navigation, the neceſſity of diſpatch, according to the urgency or importance of the expedition, or the expectation of an enemy in the paſſage. The moſt convenient order is probably to range it into three lines or columns, each of which is parallel to a line cloſe-hauled according to the tack on which the line of battle is deſigned to be formed. This arrangement is more uſeful than any, becauſe it contains the advantages of every other form, without their inconveniences. The fleet being thus more incloſed will more readily obſerve the ſignals, and with greater facility form itſelf into the line of battle; a circumſtance which ſhould be kept in view in every order of ſailing. See *Naval* Tactics.

Fleet, is alſo a noted priſon in London, where perſons are committed for contempt of the king and his laws, particularly of his courts of juſtice: or for debt, where any perſon will not or is unable to pay his creditors.

There are large rules and a warden belonging to the Fleet priſon; which had its name from the float or fleet of the river or ditch, on the ſite whereof it was originally built.

FLEETWOOD (William), a very learned Engliſh biſhop in the beginning of the 18th century, of an ancient family in Lancaſhire. He diſtinguiſhed himſelf during king William's reign, by his *Inſcriptionum Antiquarum Sylloge*, by ſeveral ſermons he preached on public occaſions, and by his Eſſay on Miracles. It was deſigned by king William to give him a canonry of Windſor. The grant did not paſs the ſeals before the king's death; but the queen gave it him, and he was inſtalled in 1702. In 1703 he took a reſolution to retire; and in 1707 publiſhed, without his name, his *Chronicon Pretioſum*. In 1708 he was nominated by the queen to the ſee of St. Aſaph. The change of the queen's miniſtry gave him much regret. In 1715 he publiſhed a pamphlet, intitled "The 13th chapter of the Romans vindicated from the abuſive ſenſes put upon it." In 1714 he was tranſlated to the biſhopric of Ely; and died in 1723, aged 67. He publiſhed ſeveral other ſermons and tracts, and was a man of great learning and exemplary piety.

FLEMINGIANS, or Flandrians, in eccleſiaſtical hiſtory, a ſect of rigid anabaptiſts, who acquired this name in the 16th century, becauſe moſt of them were natives of Flanders, by way of diſtinction from the Waterlandians. In conſequence of ſome diſſenſions among the Flemingians relating to the treatment of excommunicated perſons, they were divided into two ſects, diſtinguiſhed by the appellations of *Flandrians* and *Frieſlanders*, who differed from each other in their manners and diſcipline. Many of theſe in proceſs of time came over to the moderate community of the Waterlandians, and thoſe who remained ſeparate are ſtill known by the name of the Old Flemingians or Flandrians; but they are comparatively few in number. Theſe maintain the opinion of Menno with reſpect to the incarnation of Chriſt; alleging that his body was produced by the creating power of the Holy Ghoſt, and not derived from his mother Mary.

FLEMISH, or the Flemish tongue, is that which we otherwiſe call *Low Dutch*, to diſtinguiſh it from the *German*, whereof it is a corruption and a kind of dialect. See German. It differs from the *Walloon*, which is a corruption of the French language. The Flemiſh is uſed through all the provinces of the Netherlands.

Flemish-*Bricks*, a neat, ſtrong, yellow kind of bricks, brought from Flanders, and commonly uſed in paving yards, ſtables, &c. being preferable for ſuch purpoſes to the common bricks. See the article Bricks.

FLESH, a compound ſubſtance, conſiſting of the various ſofter ſolids of the animal body, and ſo denominated in contradiſtinction to bones. On the power of fixed alkaline ſalts to preſerve the fleſh of animals from putrefaction, we find in the Tranſactions of the Royal Iriſh Academy the following remarks by Dr. Hugh Hamilton:

"I came (ſays the Doctor) to the knowledge of the abovementioned power of alkaline ſalts, I may ſay, accidentally: I had a wiſh to procure ſome kind of alkaline liquor that might be ſafely taken, for the purpoſe of correcting acidities in the ſtomach. I knew that a ſolution of ſalt of tartar was exceedingly offenſive to the taſte; and that, if it was of ſtrength ſufficient to neutralize any quantity of acid in the ſtomach, it could not be ſwallowed without danger to the paſſages, from its cauſticity. It occurred to me, that its cauſticity might probably ariſe from its having a ſtrong affinity to ſomething or other, to get at which it burned or deſtroyed the texture of the fleſh. If this ſhould be the caſe, it was natural to ſuppoſe that this ſalt, if intimately

mixed with flesh, would saturate itself with whatever it was that it had such a strong appetite for; and, being so saturated, it would act no farther on our flesh, and might without danger be taken inwardly. To try this, I first inclosed some bits of lean raw mutton in a vial, with a strong solution of salt of tartar; but, after standing several days, no such alteration as I expected appeared in the liquor. I was willing to account for this, by supposing the salt had a greater affinity to the water than to any thing in the flesh; I therefore cut some flesh from the breast of a turkey, roasted the day before, and made it as dry as I could; this I pounded in a mortar, adding, by degrees, some dry and finely powdered salt of tartar *, until I thought there was enough, for I had no rule to judge by. The mixture grew moist; and, when it was sufficiently pounded, I spread it into a thin cake on an earthen dish, and set it before the fire, where it soon became dry. I found it had then a saponaceous mild taste; for the taste of the salt was scarcely perceptible. Having macerated this flesh in warm water, and poured off the clear liquor, I found it effervesced with vinegar, which shewed that the salt was not so far neutralized but that it would unite itself with an acid, so that I considered it as a mild alkaline liquor, such as I sought for. However, that I might have an opinion from a person of skill on the subject, I wrote to my late worthy and ingenious friend Dr. M'Bride, and acquainted him with the preparation I had made, and the intention of it. In his answer, he was pleased to say he approved of the idea, and would make some of the liquor I described, and let me know what he thought of it. He afterwards wrote to me, and said he had tried the alkaline liquor, and thought it might prove an useful medicine, particularly as it might be mixed with milk and given to children, who have often acids in their stomachs. He also mentioned a physician, then in Dublin, to whom he had recommended the liquor, and who had found great benefit from it. I first made this liquor in the year 1771; and in the year 1777, being then at Bath, I met with an account of some experiments made by Mr. Bewly, an ingenious chemist, which plainly proved that fixed air is an acid, and saturates alkaline salts; this at once informed me what it was, in the flesh of an animal, that alkaline salts had such a strong affinity to. At the same time I got from London one of Dr. Nooth's glass machines, for impregnating water with fixed air, and to the water I added salt of tartar; after this, I thought no more of my alkaline broth, having got a way of obtaining what I wanted in a much more elegant manner.

"The only thing now worth attention in the experiment I have related is, that it discovered a power in even caustic alkaline salts to preserve flesh, I may say, incorruptible; though it has been generally imagined that such salts would consume it. I have some flesh prepared with these salts in the year 1772; for, finding some bits made the year before had continued unaltered, I made some more, and laid it by, to see how long it would keep, and what alterations it would undergo. I made it into a cake, and, when quite dry, I cut it into round bits about the size of half a crown, and put them into a drawer in my desk: I shewed some of them to Mr. Kirwan the summer before last, when I had the honour of receiving a visit from him at Armagh; and a few months ago I found some pieces in another drawer, where they have lain near two-and-twenty years, and remain unaltered. When these pieces are broken, they hang together by fibres, and look like a piece of plaster taken from a wall; the fibrous or stringy parts of the flesh do not seem to have been corroded or dissolved by the salt.

"After I knew that fixed air was an acid, and saturated alkaline salts, I began to form conjectures about the means by which these salts had so entirely prevented putrefaction in the flesh to which they were united. Animal substances afford much volatile alkali, and now they are known to contain also a volatile acid gas. While these two volatile principles continue united with each other, they may prevent any material change from taking place in the substance; but, if one of them by any means escapes, the other will follow; the acid seems to be the most volatile, and escapes first, though we may not be sensible of its escape, because it has no such strong smell as the alkali has. The letting loose these volatile principles seems to be the beginning of putrefaction. If this be the case, we may see the reason why flesh, when growing putrid, is restored to sweetness by fixed air; that acid replacing what had escaped, and retaining the volatile alkali. It is probably on this account, that the aërial acid is found to be of use in stopping the progress of some putrid disorders; it seems to act as a sort of pickle. If vinegar preserves flesh by keeping its volatile alkali united with this acid, which is not volatile, we may expect a fixed alkali will have a like effect in preserving flesh, by expelling the weaker volatile alkali, and uniting itself to the volatile acid, which will therefore be retained. This I found to be really the case; for, while the flesh and alkali were combining in the mortar, a very strong smell arose, like that of *sal volatile*; and, at one time that I used a brass or metal mortar, I perceived its edges to be tinged with blue, which shewed that the metal had been affected by a volatile alkali.

"There seems to be a good reason why fixed alkaline salts should preserve flesh much longer than any fluid acid, such as vinegar, can do; for when the alkaline salt combines with the flesh, it expels what is volatile, the mass grows hard, and it is easily reduced to a state of dryness, in which no sort of fermentation or any intestine motion can take place, and therefore there is nothing that can effect a change in this compound substance. Whereas, when an animal or vegetable substance is immersed in vinegar, a very heterogeneous mixture is formed, which, in length of time, will be apt to run into a sort of fermentation, with an intestine motion among the minute particles; this will bring on some change in the texture of the substance; and every fermentation, when long continued, ends in putrefaction, which, indeed, is said to be the last stage of fermentation. Whether the conjectures I have offered on this subject be well or ill-founded is of but little consequence; the facts I have mentioned may be relied on."

Flesh is also used, in theology, in speaking of the mysteries of the incarnation and eucharist. "The Word was made *flesh*," *Verbum* caro *factum est*. The Romanists hold, that the bread in the sacrament of the supper is turned into the real flesh of Jesus Christ. See Transubstantiation.

Flesh is sometimes also used by botanists for the soft pulpy substance of any fruit, inclosed between the outer rind or skin and the seeds or stone; or for that part of a root, fruit, &c. fit to be eaten.

Flesh-*Colour*. See Carnation.

FLETA, the name given to an unknown writer who lived about the end of the reign of Edward II. and beginning of Edward III. and who being a prisoner in the Fleet wrote there an excellent treatise on the common law of England.

FLETCHER. See Beaumont and Fletcher.

Fletcher (Andrew) of Salton, a celebrated Scotch patriot and political writer, was descended from an ancient family, who trace their origin to one of the followers of William the Conqueror. He was the son of Sir Robert Fletcher of Salton and Innerpeffer, and born in the year 1650. The tuition of our author was committed by his father, on his death-bed, to Mr.

* This salt had been sent to me rendered caustic by quick-lime, though I had not desired it.

(afterwards bishop) Burnet, then his parish-minister; by whose care he received a pious, learned, and polite education. Endowed with uncommon genius, and possessed of virtues and abilities peculiarly suited to the times in which he lived, Mr. Fletcher quickly shone forth the ornament of his country, and the champion of its freedom. Having in the course of his classical studies and historical reading been impressed with an enthusiastic admiration both of ancient and modern republics, he had early contracted an ardent love of liberty, and an aversion to arbitrary power. Hence his spirit the more readily took alarm at certain measures in the reign of Charles II. Being knight of the shire for Lothian to that parliament where the duke of York was commissioner, he openly opposed the designs of that prince and the bill of accession. He had a share with lord viscount Stair in framing the test-act, by which the duke of York complained that he lost Scotland. On these accounts he became peculiarly obnoxious to the duke; and was at last obliged to flee to Holland, to avoid the fatal consequences of prosecutions which on various pretences were commenced against him. Being cited before the privy-council and justiciary courts, and not appearing, he was declared a traitor, and his estate confiscated.

To follow our statesman through all the mazes of his political life subsequent to the Revolution, is beyond our purpose, and would exceed our limits. In the ardour of these pursuits, however, he forgot not the interests of the place that gave him birth. He esteemed the education of youth one of the noblest objects of government; and on this subject wrote a treatise, still extant, most characteristic of himself: he also established at Salton a foundation for the purpose of applying his doctrines to practice, and which was of great utility while it lasted. Mr. Fletcher died at London in 1716, aged 66. His remains were conveyed to Scotland, and deposited in the family vault at Salton.

FLETEWOOD (William), an eminent English lawyer and recorder of London, in the reign of queen Elizabeth. He was very zealous in suppressing mass-houses, and committing Popish priests: but once rushing in during mass at the Portuguese ambassador's house, he was committed to the Fleet for breach of privilege, but soon released. Mr. Wood says, "he was a learned man, and a good antiquary, but of a marvellous merry and pleasant conceit." He was a very popular speaker, and wrote well upon subjects of government. His principal works are, 1. *Annalium tam Regum Edvardi V. Richardi III. & Henrici VII. quam Henrici VIII.* 2. A Table of the Reports of Edmund Plowden. 3. The Office of a Justice of Peace. He died about the year 1593.

FLEVILLEA, in botany; a genus of the hexandria order, belonging to the diœcia class of plants. The male calyx and corolla are quinquefid; the stamina five; the nectarium five converging filaments. The female calyx is quinquefid; there are three styli; the fruit an hard trilocular barky apple.

FLEURI (Claude), one of the best French critics and historians of his age, was born at Paris in 1640. He applied himself to the law, was made advocate for the parliament of Paris, and attended the bar nine years; he then entered into orders, and was made preceptor to the princes of Conti. In 1689 the king made him sub-preceptor to the dukes of Burgundy, Anjou, and Berry; and in 1706, when the education of those young princes was completed, the king gave him the priory of Argenteville belonging to the Benedictines in the diocese of Paris. In 1716 he was chosen counsellor to Louis XV. and died in 1723. He was the author of a great number of esteemed French works; the principal of which are, 1. An ecclesiastical history, in 20 volumes, the last of which ends with the year 1441. 2. The manners of the Israelites and Christians. 3. Institutions of ecclesiastical law. 4. An historical catechism. 5. On the choice and method of study. 6. The duties of masters and servants, &c.

FLEURI (Andrew Hercules de), bishop of Frejus, preceptor to Louis XV. grand almoner to the queen, cardinal and minister of state, was born in 1653, and died in 1743. He was an able negotiator, and distinguished himself during his ministry by his probity, his zeal for the happiness of his country, and his pacific disposition.

FLEXIBLE, in physics, a term applied to bodies capable of being bent or diverted from their natural figure or direction.

FLEXOR, in anatomy, a name applied to several muscles, which are so called from their office, which is to bend the parts to which they belong; in opposition to the *extensors*, which open or stretch them. See Anatomy, *Table of the Muscles*.

FLIGHT, the act of a bird in flying; or the manner, duration, &c. thereof. Almost every kind of bird has its particular flight: the eagle's flight is the highest; the flight of the sparrow-hawk and vulture is noble, and fit for high enterprise and combat. The flight of some birds is low, weak, and transient; the flight of the partridge and pheasant is but of short continuance; that of the dove is laboured; that of the sparrow undulatory, &c. The augurs pretended to foretel future events from the flight of birds. See Augury.

Flight. In melting the lead-ore in the works at Mendip, there is a substance which flies away in the smoke, which they call the flight. They find it sweetish upon their lips, if their faces happen to be in the way of the smoke, which they avoid as much as possible. This, falling on the grass, kills cattle that feed thereon; and, being gathered and carried home, kills rats and mice in their houses; that which falls on the sand, they gather, and melt upon a flag-hearth into shot and sheet-lead.

FLINT, in natural history, a kind of semitransparent or quite opaque stones; generally of a roundish form, and covered with white crust; of a smooth, uniform, shining texture; so hard, that they will strike fire with steel; calcinable by fire, after which they become white, friable, and, according to Henckel, heavier than before, and soluble by acids; vitrifiable only by the very violent heat of the largest speculums, such as that of Villette, and not even by the focus of one of Tschirnhausen's lenses, according to an experiment of Neumann. They are found generally in beds of chalk and of sand; but never forming entire strata of rock as jasper does. By long exposure to air and the sun, they seem to decay, to lose their lustre, their firmness of texture, and to be changed to a white calcareous earth or chalk. Hence they are almost always found covered with a white chalky crust. They are also convertible into a calcareous earth, by fusion, or vitrification with so much fixed alkali that they shall resolve into a liquid mass called the *liquamen* or *oil of flints*, and by precipitation from the fixed alkali by means of acids. See Chemistry, p. 428. This genus of stones, or siliceous earths, Cronstedt considers as of an intermediate nature between the quartz and jasper; both of which it so nearly resembles, that it is difficult to distinguish them. Our author characterises it in the following manner: 1. It is more uniformly solid and not so much cracked in the mass as quartz, but more pellucid than the jasper. 2. It bears the air better than the jasper, but worse than the quartz. 3. For the purpose of glass-making it is better than jasper, but not quite so good as quartz. 4. Whenever it has had an opportunity of shooting into crystals, those of quartz are always found in it; as if the quartz made one of its constituent parts, and had been squeezed out of it. This may be seen in every hollow flint and its clefts, which are always filled up with quartz. 5. It often shows most evident marks of having been originally in a soft and slimy tough state like jelly.—To these properties the following are added by other authors. 7. When broken, it is scaly, generally unequal, and cracks into thin lamellæ. 8. In a calcining heat it becomes opaque, white, and milky.

The way of preparing flints for the nicest operations in the

glafs-trade is this. Choofe the hardeft flints, fuch as are black and will refift the file, and will grow white when calcined in the fire. Cleanfe thefe of the white cruft that adheres to them, then calcine them in a ftrong fire, and throw them while red-hot into cold water; wafh off the afhes that may adhere to them, and powder them in an iron mortar, and fift them through a very fine fieve; pour upon this powder fome weak aquafortis, or the phlegm of aquafortis, to diffolve and take up any particles of iron it may have got from the mortar; ftir this mixture feveral times, then let it reft, and in the morning pour off the liquor, and wafh the powder feveral times with hot water, and afterwards dry it for ufe. You will thus have a powder for making the pureft glafs as perfectly fine and faultlefs as if you had ufed rock-cryftal itfelf. Wafhing off the ferrugineous particles with aquafortis is not neceffary when the glafs intended to be made is to be tinged with iron afterwards; but when meant to be a pure white, this is the method that will fecure fuccefs.

Breaking of FLINTS. The art of cutting, or rather breaking, flint ftones into uniform figures, is by fome fuppofed to be one of the arts now loft. That it was known formerly appears from the ancient Bridewell at Norwich, from the gate of the Auguftin friars at Canterbury, that of St. John's Abbey at Colchefter, and the gate near Whitehall, Weftminfter. But that the art is not loft, and that the French know it, appears from the platform on the top of the royal obfervatory at Paris; which, inftead of being leaded, is paved with flint cut or broken into regular figures. But we know not that this art hath been any where defcribed.

FLINT, the capital of Flintfhire, feated on the river Dee. Here are the remains of a caftle, in which the unhappy king Richard II. was delivered into the hands of his rival, afterward Henry IV. Flint fends one member to parliament; but it is a fmall place, without trade, and the affizes are held at Mold. It is 12 miles N. W. of Chefter, and 193 N. W. of London. Lon. 3. 2. W. Lat. 53. 16. N.

FLINTSHIRE, a county of N. Wales, bounded on the N. and N. E. by an arm of the fea, forming a large bay at the mouth of the river Dee, which divides it from Chefhire; on the N. W. by the Irifh Sea; on the E. by the river Dee, which continues to divide it from Chefhire, and on the S. and S. W. from Denbighfhire. It is 29 miles in length from N. W. to S. E. and 12 where broadeft. Part of Flintfhire extends on the E. fide of the Dee, about nine miles, between Chefhire and Shropfhire. It is at firft no more than five miles acrofs, but fpreads out in its moft eaftern part to about eight miles. It is divided into five hundreds, in which are two market-towns and 28 parifhes. It lies in the diocefe of St. Afaph and Chefter. It fends two members to parliament, one for the county, and one for the town of Flint. The valleys poffefs coal and freeftone, the hills lead and calamine, with vaft quantities of limeftone. The principal trade is mining and fmelting. The northern part produces wheat: there is alfo much wood. A lofty range of mountains rifes on the W. and forms a bold frontier. This county is entirely deftitute of the foffil ufually called by the fame name. The cows, though fmall, yield a great quantity of milk, and their flefh is excellent. There is good butter, cheefe, and honey, of which laft the natives make metheglin, a wholefome liquor, much ufed in thofe parts. The principal rivers are the Clwyd, Wheeler, Dee, Sevion, Elwy, and Allen.

FLIP, a fort of failors drink, made of malt liquor, brandy, and fugar, mixed.

FLOAT, a certain quantity of timber bound together with rafters athwart, and put into a river to be conveyed down the ftream; and even fometimes to carry burdens down a river with the ftream.

FLOAT-*Boards*, thofe boards fixed to water-wheels of under-fhot-mills, ferving to receive the impulfe of the ftream, whereby the wheel is carried round. See the articles WHEEL and MILL. It is no advantage to have too great a number of float-boards; becaufe, when they are all ftruck by the water in the beft manner that it can be brought to come againft them, the fum of all the impulfes will be but equal to the impulfe made againft one float-board at right angles, by all the water coming out of the penftock through the opening, fo as to take place on the float-board. The beft rule in this cafe is, to have juft fo many, that each of them may come out of the water as foon as poffible, after it has received and acted with its full impulfe. As to the length of the float-board, it may be regulated according to the breadth of the mill.

FLOATS *for Fifhing*. See FISHING-*Floats*.

FLOATAGES, all things floating on the furface of the fea or any water: a word much ufed in the commiffions of water-bailiffs.

FLOATING-*Bridge*. See BRIDGE.

FLOCK-*Paper*. See PAPER.

FLOOD, a deluge or inundation of waters. See DELUGE. *Flood* is alfo ufed in fpeaking of the tide. When the water is at loweft, it is called *flood*; when rifing, *young*, or *old flood*; when at higheft, *high flood*; when beginning to fall, *ebb-water*.

FLOOD-*mark*, the mark which the fea makes on the fhore at flowing water and the higheft tide: it is alfo called *high-water mark*.

FLOOK of an anchor. See ANCHOR.

FLOOKING, among miners, a term ufed to exprefs a peculiarity in the load of a mine. The load or quantity of ore is frequently intercepted in its courfe by the croffing of a vein of earth or ftone, or fome different metallic fubftance; in which cafe the load is moved to one fide, and this tranfient part of the land is called a *flooking*.

FLOOR, in building, the underfide of a room, or that part we walk on. Floors are of feveral forts; fome of earth, fome of brick, others of ftone, others of boards, &c. For an account of brick and *ftone* FLOORS, fee PAVEMENT. For *boarded* FLOORS, it is obfervable, that the carpenters never floor their rooms with boards till the carcafe is fet up, and alfo inclofed with walls, left the weather fhould injure the flooring. Yet they generally rough-plane their boards for the flooring before they begin any thing elfe about the building, that they may fet them up to dry and feafon, which is done in the moft careful manner. The beft wood for flooring is the fine yellow deal well feafoned, which, when well laid, will keep its colour for a long while; whereas the white fort becomes black by often wafhing, and looks very bad. The joints of the boards are commonly made plain, fo as to touch each other only; but, when the ftuff is not quite dry, and the boards fhrink, the water runs through them whenever the floor is wafhed, and injures the ceiling underneath. For this reafon they are made with feather edges, fo as to cover each other about half an inch, and fometimes they are made with grooves and tenons; and fometimes the joints are made with dove-tails; in which cafe the lower edge is nailed down and the next drove into it, fo that the nails are concealed. The manner of meafuring floors is by fquares of 10 feet on each fide, fo that taking the length and breadth and multiplying them together and cutting off two decimals, the content of a floor in fquare will be given. Thus 18 by 16 gives 288 or 2 fquares and 88 decimal parts.

Earthen-FLOORS, are commonly made of loam, and fometimes, efpecially to make malt on, of lime, and brookfand, and gun-duft, or anvil-duft from the forge. Ox-blood and fine clay tempered together, Sir Hugh Plat fays, make the fineft floor in the world. The manner of making earthen floors for plain country habitations is as follows: Take two thirds of lime, and one of coal-afhes well fifted, with a fmall quantity of loam clay; mix the whole together, and temper it well with water,

making it up into a heap: let it lie a week or ten days, and then temper it over again. After this, heap it up for three or four days, and repeat the tempering very high, till it become ſmooth, yielding, tough, and gluey. The ground being then levelled, lay the floor therewith about $2\frac{1}{2}$ or 3 inches thick, making it ſmooth with a trowel: the hotter the ſeaſon is, the better; and when it is thoroughly dried, it will make the beſt floor for houſes, eſpecially malt-houſes. If any one would have their floors look better, let them take lime made of rag-ſtones, well tempered with whites of eggs, covering the floor about half an inch thick with it, before the under flooring is too dry. If this be well done, and thoroughly dried, it will look when rubbed with a little oil as tranſparent as metal or glaſs. In elegant houſes, floors of this nature are made of ſtucco, or of plaiſter of Paris beaten and ſifted, and mixed with other ingredients.

Floor *of a ſhip*, ſtrictly taken, is only ſo much of her bottom as ſhe reſts on when aground. Such ſhips as have long, and withal broad floors, lie on the ground with moſt ſecurity, and are not apt to heel, or tilt on one ſide; whereas others, which are narrow in the floor, or, in the ſea-phraſe, *cranked by the ground*, cannot be grounded without danger of being overturned.

Floor-*Timbers*, in a ſhip, are thoſe parts of a ſhip's timbers which are placed immediately acroſs the keel, and upon which the bottom of the ſhip is framed; to theſe the upper parts of the timbers are united, being only a continuation of floor-timbers upwards.

FLORA, the reputed goddeſs of flowers, was, according to Lactantius, only a lady of pleaſure, who, having gained large ſums of money by proſtituting herſelf, made the Roman people her heir, on condition that certain games called *Floralia* might be annually celebrated on her birth-day. Some time afterwards, however, ſuch a foundation appearing unworthy the majeſty of the Roman people, the ſenate, to ennoble the ceremony, converted Flora into a goddeſs, whom they ſuppoſed to preſide over flowers; and ſo made it a part of religion to render her propitious, that it might be well with their gardens, vineyards, &c. But Voſſius (*de Idolol.* lib. i. c. 12.) can by no means allow the goddeſs Flora to have been the courteſan above mentioned: he will rather have her a Sabine deity, and thinks her worſhip might have commenced under Romulus. His reaſon is, that Varro, in his fourth book of the Latin tongue, ranks Flora among the deities to whom Tatius king of the Sabines offered up vows before he joined battle with the Romans. Add, that from another paſſage in Varro it appears, that there were prieſts of Flora, with ſacrifices, &c. as early as the times of Romulus and Numa. The goddeſs Flora was, according to the poets, the wife of Zephyrus. Her image in the temple of Caſtor and Pollux was dreſſed in a cloſe habit, and ſhe held in her hands the flowers of peaſe and beans: but the modern poets and painters have been more laviſh in ſetting off her charms, conſidering that no parts of nature offered ſuch innocent and exquiſite entertainment to the ſight and ſmell, as the beautiful variety which adorns, and the odour which embalms, the floral creation.

FLORALES ludi, or Floral Games, in antiquity, were games held in honour of Flora, the goddeſs of flowers. They were celebrated with ſhameful debaucheries. The moſt licentious diſcourſes were not enough, but the courteſans were called together by the ſound of a trumpet, made their appearance naked, and entertained the people with indecent ſhows and poſtures: the comedians appeared after the ſame manner on the ſtage. Val. Maximus relates, that Cato being once preſent in the theatre on this occaſion, the people were aſhamed to aſk for ſuch immodeſt repreſentations in his preſence; till Cato, appriſed of the reſervedneſs and reſpect with which he inſpired them, withdrew, that the people might not be diſappointed of their accuſtomed diverſion. There were ſeveral other ſorts of ſhows exhibited on this occaſion; and, if we may believe Suetonius in *Galba*, c. vi. and Vopiſcus in *Carinus*, theſe princes preſented elephants dancing on ropes on theſe occaſions. The ludi florales, according to Pliny, lib. xviii. c. 29. were inſtituted by order of an oracle of the Sibyls, on the 28th of April; not in the year of Rome IↃXVI. as we commonly read it in the ancient editions of that author; nor in IↃXIV. as F. Hardouin has corrected it, but, as Voſſius reads it, in 513: though they were not regularly held every year till after 580. They were chiefly held in the night-time, in the Patrician-ſtreet: ſome will have it there was a circus for the purpoſe on the hill called Hortulorum.

FLORALIA, in antiquity, a general name for the feaſts, games, and other ceremonies, held in honour of the goddeſs Flora. See Flora and Florales *Ludi*.

FLORENCE, an ancient, large, and celebrated city of Italy, capital of Tuſcany. It is a very beautiful city. Excluſive of the churches and palaces, ſome of which are magnificent, the architecture of the houſes in general is in a good taſte. The ſtreets are remarkably clean, and paved with large broad ſtones, chiſeled ſo as to prevent the horſes from ſliding. This city is divided into two unequal parts by the river Arno, over which are no leſs than four bridges in ſight of each other. That called the Ponte della Trinità is uncommonly elegant. It is built entirely of white marble, and ornamented with four beautiful ſtatues, repreſenting the four ſeaſons. The quays, the buildings on each ſide, and the bridges, render that part of Florence through which the river runs, by far the fineſt. The ſtreets, ſquares, and fronts of the palaces, are adorned by a great number of ſtatues; ſome of them by the beſt modern maſters, Michael Angelo, Bandinelli, Donatello, Giovanni di Bologna, Benvenuto Cellini, and others. Some of the Florentine merchants, formerly, were men of vaſt wealth, and lived in a magnificent manner. One of them, about the middle of the 15th century, built that noble fabric which from the name of its founder is ſtill called the Palazzo Pitti. He was ruined by the prodigious expence of this building, which was immediately purchaſed by the Medici family, and has continued ever ſince to be the reſidence of the grand dukes of Tuſcany. The gardens belonging to this palace are on the declivity of an eminence. On the ſummit is a kind of a fort, called Belvedere, from which, and ſome of the higher walks, is a complete view of the city of Florence, and the beautiful vale of Arno, in the middle of which it ſtands. The proſpect is bounded on every ſide by an amphitheatre of fertile hills, adorned with country-houſes and gardens. The Palazzo Pitti is on the oppoſite ſide of the Arno from the famous gallery. It has been enlarged ſince it was purchaſed from the ruined family of Pitti. The furniture is rich and curious; but the moſt valuable ornaments are the paintings. The gallery juſt mentioned attracts univerſal attention. One of the moſt intereſting parts of it, in the opinion of many, is the ſeries of Roman emperors from Julius Cæſar to Gallienus, which is almoſt complete. The celebrated Venus of Medici, the ſtandard of taſte in female beauty and proportion, is in a room called the Tribunal. The inſcription on the pedeſtal aſcribes it to Cleomenes, an Athenian, the ſon of Apollodorus. It is of white marble, and ſurrounded by other maſterpieces of ſculpture, ſaid to be the works of Praxiteles and other Greek maſters. Beſide the gallery and tribunal, the hundredth part of whoſe treaſures it is impoſſible to particularize here, there are other rooms, whoſe contents are indicated by the names they bear; as the cabinet of arts, of aſtronomy, of natural hiſtory, of medals, of porcelain, of antiquities, &c. The gallery of portraits contains the portraits, all executed by themſelves, of the moſt eminent painters who have flouriſhed in

Europe during the three laſt centuries. They amount to above 200. Three of them, which have been added lately, vie with the fineſt in this collection—thoſe of Mengs, ſir Joſhua Reynolds, and the electreſs dowager of Saxony. It is in vain to attempt a deſcription of the churches and other public buildings; but the chapel of Lorenzo muſt not be omitted. It is, perhaps, the fineſt and moſt expenſive habitation that ever was reared for the dead: it is incruſted with precious ſtones, and adorned by the workmanſhip of the beſt modern ſculptors. Mr. Addiſon remarked, that this chapel advanced ſo very ſlowly, "that it is not impoſſible but the family of Medici may be extinct before their burial-place is finiſhed." This has actually taken place: the Medici family is extinct, and the chapel unfiniſhed. Florence is a place of ſome ſtrength, and contains an archbiſhop's ſee and a univerſity. It is 45 miles S. of Bologna, and 125 N. W. of Rome. Lon. 11. 15. E. Lat. 43. 46. N.

Florence, an ancient piece of Engliſh gold-coin. Every pound-weight of ſtandard-gold was to be coined into 50 Florences, to be current at ſix ſhillings each; all which made in tale 15 pounds; or into a proportionate number of half-Florences or quarter-pieces, by indenture of the mint: 18 Edw. III.

FLORENTINE marble. See Citadanesca.

FLORESCENTIA, from *floreſco* "to flouriſh or bloom"; the act of flowering, which Linnæus and the ſexualiſts compare to the act of generation in animals; as the ripening of the fruit in their opinion reſembles the birth. See Flower.

FLORID style, is that too much enriched with figures and flowers of rhetoric. See Oratory.

FLORIDA, a country of N. America, bounded on the N. by Georgia, on the E. by the Atlantic Ocean, on the S. by the gulf of Mexico, and on the W. by the Miſſiſſippi. It is 600 miles long, and 130 broad, lying between 25° and 31° N. lat. and 82° and 92° W. lon. It is divided into E. and W. Florida. St. Auguſtine is the capital of the former, and Penſacola of the latter. The country about St. Auguſtine is by far the moſt unfruitful; yet even here two crops of Indian corn are annually produced. The banks of the rivers are of a ſuperior quality, and well adapted to the culture of rice and corn. The interior country, which is high and pleaſant, abounds with wood of almoſt every kind; particularly white and red oak, pine, hiccory, cypreſs, red and white cedar. The intervals between the hilly parts are very rich, and produce ſpontaneouſly the fruits common to Georgia and the Carolinas. But this country is valuable, in a particular manner, for the extenſive ranges for cattle. Florida was diſcovered by Sebaſtian Cabot in 1497. Having often changed maſters, belonging alternately to the French and Spaniards, it was ceded by the latter to the Engliſh in 1763; in whoſe hands it continued till 1781, when it was taken by the Spaniards, and ceded to them by the treaty of peace in 1783.

FLORILEGIUM, Florilege, a name the Latins have given to what the Greeks call ανθολογιον, *anthology*; viz. a collection of choice pieces, containing the fineſt and brighteſt things in their kind.

Florilege is alſo particularly uſed for a kind of breviary, in the Eaſtern church, compiled by Arcadius, for the convenience of the Greek prieſts and monks, who cannot carry with them, in their travels and pilgrimages, all the volumes wherein their office is diſperſed. The florilegium contains the general rubrics, pſalter, canticles, the horologium, and the office of the feriæ, &c.

FLORIN, is ſometimes uſed for a coin, and ſometimes for a money of account. Florin, as a coin, is of different values, according to the different metals and different countries where it is ſtruck. The gold florins are moſt of them of a very coarſe alloy, ſome of them not exceeding thirteen or fourteen carats, and none of them ſeventeen and a half. See Money-*Table*. Florin, as a money of account, is uſed by the Italian, Dutch, and German merchants and bankers, but admits of different diviſions in different places. *Ibid.*

FLORINIANI, or Floriani, a ſect of heretics, of the ſecond century, denominated from its author Florinus, or Florianus, a prieſt of the Roman church, depoſed along with Blaſtus for his errors. Florinus had been a diſciple of St. Polycarp, along with Irenæus. He made God the author of evil; or rather aſſerted, that the things forbidden by God are not evil, but of his own appointing: in which he followed the errors of Valentinus, and joined himſelf with the Carpocratians. They had alſo other names given them. Philaſtrius ſays, they were the ſame with the *Carpophorians*. He adds, that they were alſo called *ſoldiers*, *milites*, *quia de militaribus fuerunt*. St. Irenæus calls them *Gnoſtics*; St. Epiphanius, *Phibionites*; and Theodoret, *Borborites*, on account of the impurities of their lives. Others call them *Zaccheans*; others *Coddians*, &c. though for what particular reaſons it is not eaſy to ſay, nor perhaps would it be worth while to inquire.

FLORIS (Francis), an eminent hiſtorical painter, was born at Antwerp in 1520. He followed the profeſſion of a ſtatuary till he was twenty years of age; when, preferring painting, he entered the ſchool of Lambert Lombard, whoſe manner he imitated very perfectly. He afterwards went to Italy, and completed his ſtudies from the moſt eminent maſters. The great progreſs he made in hiſtorical painting, at his return, procured him much employment; and his countrymen complimented him with the flattering appellation of *the Flemiſh Raphael*. He got much money, and might have rendered his acquaintance more worthy of the attention of the great, had he not debaſed himſelf by frequent drunkenneſs. He died in 1570, aged 50.

FLORIST, a perſon curious or ſkilled in flowers; their kinds, names, characters, culture, &c. It is alſo applied to an author who writes what is called the flora of any particular place, that is, a catalogue of the plants and trees which are found ſpontaneouſly growing there.

FLORUS (Lucius Annæus), a Latin hiſtorian, of the ſame family with Seneca and Lucan. He flouriſhed in the reigns of Trajan and Adrian; and wrote an Abridgment of the Roman Hiſtory, of which there have been many editions. It is compoſed in a florid and poetical ſtyle, and is rather a panegyric on many of the great actions of the Romans, than a faithful and correct recital of their hiſtory. He alſo wrote poetry, and entered the liſts againſt the emperor Adrian, who ſatirically reproached him with frequenting taverns and places of diſſipation.

FLORY, Flowry, or *Fleury*, in heraldry, a croſs that has the flowers at the end circumflex and turning down; differing from the *potence*, in as much as the latter ſtretches out more like that which is called *patee*.

FLOS, Flower, in botany. See Flower. *Fœmineus* Flos, is a flower which is furniſhed with the pointal or female organs of generation, but wants the ſtamina or male organ. Female flowers may be produced apart from the male, either on the ſame root or on diſtinct plants. Birch and mulberry are examples of the firſt caſe; willow and poplar of the ſecond. *Maſculus* Flos, is a male flower. By this name Linnæus and the ſexualiſts diſtinguiſh a flower which contains the ſtamen, reckoned by the ſexualiſts the male organ of generation; but not the ſtigma or female organ. All the plants of the claſs diœcia of Linnæus have male and female flowers upon different roots: thoſe of the claſs monœcia bear flowers of different ſexes on the ſame root. The plants, therefore, of the former are only male and female: thoſe of the latter are androgynous; that is, contain a mixture of both male and female flowers.

Flos, in chemiſtry, denotes the moſt ſubtle part of bodies ſeparated from the more groſs parts by ſublimation in a dry form.

FLOTA, or Flotta, *fleet*; a name the Spaniards give par-

ticularly to the ſhips which they fend annually from Cadiz to the port of Vera Cruz, to fetch thence the merchandizes gathered in Mexico for Spain. It conſiſts of the captains, admiral, and patach, or pinnace, which go on the king's account; and about 16 ſhips, from 400 to 1000 tons, belonging to particular perſons. They ſet out from Cadiz about the month of Auguſt, and are 18 or 20 months before they return. Thoſe ſent to fetch the commodities prepared in Peru are called *galleons*. The name *flotilla* is given to a number of ſhips, which get before the reſt in their return, and give information of the departure and cargo of the flota and galleons.

FLOTSON, or FLOTSOM, goods that by ſhip-wreck are loſt, and floating upon the ſea: which, with jetſon and lagan, are generally given to the lord admiral: but this is the caſe only where the owners of ſuch goods are not known. And here it is to be obſerved, that *jetſon* ſignifies any thing that is caſt out of a ſhip when in danger, and afterwards is beat on the ſhore by the water, notwithſtanding which the ſhip periſhes. *Lagan* is where heavy goods are thrown overboard, before the wreck of the ſhip, and ſink to the bottom of the ſea.

FLOUNDER, FLUKE, or *But*, in ichthyology. See PLEURONECTES. Flounders may be fiſhed for all day long, either in a ſwift ſtream, or in the ſtill deep water; but beſt in the ſtream, in the months of April, May, June, and July: the moſt proper baits are all ſorts of worms, waſps, and gentles.

FLOUR, the meal of wheat-corn, finely ground and ſifted. See MEAL. The grain itſelf is not only ſubject to be eaten by inſects in that ſtate; but, when ground into flour, it gives birth to another race of deſtroyers, who eat it unmercifully, and increaſe ſo faſt in it, that it is not long before they wholly deſtroy the ſubſtance. The fineſt flour is moſt liable to breed theſe, eſpecially when ſtale or ill prepared. In this caſe, if it be examined in a good light, it will be obſerved to be in continual motion, and on a nicer inſpection there will be found in it a great number of little animals of the colour of the flour, and very nimble. If a little of this flour is laid on the plate of the double microſcope, the inſects are very diſtinctly ſeen in great numbers, very briſk and lively, continually crawling over one anothers backs, and playing a thouſand antic tricks together; whether in diverſion, or in ſearch of food, is not eaſy to be determined. Theſe animals are of an oblong and ſlender form; their heads are furniſhed with a kind of trunk or hollow tube, by means of which they take in their food, and their body is compoſed of ſeveral rings. They do vaſt miſchief among magazines of flour laid up for armies and other public uſes. When they have once taken poſſeſſion of a parcel of this valuable commodity, it is impoſſible to drive them out; and they increaſe ſo faſt, that the only method of preventing the total loſs of the parcel is to make it up into bread as ſoon as can be done. The way to prevent their breeding in the flour is to preſerve it from damp: nothing gets more injury by being put up in damp than flour; and yet nothing is more frequently put up ſo. It ſhould be always carefully and thoroughly dried before it is put up; and the barrels alſo dried into which it is to be put; then, if they are placed in a room tolerably warm and dry, they will keep it well. Too dry a place never does flour any hurt, though one too moiſt almoſt always ſpoils it. Flour, when carefully analyſed, is found to be compoſed of three very different ſubſtances. The firſt and moſt abundant is pure *ſtarch*, or white fecule, inſoluble in cold but ſoluble in hot water, and of the nature of mucous ſubſtances; which, when diſſolved, form water-glues. The ſecond is the *gluten*, moſt of whoſe properties have been deſcribed under the article BREAD. The third is of a mild nature, perfectly ſoluble in cold water, of the nature of *ſaccharine* extractive mucous matters. It is ſuſceptible of the ſpirituous fermentation, and is found but in ſmall quantity in the flour of wheat. See BREAD, GLUTEN, STARCH, and SUGAR.

FLOWER, FLOS, among botaniſts and gardeners, the moſt beautiful part of trees and plants, containing the organs or parts of fructification. See BOTANY, p. 33, and explanation of Plate 52. in p. 35. Flowers deſigned for medicinal uſe ſhould be plucked when they are moderately blown, and on a clear day before noon: roſes, for conſerve, muſt be taken in the bud.

FLOWERS, in antiquity. We find flowers in great requeſt at the entertainments of the ancients, being provided by the maſter of the feaſt, and brought in before the ſecond courſe; or, as ſome are of opinion, at the beginning of the entertainment. They not only adorned their heads, necks, and breaſts, with flowers, but often beſtrewed the beds whereon they lay, and all parts of the room with them. But the head was chiefly regarded. See GARLAND. Flowers were likewiſe uſed by the Greeks and Romans in bedecking tombs.

Eternal FLOWER. See XERANTHEMUM.

Everlaſting FLOWER. See GNAPHALIUM.

FLOWER-*Fence*. See POINCIANA.

Sun-FLOWER. See HELIANTHUS.

Sultan-FLOWER. See CYANUS.

Trumpet-FLOWER. See BIGNONIA.

Wind-FLOWER. See ANEMONE.

FLOWER *de-lis*, or *Flower-de-luce*, in heraldry, a bearing repreſenting the lily, called the *queen of flowers*, and the true hieroglyphic of majeſty; but of late it is become more common, being borne in ſome coats one, in others three, in others five, and in ſome *ſemee* or ſpread all over the eſcutcheon in great numbers. The arms of France, before the eſtabliſhment of the republican conſtitution in that country, were three flower-de-lis or, in a field azure.

FLOWER-*de-Luce*, in botany: ſee IRIS.

FLOWERS, in heraldry. They are much uſed in coats of arms; and in general ſignify hope, though ſometimes they denote human frailty and momentary proſperity.

FLOWERS, in chemiſtry. By this name are generally underſtood bodies reduced into very fine parts, either ſpontaneouſly or by ſome operation of art; but the term is chiefly applied to volatile ſolid ſubſtances, reduced into very fine parts, or into a kind of meal by ſublimation. Some flowers are nothing elſe than the bodies themſelves, which are ſublimed entire, without ſuffering any alteration or decompoſition; and other flowers are formed only of ſome of the conſtituent parts of the body ſubjected to ſublimation. See CHEMISTRY, pages 379 and 381.

Preſerving of FLOWERS. The method of preſerving flowers in their natural beauty through the whole year has been much ſought after by many people. Some have attempted it by gathering them when dry and not too much opened, and burying them in dry ſand; but this, though it preſerves their figure well, takes off from the livelineſs of their colour. Muntingius prefers the following method to all others. Gather roſes, or other flowers, when they are not yet thoroughly open, in the middle of a dry day: put them into a good earthen veſſel glazed within; fill the veſſel up to the top with them; and when full, ſprinkle them over with ſome good French wine, with a little ſalt in it; then ſet them by in a cellar, tying down the mouth of the pot. After this they may be taken out at pleaſure; and, on ſetting them in the ſun, or within reach of the fire, they will open as if growing naturally; and not only the colour, but the ſmell alſo will be preſerved.

The flowers of plants are by much the moſt difficult parts of them to preſerve in any tolerable degree of perfection; of which we have inſtances in all the collections of dried plants, or *horti ſicci*. In theſe, the leaves, ſtalks, roots, and ſeeds of the plants appear very well preſerved; the ſtrong texture of theſe parts making them always retain their natural form, and the colours in many ſpecies naturally remaining. But where theſe fade,

the plant is little the worſe for uſe as to the knowing the ſpecies by it. But it is very much otherwiſe in regard to the petals: theſe are naturally by much the moſt beautiful parts of the plant to which they belong; but they are ſo much injured in the common way of drying, that they not only loſe, but change their colours one into another, by which means they give occaſion to many errors; and they uſually alſo wither up, ſo as to loſe their very form and natural ſhape. The primroſe and cowſlip kinds are very eminent inſtances of the change of colours in the flowers of dried ſpecimens: for thoſe of this claſs of plants eaſily dry in their natural ſhape; but they loſe their yellow, and, inſtead of it, acquire a fine green colour, much ſuperior to that of the leaves in their moſt perfect ſtate. The flowers of all the violet kind loſe their beautiful blue, and become of a dead white: ſo that in dried ſpecimens there is no difference between the blue-flowered violet and the white-flowered kinds.

Sir Robert Southwell has communicated to the world a method of drying plants, by which this defect is propoſed to be in a great meaſure remedied, and all flowers preſerved in their natural ſhape, and many in their natural colours. For this purpoſe, two plates of iron are to be prepared of the ſize of a large half-ſheet of paper, or larger for particular occaſions: theſe plates muſt be made ſo thick as not to be apt to bend; and there muſt be a hole made near every corner, for the receiving a ſcrew to faſten them cloſe together. When theſe plates are prepared, lay in readineſs ſeveral ſheets of paper, and then gather the plants with their flowers when they are quite perfect. Let this be always done in the middle of a dry day; and then lay the plant and its flower on one of the ſheets of paper doubled in half, ſpreading out all the leaves and petals as nicely as poſſible. If the ſtalk is thick, it muſt be pared or cut in half, ſo that it may lie flat; and if it is woody, it may be peeled, and only the bark left. When the plant is thus expanded, lay round about it ſome looſe leaves and petals of the flower, which may ſerve to complete any part that is deficient. When all is thus prepared, lay ſeveral ſheets of paper over the plant, and as many under it; then put the whole between the iron plates, laying the papers ſmoothly on one, and laying the other evenly over them: ſcrew them cloſe, and put them into an oven after the bread is drawn, and let them lie there two hours. After that, make a mixture of equal parts of aquafortis and common brandy; ſhake theſe well together, and when the flowers are taken out of the preſſure of the plates, rub them lightly over with a camel's-hair pencil dipped in this liquor; then lay them upon freſh brown paper, and covering them with ſome other ſheets, preſs them between this and other papers with a handkerchief till the wet of theſe liquors is dried wholly away. When the plant is thus far prepared, take the bulk of a nutmeg of gum-dragon; put this into a pint of fair water cold, and let it ſtand 24 hours; it will in this time be wholly diſſolved: then dip a fine hair-pencil in this liquor, and with it daub over the back ſides of the leaves, and lay them carefully down on a half-ſheet of white paper fairly expanded, and preſs them down with ſome more papers over theſe. When the gum-water is fixed, let the preſſure and papers be removed, and the whole work is finiſhed. The leaves retain their verdure in this caſe, and the flowers uſually keep their natural colours. Some care, however, muſt be taken, that the heat of the oven be not too great. When the flowers are thick and bulky, ſome art may be uſed to pare off their backs, and diſpoſe the petals in a due order; and after this, if any of them are wanting, their places may be ſupplied with ſome of the ſupernumerary ones dried on purpoſe; and if any of them are only faded, it will be prudent to take them away, and lay down others in their ſtead: the leaves may be alſo diſpoſed and mended in the ſame manner.

Another method of preſerving both flowers and fruit ſound throughout the whole year is alſo given by the ſame author. Take ſaltpetre, one pound; armenian bole, two pounds; clean common ſand, three pounds. Mix all well together; then gather fruit of any kind that is not fully ripe, with the ſtalk to each; put theſe in, one by one, into a wide-mouthed glaſs, laying them in good order. Tie over the top with an oil-cloth, and carry them into a dry cellar, and ſet the whole upon a bed of the prepared matter of four inches thick in a box. Fill up the remainder of the box with the ſame preparation; and let it be four inches thick all over the top of the glaſs, and all round its ſides. Flowers are to be preſerved in the ſame ſort of glaſſes, and in the ſame manner; and they may be taken up after a whole year as plump and fair as when they were buried.

Flowers (artificial) of the Chineſe. See Tongtsao.

Flowers, in rhetoric, are figures or ornaments of diſcourſe, by the Latins called *floſculi*.

FLOWERING *of Bulbous* Plants. Theſe plants will grow and flower in water alone, without any earth, and make a very elegant appearance. We daily ſee this practiſed in ſingle roots; but there is a method of doing it with ſeveral roots in the ſame veſſel. Take a common ſmall garden-pot; ſtop the hole at the bottom with a cork, and lute in the cork with putty, that no water can get through; then fit a board to the top of the pot, and bore ſix or ſeven holes in it at equal diſtances, to place the bulbs in; and as many ſmaller ones near them to receive ſticks, which will ſerve ſupport up the flowers. Then fill up the pot with water to the board; and place tulips, jonquils, narciſſuſes, and the like plants in the root upon the holes, ſo that the bottom of the roots may touch the water: thus will they all flower early in the ſeaſon, and be much more beautiful than any pot of gathered flowers, and will laſt many weeks in their full perfection. After the ſeaſon of flowering is over, the roots will gradually ſhrink through the holes of the board, and get looſe into the water; but, inſtead of being ſpoiled there, they will ſoon increaſe in ſize; ſo that they cannot return through the holes, and will produce ſeveral off-ſets. It is natural to try from this the conſequence of keeping the roots under water during the whole time of their blowing; and in this way they have been found to ſucceed very well, and flower even ſtronger and more beautifully than when in the ground. They may thus alſo, with proper care in the degree of heat in the room, be kept flowering from before Chriſtmas till March or April. It is more agreeable to ſome to uſe glaſs-jars in this laſt method, inſtead of earthen pots. The bulbs ſucceed full as well in theſe: and there is this advantage, that the progreſs of the roots is ſeen all the while, and they are managed better as to the ſupply of water.

By repeated experiments in this way on dried bulbs, and on thoſe taken freſh out of the ground, the former have been found to ſucceed the beſt. For thoſe taken freſh out of the ground, being full of moiſture, will not ſo ſoon, upon changing their element, be nouriſhed fully by a new one; and the fibres which they had ſtruck in the ground always rot when put into the water, and new ones muſt be formed in their places; ſo that it requires more time for them to come to flowering. The bulbs themſelves will not rot in this manner; but they will never be ſo ſtrong as thoſe which were put into the water dry, which gradually fill themſelves with moiſture from it, and regularly plump up. The beſt method of managing the whole proceſs is this: place the bulbs at firſt only on the ſurface of the water; for thus they will ſtrike out their fibres moſt ſtrongly. When they have ſtood thus ſix weeks, pour in the water ſo high as to cover them entirely, and keep them thus till they have done flowering.

Ranunculus and anemone roots have been found to ſhoot up their ſtalks very well in this way; but the flowers are uſually

blafted, which feems to arife from want of free air. Pinks will flower very well in this manner; auriculas alfo may with care be brought to flower, but not ftrongly. Rofes, jeffamines, and honey-fuckles, may alfo be made to flower this way, and will thrive and fend out fuckers; the beft pieces to plant are fuckers cut off about three inches under ground, without any fibres. The fucculent plants may alfo be raifed this way; for inftance, the opuntia or Indian fig. If a fragment of a leaf of this plant be cut, and laid by to dry for a month till it is an abfolute fkin, as foon as it is put in this manner into water, it begins to plump up, and foon fends out fibrous roots, and produces new leaves as quickly as it would do in the ground.

This is the more fingular in this fort of plants, becaufe in their natural ftate in the ground they cannot bear much water. This method of growing in water is not peculiar to the bulbous-rooted ones, but others may even be raifed from feed by it. A bean or pea, fet in this manner, will grow up to its proper ftandard, and will flower and produce pods which will ripen their feed. The fmaller feeds may be alfo raifed in this manner, by the help of wool to fupport them.

No vegetable tranfplanted out of the earth into water will thrive kindly; but any plant, whether raifed from the root or feed in water, may be tranfplanted to the earth, and will fucceed very well. It may be poffible, therefore, from this method of raifing plants in water, to come at a better way than is ufually practifed of raifing fome roots in the earth which are fubject to rot there; fuch as anemonies, ranunculufes, and hyacinths. A bulb dropped by chance upon the ground will ftrike out both ftronger and more numerous fibres than thofe which are planted in the ufual way in the ground. On this principle, it may be proper to take out the earth of the bed where the bulbs are to ftand at the time of planting them, to fuch a depth as they are to be placed under it when fet for flowering. The bulbs are then to be fet in their places, on the furface of this low ground; and to ftand there till they have fhot out their fibres and their head: then the earth is to be added over them by degrees, till they are covered as high above the head as they are in the ufual manner of planting them: thus they would be preferved from the danger of rotting; and their fibres would be much ftronger, and confequently they would draw more nourifhment, and flower better, than in the common way. The common method of planting thefe roots renders them liable to be deftroyed by either extreme of a wet or a dry feafon. In the firft cafe, they immediately rot by the abundant moifture they receive; and, in the fecond, they become dry as a ftick, and mouldy; fo that they are infallibly rotted by the firft rain that falls afterwards.

FLUDD (Robert), a famous philofopher, born in 1574. He was fellow of the college of phyficians in London, and became a moft voluminous writer. He doted greatly on the wonders of chemiftry; was a zealous brother of the Roficrucian order; and his books, which are moftly in Latin, are as dark and myfterious in their language as in their matter. He died in 1637.

FLUID, an appellation given to all bodies whofe particles eafily yield to the leaft partial preffure, or force impreffed. For the *Laws and Properties of* FLUIDS, fee HYDROSTATICS. There are immenfe numbers of animalcules to be difcerned in different fluids by the microfcope. Of many remarkable kinds a defcription is given under the article ANIMALCULE.

Nervous FLUID. See ANATOMY, p. 203.

Elaftic FLUIDS. See AEROLOGY, AIR, FIXED *Air*, GAS, VAPOUR, &c.

FLUIDITY, that ftate or affection of bodies which denominates or renders them fluid; or that property by which they yield to the fmalleft force impreffed: in contradiftinction to folidity or firmnefs.

Fluidity is to be carefully diftinguifhed from liquidity or humidity, which latter implies wetting or adhering. Thus air, ether, mercury, and other melted metals, and even fmoke and flame itfelf, are fluid bodies, but not liquid ones; whilft water, beer, milk, urine, &c. are both fluids and liquids at the fame time.

The nature and caufes of fluidity have been varioufly affigned. The Gaffendifts, and ancient corpufcularians, require only three conditions as neceffary to it, viz. a fmallnefs and fmoothnefs of the particles of the body, vacuities interfperfed between them, and a fpherical figure. The Cartefians, and after them Dr. Hook, Mr. Boyle, &c. befide thefe circumftances, require alfo a certain internal or inteftine motion of the particles as chiefly contributing to fluidity. Thus Mr. Boyle, in his Hiftory of Fluidity, argues from various experiments: for example, a little dry powder of alabafter, or plafter of Paris, finely fifted, being put into a veffel over the fire, foon begins to boil like water; exhibiting all the motions and phenomena of a boiling liquor: it will tumble varioufly in great waves like that; will bear ftirring with a ftick or ladle like that, without refifting; and, if ftrongly ftirred near the fide of the veffel, its waves will apparently dafh againft it: yet it is all the while a dry parched powder.

The like is obferved in fand; a difh of which being fet on a drum-head, brifkly beaten by the fticks, or on the upper ftone of a mill, it in all refpects emulates the properties of a fluid body. Thus, a heavy body will immediately fink in it to the bottom, and a light one emerge to the top: each grain of fand has a conftant vibratory and dancing motion; and if a hole be made in the fide of the difh, the fand will fpin out like water.

The Cartefians bring many confiderations to prove, that the parts of fluids are in continual motion: as 1ft, The change of folids into fluids, e. g. ice into water, and *vice verfa*; the chief difference between the body in thofe two ftates confifting in this, that the parts, being fixed and at reft in the one, refift the touch; whereas in the other, being already in motion, they give way to the flighteft impulfe. 2dly, The effects of fluids, which commonly proceed from motion: fuch are the infinuation of fluids among the pores of bodies; the foftening and diffolving hard bodies; the actions of corrofive menftruums; &c.: add, that no folid can be brought to a ftate of fluidity, without the intervention of fome moving or moveable body, as fire, air, or water. Air, the fame gentlemen hold to be the firft fpring of thefe caufes of fluidity, it being this that gives motion to fire and water, though itfelf receives its motion and action from the ether, or fubtle medium.

But Boerhaave pleads ftrenuoufly that fire is the firft mover, and the caufe of all fluidity in other bodies, as air, water, &c.: without this, he fhews that the atmofphere itfelf would fix into one folid mafs. And in like manner, Dr. Black of Edinburgh mentions fluidity as an effect of heat. The different degrees of heat which are required to bring different bodies into a ftate of fluidity, he fuppofes may depend on fome particulars in the mixture and compofition of the bodies themfelves: which is rendered farther probable from confidering that the natural ftate of bodies in this refpect is changed by certain mixtures; thus, when two metals are compounded, the mixture is commonly more fufible than either of them feparately.

Newton's idea of the caufe of fluidity is different: he makes it to be the great principle of attraction. The various inteftine motion and agitation among the particles of fluid bodies he thinks is naturally accounted for, by fuppofing it a primary law of nature, that as all the particles of matter attract each other when within a certain diftance, fo at all greater diftances they avoid and fly from one another. For then though their common gravity, together with the preffure of other bodies upon them, may keep them together in a mafs, yet their continual

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endeavour to avoid one another fingly, and the adventitious impulfes of heat and light, or other external caufes, may make the particles of fluids continually move round about one another, and fo produce this quality.

As therefore the caufe of cohefion of the parts of folid bodies appears to be their mutual attraction; fo, on this principle, the chief caufe of fluidity feems to be a contrary motion impreffed on the particles of fluids; by which they avoid and fly from one another, as foon as they come at, and as long as they keep at, fuch a diftance from each other.

It is obferved alfo in all fluids, that the direction of their preffure againft the veffels which contain them is in lines perpendicular to the fides of fuch veffels; which property, being the neceffary refult of the fpherical figure of the particles of any fluid, fhews that the parts of all fluids are fo, or of a figure very nearly approaching to it.

FLUKE, or Flounder, in ichthyology. See Pleuronectes.

Fluke-*Worm*. See Fasciola.

Fluke *of an Anchor*, that part of it which penetrates the ground. See Anchor.

FLUMMERY, a wholefome fort of jelly made of oat-meal. The manner of preparing it is as follows: Put three large handfuls of finely-ground oat-meal to fteep, for 24 hours, in two quarts of fair water: then pour off the clear water, and put two quarts of frefh water to it: ftrain it through a fine hair-fieve, putting in two fpoonfuls of orange-flower water and a fpoonful of fugar: boil it till it is as thick as a hafty-pudding, ftirring it continually while it is boiling, that it may be very fmooth.

FLUOR, in phyfics, a fluid; or, more properly, the ftate of a body that was before hard or folid, but is now reduced by fufion or fire into a ftate of fluidity.

Fluor *Acid*. See Chemistry, p. 424.

Fluor-*Spar*, or *Blue-John*, called alfo fluxing fpars, vitrefcent or glafs fpars, are a genus of foffils compofed of calcareous earth united with an acid of a peculiar kind, of which an account is given under Chemistry. Thefe fubftances are little harder than common calcareous fpars, and do not ftrike fire with fteel; nor do they effervefce with acids either before or after calcination. When expofed to a ftrong fire, they crack and fplit in pieces, but do not melt without a violent heat. Engenftroom informs us, that all of them which he tried melted pretty eafily before the blow-pipe; but he was obliged to take great care to prevent them from flying away before they were thoroughly heated. Their fpecific gravity is from 3144 to 3175. Notwithftanding the difficulty with which they are fufed by themfelves, however, they melt very readily in conjunction with other earths; running into a corrofive glafs which diffolves the ftrongeft crucibles, unlefs fome quartz or fire-clay be mixed in their compofition. When gradually heated, they give a phofphorefcent light; but lofe this property when made red-hot. Thofe which are coloured, particularly the green ones, give the ftrongeft light. They melt eafily with borax, and next to that with the microcofmic falt, neither of them making any effervefcence. They diffolve in acids when boiling, particularly aqua-regia; and the folutions are precipitated by an alkali even though cold, but not fo completely. M. Magellan informs us, that he has frequently diffolved them in boiling vitriolic acid, in order to get that of fluor in an aerial ftate.

There are three fpecies. 1. The indurated fluor is folid, and of an indeterminate figure, of a dull texture, femitranfparent, and full of cracks in the rock. It is of a white colour. 2. Sparry fluor. This has nearly the figure of fpar; though, on clofe obfervation, it is found lefs regular; nothing but its gloffy furface giving it the refemblance of fpar. It is found of various colours, viz. white, blue, green, pale-green, violet, and yellow. 3. The cryftallized fluor is of four kinds. 1. Having an irregular figure, of a white, blue, or red colour. 2. Cryftallized in cubes, of a yellow or violet colour. 3. Of a polygonal fpherical figure, white or blue coloured. 4. Of an octoedral figure, clear and colourlefs.

The principal ufe of fluors is for fmelting ores, where they act as very powerful fluxes, and on this account are much valued. They are found in various countries, particularly Sweden, and fome other northern countries of Europe. From this quality of melting eafily in combination with other earthy matters, they have got the name of *fluors*. "The refemblance between the coloured fluors and the compofitions made of coloured glafs (fays Cronftedt) has perhaps contributed not only to the fluors being reckoned of the fame value with the coloured quartz cryftals, by fuch collectors as only mind colour and figure, but to their alfo obtaining a rank among the precious ftones in the apothecaries' and druggifts' fhops." Mr. Fabroni obferves, that this combination of calcareous earth with the fparry acid is almoft always tranfparent: it often cryftallizes in regular cubes, fometimes fingle from one line to two inches in diameter, and fometimes of an indeterminate figure. They are fometimes of a blue colour; others are purple like amethyfts; fome are of a brown colour, others opaque. M. Magellan fays, that fluors in general have this fingular property, that on being melted by the flame of the blow-pipe, together with gypfum, the lead refulting from both is all formed with facets on the outfide; but, if melted with terra ponderofa, its furface is quite round or fpherical.

M. Margraaf has made experiments in order to difcover the nature of thefe ftones. He afcertained the above-mentioned diftinctions between them and the gypfeous fpars; and therefore infers, that they are not compounded of vitriolic acid with calcareous earth. He obferved fingular appearances on mixing them with vitriolic and other acids, and fubjecting the mixtures to diftillation. Eight ounces of the powder of a green fluor, being mixed with an equal weight of pure oil of vitriol, and diftilled together with a graduated heat, yielded, after the watery part of the acid had paffed, a fine white fublimate, which arofe and adhered to the neck of the retort, and even paffed into the receiver. The firft parts of this fublimate which arofe, appeared like butter of antimony; and, like this butter, they melted by the heat of a live coal brought near the neck of the retort: but the parts which arofe towards the end of the operation, with the greateft degree of heat, could not be melted by that heat. The retort being broken, a refiduum was found weighing 12 ounces. Hence 4 ounces of oil of vitriol remained united with the fpar. The bottom of the retort was obferved to be pierced with holes. Laftly, the liquor which had paffed into the receiver and alfo the white fublimate, had, very fenfibly, a fulphureous fmell. The fublimate, triturated a long time in a mortar with hot diftilled water, diffolved, and paffed through a filter. To the filtrated liquor fome fixed alkali being added, a precipitate was formed; which, being well wafhed and dried, was readily melted by fire into a mafs refembling porcelain. The fame excellent and accurate chemift produced the fame effects upon this ftone, by fubftituting, inftead of the vitriolic acid, the nitrous, marine, phofphoric, or the concentrated acetous acids.

Fluor *Albus* or *Uterinus*, in medicine, a kind of vaginal flux in women, popularly called the *whites*. See Medicine.

FLUSHING, a handfome, ftrong, and confiderable town of the United Provinces, in Zealand, and in the ifland of Walcheren, with a good harbour, and a great foreign trade. It was put into the hands of queen Elizabeth as a fecurity for the money fhe advanced. It is one of the three places which Charles V. advifed Philip II. to preferve with care. It is four miles S. W. of Middleburg. Lon. 3. 35. E. Lat. 51. 29. N.

FLUTE, an inftrument of mufic, the fimpleft of all thofe

of the wind kind. It is played on by blowing it with the mouth; and the tones or notes are changed, by ſtopping properly the holes diſpoſed for that purpoſe along its ſide. This is a very ancient inſtrument. It was at firſt called the flute *à bec*, from *bec*, an old Gauliſh word ſignifying the beak of a bird or fowl, but more eſpecially of a cock; the term *flute à bec* muſt therefore ſignify the *beaked flute*; which appears very proper, on comparing it with the traverſe or German flute. The word *flute* is derived from *fluta*, the Latin for a lamprey or ſmall eel taken in the Sicilian ſeas, having ſeven holes immediately below the gills on each ſide, which is the preciſe number of thoſe in the front of the flute.

By Merſennus this inſtrument is called the *fiſtula dulcis*, *ſeu Anglica*; the loweſt note, according to him, for the treble flute, is *C fa ut*, and the compaſs of the inſtrument 15 notes. There is, however, a flute known by the name of the *concert-flute*, the loweſt note of which is F. Indeed, ever ſince the introduction of the flute into concerts, the loweſt note of the inſtrument, of what ſize ſoever it is, has been called F; when in truth its pitch is determinable only by its correſpondence in reſpect of acuteneſs or gravity with one or other of the chords in the *ſcala maxima* or great ſyſtem.

Beſides the true concert-flute, others of a leſs ſize were ſoon introduced into concerts of violins; in which caſe the method was to write the flute-part in a key correſpondent to its pitch. This practice was introduced in 1710 by one Woodcock, a celebrated performer on this inſtrument, and William Babell, organiſt of the church of All-hallows, Bread-ſtreet, London. They failed, however, in procuring for the flute a reception into concerts of various inſtruments; for which reaſon, one Thomas Staneſby, a very curious maker of flutes and other inſtruments of the like kind, about the year 1732, adverting to the ſcale of Merſennus, in which the loweſt note was C, invented what he called the *new ſyſtem*; in which, by making the flute of ſuch a ſize as to be a fifth above concert pitch, the loweſt note became *C ſol fa ut*. By this contrivance the neceſſity of tranſpoſing the flute-part was taken away; for a flute of this ſize, adjuſted to the ſyſtem above mentioned, became an octave to the violin. To further this invention of Staneſby, one Lewis Merci, an excellent performer on the flute, publiſhed, about the year 1735, ſix ſolos for this inſtrument, three of which are ſaid to be accommodated to Mr. Staneſby's new ſyſtem; but the German flute was now become a favourite inſtrument, and Staneſby's ingenuity failed of its effect. One great objection indeed lies againſt this inſtrument, which, however, equally affects all perforated pipes; namely, that they are never perfectly in tune, or cannot be made to play all their notes with equal exactneſs. The utmoſt that the makers of them can do is to tune them to ſome one key; as the hautboy to C, the German flute to D, and the Engliſh flute to F; and to effect this truly is a matter of no ſmall difficulty. The Engliſh flutes made by the younger Staneſby came the neareſt of any to perfection; but thoſe of Breſſan, though excellent in their tone, are all too flat in the upper octave. For theſe reaſons ſome are induced to think, that the utmoſt degree of proficiency on any of thoſe inſtruments is not worth the labour of attaining it.

German FLUTE, is an inſtrument entirely different from the common flute. It is not, like that, put into the mouth to be played; but the end is ſtopped with a tompion or plug, and the lower lip is applied to a hole about two inches and a half or three inches diſtant from the end. This inſtrument is uſually about a foot and a half long; rather bigger at the upper end than the lower; and perforated with holes, beſides that for the mouth, the loweſt of which is ſtopped and opened by the little finger's preſſing on a braſs or ſometimes a ſilver key, like thoſe in hautboys, baſſoons, &c. Its ſound is exceedingly ſweet and agreeable, and ſerves as a treble in a concert.

FLUTE, or FLUYT, is a kind of long veſſel, with flat ribs or floor-timbers, round behind, and ſwelled in the middle; ſerving chiefly for the carrying of proviſions in fleets or ſquadrons of ſhips; though it is often uſed in merchandize. The word *flute*, taken for a ſort of boat or veſſel, is derived, according to Borel, from the ancient *flotte*, a little boat. In the verbal proceſs of the miracles of St. Catherine of Sweden, in the 12th century, we read, *Unus equum ſuum una cum mercibus magni ponderis introduxit ſuper inſtrumentum de lignis fabricatum, vulgariter dictum fluta*: upon which the Bollandiſts obſerve, that in ſome copies it is read *flotta*, an inſtrument called by the Latins *ratis*; and that the word *flutta* or *flotta* aroſe from *flotten* or *vlotten* "to float."

FLUTES, or FLUTINGS, in architecture, are perpendicular channels or cavities cut along the ſhaft of a column or pilaſter. They are ſuppoſed to have been firſt introduced in imitation of the plaits of women's robes; and are therefore called by the Latins *ſtriges* and *rugæ*. The French call them *cannelures*, as being excavations; and we, *flutes* or *flutings*, as bearing ſome reſemblance to the muſical inſtrument ſo called. They are chiefly affected in the Ionic order, in which they had their firſt riſe; though they are alſo uſed in all the richer orders, as the Corinthian and Compoſite; but rarely in the Doric, and ſcarce ever in the Tuſcan.

FLUX, in medicine, an extraordinary iſſue or evacuation of ſome humour. Fluxes are variouſly denominated according to circumſtances; as uterine flux, ſalival flux, &c. The flux of the belly is of two kinds; the *diarrhœa*; and the *dyſentery*, or *bloody flux*. Theſe are properly treated of under MEDICINE.

FLUX, in hydrography, a regular periodical motion of the ſea, happening twice in 24 hours; wherein the water is raiſed and driven violently againſt the ſhores. The flux or flow is one of the motions of the tide; the other, whereby the water ſinks and retires, is called the reflux or ebb. There is alſo a kind of reſt or ceſſation of about half an hour between the flux and reflux; during which time the water is at its greateſt height, called *high-water*. The flux is made by the motion of the water of the ſea from the equator towards the poles; which, in its progreſs, ſtriking againſt the coaſts in its way, and meeting with oppoſition from them, ſwells, and where it can find paſſage, as in flats, rivers, &c. riſes up and runs into the land. This motion follows, in ſome meaſure, the courſe of the moon; as it loſes or comes later every day by about three quarters of an hour, or, more preciſely, by 48 minutes; and by ſo much is the motion of the moon ſlower than that of the ſun. It is always higheſt and greateſt in full moons, particularly thoſe of the equinoxes. In ſome parts, as at Mount St. Michael, it riſes 80 or 90 feet, though in the open ſea it never riſes above a foot or two; and in ſome places, as about the Morea, there is no flux at all. It runs up ſome rivers above 120 miles. Up the river Thames it only goes 80, viz. near to Kingſton in Surry. Above London bridge the water flows four hours and ebbs eight; and below the bridge, flows five hours and ebbs ſeven.

FLUX, in metallurgy, is ſometimes uſed ſynonymouſly with *fuſion*. For inſtance, an ore, or other matter, is ſaid to be in liquid flux, when it is completely fuſed. But the word *flux* is generally uſed to ſignify certain ſaline matters, which facilitate the fuſion of ores, and other ſubſtances which are difficultly fuſible in eſſays and in the reductions of ores.

Under the article BLOW-PIPE, we have very fully deſcribed the method of vitrifying any ſmall portion of mineral ſubſtance, by which the proceſs of aſſaying may be very quickly performed. We ſhall here continue the ſubject by deſcribing the *fluxes* recommended by Mr. Bergman.

1. The *phosphoric acid*, or rather the microcosmic salt, as it is called, which contains that acid partly saturated with mineral, partly with volatile alkali, and loaded besides with much water and a gelatinous fat. This salt, when exposed to the flame, boils and foams violently, with a continual crackling noise, until the water and volatile alkali have flown off; afterwards it is less agitated, sending forth something like black scoriæ arising from the burned gelatinous part: these, however, are soon dispelled, and exhibit a pellucid sphericle encompassed by a beautiful green cloud, which is occasioned by the deflagration of the phosphorus, arising from the extrication of the acid by means of the inflammable matter. The clear globule which remains, upon the removal of the flame, continues longer soft than that formed by borax; and therefore is more fit for the addition of the matter to be dissolved. The volatile alkali is expelled by the fire; therefore an excess of acid remains in what is left behind, which readily attracts moisture in a cool place. 2. The *mineral alkali*, or sal sodæ, when put upon charcoal, melts superficially, penetrates the charcoal with a crackling noise, and then disappears. In the spoon it yields a permanent and pellucid sphericle, as long as it is kept fluid by the blue apex of the flame; but, when the heat is diminished, it becomes opaque, and assumes a milky colour. It attacks several earthy matters, particularly those of the siliceous kind, but cannot be employed on charcoal. 3. *Crystallized borax*, exposed to the flame urged by the blow-pipe or charcoal, first becomes opaque, white, and excessively swelled, with various protuberances, or branches proceeding out from it. When the water is expelled, it easily collects itself into a mass, which, when well fused, yields a transparent sphericle, retaining its transparency even after cooling. If calcined borax be employed, the clear sphericle is obtained the sooner.

Having provided every thing necessary, the following directions are next to be attended to. 1. A common tallow candle, not too thick, is generally preferable to a wax candle or to a lamp. The snuff must not be cut too short, as the wick should bend towards the object. 2. The weaker exterior flame must first be directed upon the object, until its effects be discovered; after which the interior flame must be applied. 3. We must observe with attention whether the matter decrepitates, splits, swells, vegetates, boils, &c. 4. The piece exposed to the flame should scarce ever exceed the size of a pepper-corn; but ought always to be large enough to be taken up by the forceps represented fig. 10. in plate 49, vol. 1. When the particle is too large, part of it must necessarily be without the focus; and thus cool both the support and the part immersed in the blue apex *n*, fig. 6. It may, however, be broken into pieces sufficiently small by means of the hammer fig. 8, upon the steel plate fig. 9; any of the small parts being prevented from flying off by the ring H. 5. A small piece should be added separately to each of the fluxes: concerning which it must be observed, whether it dissolves wholly, or only in part; whether this be effected with or without effervescence, quickly or slowly; whether the mass be divided into a powder, or gradually and externally corroded; with what colour the glass is tinged; and whether it becomes opaque, or remains pellucid.

Having given these directions, Mr. Bergman proceeds next to consider the subjects proper to be examined by the blow-pipe. These he divides into four classes: 1. Saline; 2. Earthy; 3. Inflammable; and, 4. Metallic. As the subject, however, is treated at considerable length, we shall refer the reader to Mr. Bergman's writings, and confine ourselves in this place to what he has advanced concerning the last of these subjects, namely *metallic* substances.

The *perfect metals* lose no part of their phlogiston even in the most intense heat; and, when calcined in the moist way, recover their former nature by simple fusion. The imperfect metals are calcined by fire, especially by the exterior flame; and then, in order to their being reduced, indispensably require the contact of a phlogistic substance. With respect to fusibility, the two extremes are mercury and platina; the former being scarce ever seen in a solid form, and the latter almost as difficult of fusion. The metals, therefore, may be ranked in this order, according to their degrees of fusibility. 1. Mercury. 2. Tin. 3. Bismuth. 4. Lead. 5. Zinc. 6. Antimony. 7. Silver. 8. Gold. 9. Arsenic. 10. Cobalt. 11. Nickel. 12. Iron. 13. Manganese. 14. Platina. The two last do not yield to the blow-pipe, and indeed forged iron does not melt without difficulty; but cast iron perfectly.

Metals in fusion affect a globular form, and easily roll off the charcoal, especially when of the size of a grain of pepper. Smaller pieces, therefore, ought either to be used, or they should rest in hollows made in the charcoal. On their first melting they assume a polished surface, an appearance always retained by the perfect metals; but the imperfect are soon obscured by a pellicle formed of the calx of the metal. The colours communicated by the calces vary, according to the nature of the metal from which the calx is produced. Some of the calces easily recover their metallic form by simple exposure to flame upon the charcoal; others are reduced in this way with more difficulty; and some not at all. The reduced calces of the volatile metals immediately fly off from the charcoal. In the spoon they exhibit nitrous globules; but it is very difficult to prevent them from being first dissipated by the blast.

The metals are taken up by the fluxes: but as mineral alkali yields an opaque spherule, it is not to be made use of. Globules of borax dissolve and melt any metallic calx; and, unless too much loaded with it, appear pellucid and coloured. A piece of metal calcined in the flux produces the same effect, but more slowly. A portion of the calx generally recovers its metallic form, and floats on the melted matter like one or more excrescences. In proportion as the globule is more loaded it extends itself more on the charcoal, and at length cannot assume a globular form; for the metallic additament augments the attraction for phlogiston. The *calces* of the perfect metals are reduced by borax in the spoon, and adhere to it at the point of contact, and there only. The microcosmic salt acts like borax, but does not reduce the metals. It attacks them more powerfully on account of its acid nature; at the same time it preserves the spherical form, and therefore is adapted in a peculiar manner to the investigation of metals.

The tinge communicated to the flux frequently varies, being different in the fused and in the cooled globule; for some of the dissolved calces, while fused, show no colour, but acquire one while cooling; but others, on the contrary, have a much more intense colour while in the state of fluidity. Should the transparency be injured by too great a concentration of colour, the globule, on compressing it with the forceps, or drawing it out into a thread, will exhibit a thin and transparent mass: but, if the opacity arises from supersaturation, more flux must be added; and as the fluxes attract the metals with unequal forces, the latter precipitate one another.

Metals when mineralized by acids have the properties of metallic salts; when mineralized by fixed air, they possess the properties of calces, that volatile substance being easily expelled without any effervescence; but when combined with sulphur they possess properties of a peculiar kind. They may then be melted, or even calcined upon the charcoal, as also in a golden or silver spoon. The volatile parts are distinguished by the smell or smoke; the fixed residua, by the particles reduced or precipitated upon iron, or from the tinge of the fluxes.

Gold in its metallic state fuses on the charcoal, and is the only metal which remains unchanged. It may be deprived of its phlogiston in the moist way by solution in aqua regia; but, to

calcine it alſo by fire, we muſt purſue the following method: To a globule of microcoſmic ſalt let there be added a ſmall piece of ſolid gold, of gold leaf, purple mineral, or, which is beſt of all, of the cryſtalline ſalt formed by a ſolution of gold in aqua regia containing ſea-ſalt. Let this again be melted, and added while yet ſoft to turbith mineral, which will immediately grow red on the contact. The fuſion being afterwards repeated, a vehement efferveſcence ariſes; and, when this is conſiderably diminiſhed, let the blaſt be ſtopped for a few moments, again begun, and ſo continued until almoſt all the bubbles diſappear. After this the ſpherule, on cooling, aſſumes a ruby colour; but if this does not happen, let it be juſt made ſoft by the exterior flame, and, upon hardening, this tinge generally appears. Should the proceſs fail at firſt, owing to ſome minute circumſtances which cannot be deſcribed, it will ſucceed on the ſecond or third trial. The ruby-coloured globule, when compreſſed by the forceps while hot, frequently becomes blue; by ſudden fuſion it generally aſſumes an opal colour, which by refraction appears blue, and by reflection of a brown red. If further urged by the fire, it loſes all colour, and appears like water; but the redneſs may be re-produced ſeveral times by the addition of turbith mineral. The flux is reddened in the ſame manner by the addition of tin inſtead of turbith; but it has a yellowiſh hue, and more eaſily becomes opaque; while the redneſs communicated by turbith mineral has a purple tinge, and quite reſembles a ruby. Borax produces the ſame phenomena, but more rarely; and in all caſes the ſlighteſt variation in the management of the fire will make the experiment fail entirely.

The ruby colour may alſo be produced by copper; whence a doubt may ariſe, whether it be the gold or the remains of the copper that produces this effect. Mr. Bergman thinks it probable that both may contribute towards it, eſpecially as copper is often found to contain gold.

This precious metal cannot directly be mineralized by ſulphur; but by the medium of iron is ſometimes formed into a *golden pyrites*. Here, however, the quantity of gold is ſo ſmall, that a globule can ſcarcely be extracted from it by the blow-pipe.

Grains of native *platina* are not affected by the blow-pipe, either alone or mixed with fluxes; which, however, are frequently tinged green by it: but platina, precipitated from aqua regia by vegetable or volatile alkali, is reduced by microcoſmic ſalt to a ſmall malleable globule. Our author has been able to unite ſeven or eight of theſe into a malleable maſs; but more of them produced only a brittle one. Platina ſcarcely loſes all its iron, unleſs reduced to very thin fuſion.

Silver in its metallic ſtate eaſily melts, and reſiſts calcination. Silver leaf faſtened by means of the breath, or a ſolution of borax, may eaſily be fixed on it by the flame, and through the glaſs it appears of a gold colour; but care muſt be taken not to crack the glaſs. Calcined ſilver precipitated from nitrous acid by fixed alkali is eaſily reduced. The microcoſmic acid diſſolves it ſpeedily and copiouſly; but, on cooling, it becomes opaque and of a whitiſh yellow, which is alſo ſometimes the caſe with leaf-ſilver. Copper is diſcovered by a green colour, and ſometimes by that of a ruby, unleſs we chooſe rather to impute that to gold. The globules can ſcarcely be obtained pellucid, unleſs the quantity of calx be very ſmall; but a longer fuſion is neceſſary to produce an opacity with borax. The globule, loaded with diſſolved ſilver during the time of its fuſion in the ſpoon, covers a piece of copper with ſilver, and becomes itſelf of a pellucid green: antimony quickly takes away the milky opacity of diſſolved luna cornea, and ſeparates the ſilver in diſtinct grains. Cobalt and moſt of the other metals likewiſe precipitate ſilver on the ſame principles as in the moiſt way, viz. by a double elective attraction. The metal to be diſſolved remains untouched as long as it retains its phlogiſton; but is taken up, when a ſufficient quantity of that principle has ſhifted to the precipitate and reduced it. This metal, when mineralized by marine and vitriolic acids, yields a natural luna cornea, which produces a number of ſmall metallic globules on the charcoal: it diſſolves in microcoſmic ſalt, and renders it opaque; and is reduced, partially at leaſt, by borax. Sulphurated ſilver, called alſo the glaſſy ore of that metal, fuſed upon charcoal, eaſily parts with the ſulphur it contains; ſo that a poliſhed globule is often produced, which, if neceſſary, may be depurated by borax. The ſilver may alſo be precipitated by the addition of copper, iron, or mangeneſe. When arſenic makes part of the compound, as in the red ore of arſenic, it muſt firſt be freed from the ſulphur by gentle roaſting, and finally entirely depurated by borax. It decrepitates in the fire at firſt.

Copper, together with ſulphur and arſenic mixed with ſilver, called the white ore of ſilver, yields a regulus having the ſame alloy.

Galena, which is an ore of lead containing ſulphur and ſilver, is to be freed in the ſame manner from the ſulphur; after which the lead is gradually diſſipated by alternately melting and cooling, or is ſeparated in a cupel from the galena by means of the flame. Our author has not been able to precipitate the ſilver diſtinct from the lead, but the whole maſs becomes malleable; and the ſame is true of tin, but the maſs becomes more brittle.

Pure *mercury* flies off from the charcoal with a moderate heat, the fixed heterogeneous matters remaining behind. When calcined, it is eaſily reduced and diſſipated, and the fluxes take it up with efferveſcence; but it is ſoon totally driven off. When mineralized by ſulphur, it liquefies upon the charcoal, burns with a blue flame, ſmokes, and gradually diſappears; but, on expoſing cinnabar to the fire on a poliſhed piece of copper, the mercurial globules are fixed upon it all round.

Lead in its metallic ſtate readily melts, and continues to retain a metallic ſplendour for ſome time. By a more intenſe heat it boils and ſmokes, forming a yellow circle upon the charcoal. It communicates a yellow colour, ſcarce viſible, to the fluxes; and when the quantity is large, the globule, on cooling, contracts more or leſs of a white opacity. It is not precipitated by copper when diſſolved; nor do the metals precipitate it from ſulphur in the ſame order as from the acids. When united to aerial acid, it grows red on the firſt touch of the flame: when the heat is increaſed, it melts, and is reduced to a multitude of ſmall globules. When united with phoſphoric acid, it melts, and yields an opaque globule, but is not reduced. With fluxes it ſhows the ſame appearances as calx of lead. When mineralized by ſulphur, lead eaſily liquefies, and, being gradually deprived of the volatile part, yields a diſtinct regulus, unleſs too much loaded with iron. It may be precipitated by iron and copper.

A ſmall piece of *copper*, either ſolid or foliated, ſometimes communicates a ruby colour to fluxes, eſpecially when aſſiſted by tin or turbith mineral. If the copper be a little more or further calcined, it produces a green pellucid globule, the tinge of which grows weaker by cooling, and even verges towards a blue. By long fuſion with borax, the colour is totally deſtroyed upon charcoal, but ſcarcely in the ſpoon. When once deſtroyed, this colour can ſcarcely be re-produced by nitre; but it remains fixed with microcoſmic ſalt. If the calx or metal to be calcined be added in conſiderable quantity during fuſion, it acquires an opaque red on cooling, though it appears green while pellucid and fuſed; but by a ſtill larger quantity it contracts an opacity even while in fuſion, and, upon cooling, a metallic ſplendour. Even when the quantity of copper is ſo ſmall as ſcarcely to tinge the flux, a viſible pellicle is precipitated upon a piece of poliſhed iron added to it during ſtrong fuſion, and the globule in its turn takes the colour of poliſhed iron; and

in this way the ſmalleſt portions of copper may be diſcovered. The globule made green by copper, when fuſed in the ſpoon with a ſmall portion of tin, yields a ſpherule of the latter mixed with copper, very hard and brittle: in this caſe the precipitated metal pervades the whole of the maſs, and does not adhere to the ſurface. Cobalt precipitates the calx of copper diſſolved in the ſpoon by a flux, in a metallic form, and imparts its own colour to glaſs, which nickel cannot do. Zinc alſo precipitates it ſeparately, and rarely upon its own ſurface, as we can ſcarcely avoid melting it. When *mineralized* by the aerial acid, copper grows black on the firſt contact of the flame, and melts in the ſpoon; on the charcoal, the lower part, which touches the ſupport, is reduced. With a ſuperabundance of marine acid, it tinges the flame of a beautiful colour; but with a ſmall quantity ſhows no appearance of the metal in that way. Thus the beautiful cryſtals of Saxony, which are cubic, and of a deep green, do not tinge the flame, though they impart a pellucid greenneſs to microcoſmic ſalt. An opaque redneſs is eaſily obtained with borax; but Mr. Bergman could not produce this colour with microcoſmic ſalt. Copper ſimply ſulphurated, when cautiouſly and gently roaſted by the exterior flame, yields at laſt, by fuſion, a regulus ſurrounded with a ſulphurated cruſt. The maſs roaſted with borax ſeparates the regulus more quickly.

If a ſmall quantity of iron happens to be preſent, the piece to be examined muſt firſt be roaſted; after which it muſt be diſſolved in borax, and tin added to precipitate the copper. The regulus may alſo be obtained by ſufficient calcination and fuſion, even without any precipitant, unleſs the ore be very poor. When the pyrites contain copper, even in the quantity of the one-hundredth part of their weight, its preſence may be detected by theſe experiments: Let a grain of pyrites, of the ſize of a flax-ſeed, be roaſted, but not ſo much as to expel all the ſulphur; let it then be diſſolved by borax, a poliſhed rod of iron added, and the fuſion continued until the ſurface when cooled loſes all ſp endour. As much borax is required as will make the whole of the ſize of a grain of hemp ſeed. Slow fuſion is injurious, and the precipitation is alſo retarded by too great tenuity; but this may be corrected by the addition of a little lime. Too much calcination is alſo inconvenient; for by this the globule forms ſlowly, is ſomewhat ſpread, becomes knotty when warm, corrodes the charcoal, deſtroys the iron, and the copper does not precipitate diſtinctly. This defect is corrected by a ſmall portion of crude ore. When the globule is properly melted, according to the directions already given, it ought to be thrown into cold water immediately on ſtopping the blaſt, in order to break it ſuddenly. If the copper contained in it be leſs than one-hundredth part, one end of the wire only has a cupreous appearance, but otherwiſe the whole.

Dr. Gahn has another method of examining the ores of copper; namely, by expoſing a grain of the ore, well freed from ſulphur by calcination, to the action of the flame driven ſuddenly upon it by intervals. At thoſe inſtants a cupreous ſplendour appears on the ſurface, which otherwiſe is black; and this ſplendour is more quickly produced in proportion as the ore is poorer. The flame is tinged green by cupreous pyrites on roaſting.

Forged iron is calcined, but can ſcarcely be melted; and liquefies on being fuſed. It cannot be melted by borax, though it may by microcoſmic ſalt; and then it becomes brittle. Calcined iron becomes magnetic by being heated on the charcoal, but melts in the ſpoon. The fluxes become green by this metal; but in proportion as the phlogiſton is more deficient they grow more of a browniſh yellow. On cooling, the tinge is much weakened; and, when originally weak, vaniſhes entirely. By too much ſaturation the globule becomes black and opaque. The ſulphureous pyrites may be collected into a globule by fuſion, and is firſt ſurrounded by a blue flame; but as the metal is eaſily calcined, and changes into black ſcoriæ, neither by itſelf nor with fluxes does it exhibit a regulus. It grows red on roaſting.

Tin eaſily melts before the blow-pipe, and is calcined. The fluxes diſſolve the calx ſparingly; and, when ſaturated, contract a milky opacity. Some ſmall particles of this metal diſſolved in any flux may be diſtinctly precipitated upon iron. Cryſtallized ore of tin, urged by fire upon the charcoal, yields its metal in a reguline ſtate.

Biſmuth preſents nearly the ſame appearances as lead; the calx is reduced on the coal, and fuſed in the ſpoon. The calx, diſſolved in microcoſmic ſalt, yields a browniſh yellow globule, which grows more pale upon cooling, at the ſame time loſing ſome of its tranſparency. Too much calx renders the matter perfectly opaque. Borax produces a ſimilar maſs in the ſpoon; but on the coal a grey one, which can ſcarcely be freed from bubbles. On fuſion the glaſs ſmokes and forms a cloud about it. Biſmuth is eaſily precipitated by copper and iron. *Sulphurated biſmuth* is eaſily fuſed, exhibiting a blue flame and ſulphureous ſmell. Cobalt, when added, by means of the ſulphur, enters the globule; but the ſcoria ſoon ſwells into diſtinct partitions; which, when further urged by fire, throw out globules of biſmuth. Sulphurated biſmuth, by the addition of borax, may be diſtinctly precipitated by iron or manganeſe.

Regulus of *nickel* when melted is calcined, but more ſlowly than other metals. The calx imparts an hyacinthine colour to fluxes, which grows yellow on cooling, and by long continued fire may be deſtroyed. If the calx of nickel be contaminated by ochre of iron, the latter is firſt diſſolved. Nickel diſſolved is precipitated on iron, or even on copper; an evident proof that it does not originate from either of theſe metals. Sulphurated nickel is no where found without iron and arſenic: the regulus is obtained by roaſting, and fuſing with borax, though it ſtill remains mixed with ſome other metals.

Regulus of *arſenic* takes fire by a ſudden heat, and not only depoſits a white ſmoke on charcoal, but diffuſes the ſame all around. The calx ſmokes with a ſmell of garlic, but does not burn. The fluxes grow yellow, without growing opaque, on adding a proper quantity of calx, which is diſpelled by a long continuance of the heat. This ſemimetal is precipitated in a metallic form by iron and copper, but not by gold. Yellow arſenic liquefies, ſmokes, and totally evaporates: when heated by the external flame, ſo as neither to liquefy nor ſmoke, it grows red and yellow again upon cooling. When it only begins to melt, it acquires a red colour, which remains after cooling. Realgar liquefies more eaſily, and is beſides totally diſſipated.

Regulus of *cobalt* melts, and may partly be depurated by borax, as the iron is firſt calcined and taken up. The ſmalleſt portion of the calx tinges the flux of a deep blue colour, which appears of a violet by refraction, and this colour is very fixed in the fire. Cobalt is precipitated upon iron from the blue globule, but not upon copper. When calx of iron is mixed with that of cobalt in a flux, the former is diſſolved. This ſemimetal takes up about one third of its weight of ſulphur in fuſion, after which it can hardly be melted again. It is precipitated by iron, copper, and ſeveral other metals. The common ore yields an impure regulus by roaſting. The green cobalt, examined by our author, tinges the microcoſmic ſalt blue; but at the ſame time ſhows red ſpots indicating copper.

Zinc expoſed to the blow-pipe melts, takes fire, ſending forth a beautiful blueiſh green flame, which however is ſoon extinguiſhed by a lanuginous calx; but if the reguline nucleus included in this lanuginous matter (commonly called flowers of zinc) be urged by the flame, it will be now and then inflamed,

and as it were explode and fly about. With borax it froths, and at firſt tinges the flame. It continually diminiſhes, and the flux ſpreads upon the charcoal; but in fuſed microcoſmic ſalt it not only froths, but ſends forth flaſhes with a crackling noiſe. Too great heat makes it explode with the emiſſion of ignited particles. The white calx, or flowers, expoſed to the flame on charcoal, becomes yellowiſh, and has a kind of ſplendour which vaniſhes when the flame ceaſes. It remains fixed, and cannot be melted. The fluxes are ſcarcely tinged; but, when ſaturated by fuſion, grow opaque and white on cooling. Clouds are formed round the globules of a nature ſimilar to that of the metallic calx. Diſſolved zinc is not precipitated by any other metal. When mineralized by aerial acid, it has the ſame properties as calcined zinc. In the pſeudo-galena ſulphur and iron are preſent. Theſe generally, on the charcoal, ſmell of ſulphur, melt, and tinge the flame more or leſs, depoſiting a cloud all around. Thoſe which have no matrix are tinged by thoſe which contain iron, and acquire by ſaturation a white opaque colour, verging to brown or black, according to the variety of compoſition.

Regulus of *antimony*, fuſed and ignited on the charcoal, affords a beautiful object; for if the blaſt of air be ſuddenly ſtopped, a thick white ſmoke riſes perpendicularly, while the lower part round the globule is condenſed into cryſtalline ſpiculæ, ſimilar to thoſe called *Argentine flowers*. The calx tinges fluxes of an hyacinthine colour; but on fuſion ſmokes, and is eaſily diſſipated, eſpecially on the charcoal, though it alſo depoſits a cloud on it. The diſſolved metal may be precipitated by iron and copper, but not by gold. Crude antimony liquefies on the charcoal, ſpreads, ſmokes, penetrates it, and at laſt diſappears entirely, except a ring which it leaves behind.

Regulus of *manganeſe* ſcarcely yields to the flame. The black calx tinges the fluxes of a blueiſh colour; borax, unleſs ſaturated, communicates more of a yellow colour. The colour may be gradually diſſolved altogether by the interior flame, and again re-produced by a ſmall particle of nitre, or the exterior flame alone. Combined with aerial acid, it is of a white colour, which changes by ignition to black. In other reſpects it ſhows the ſame experiments as the black calx.

Fixed alkalis, nitre, borax, tartar, and common ſalt, are the ſaline matters of which fluxes are generally compoſed. But the word *flux* is more particularly applied to mixtures of different proportions of only nitre and tartar; and theſe fluxes are called by particular names, according to the proportions of theſe ingredients, as in the following inſtances:

White FLUX is made with equal parts of nitre and of tartar detonated together, by which they are alkaliſed. The reſiduum of this detonation is an alkali compoſed of the alkalis of the nitre and of the tartar, both which are abſolutely of the ſame nature. As the proportion of nitre in this mixture is more than is ſufficient to conſume entirely all the inflammable matter of the tartar, the alkali remaining after the detonation is perfectly white, and is therefore called *white flux*; and as this alkali is made very quickly, it is alſo called *extemporaneous alkali*. When a ſmall quantity only of white flux is made, as a few ounces for inſtance, ſome nitre always remains undecompoſed, and a little of the inflammable principle of the tartar, which gives a red or even a black colour to ſome part of the flux: but this does not happen when a large quantity of white flux is made; becauſe then the heat is much greater. This ſmall quantity of undecompoſed nitre and tartar which remains in white flux is not hurtful in moſt of the metallic fuſions in which this flux is employed: but if the flux be required perfectly pure, it might eaſily be diſengaged from thoſe extraneous matters by a long and ſtrong calcination, without fuſion.

Crude FLUX. By crude flux is meant the mixture of nitre and tartar in any proportions, without detonation. Thus the mixture of equal parts of the two ſalts uſed in the preparation of the white flux, or the mixture of one part of nitre and two parts of tartar for the preparation of the black flux, are each of them a crude flux before detonation. It has alſo been called *white flux*, from its colour: but this might occaſion it to be confounded with the white flux above deſcribed. The name, therefore, of crude flux is more convenient. Crude flux is detonated and alkaliſed during the reductions and fuſions in which it is employed; and is then changed into white or black flux, according to the proportions of which it is compoſed. This detonation produces good effects in theſe fuſions and reductions, if the ſwelling and extravaſation of the detonating matters be guarded againſt. Accordingly, crude flux may be employed ſucceſsfully in many operations; as, for inſtance, in the ordinary operation for procuring the regulus of antimony.

Black FLUX. Black flux is produced from the mixture of two parts of tartar and one part of nitre detonated together. As the quantity of nitre which enters into the compoſition of this flux is not ſufficient to conſume all the inflammable matter of the tartar, the alkali which remains after the detonation contains much black matter, of the nature of coal, and is therefore called *black flux*. This flux is deſignedly ſo prepared, that it ſhall contain a certain quantity of inflammable matter; for it is thereby capable, not only of facilitating the fuſion of metallic earths like the white flux, but alſo of reviving theſe metals by its phlogiſton. From this property it is alſo called *reducing flux*; the black flux, therefore, or crude flux made with ſuch proportions of the ingredients as to be convertible into black flux, ought always to be uſed when metallic matters are at once to be fuſed and reduced, or even when deſtructive metals are to be fuſed, as theſe require a continual ſupply of phlogiſton to prevent their calcination.

FLUXIONS;

A METHOD of calculation invented by Sir Iſaac Newton.

In this branch of mathematics, magnitudes of every kind are ſuppoſed to be generated by motion; a line by the motion of a point, a ſurface by the motion of a line, and a ſolid by the motion of a ſurface.

The fluxion of any magnitude at any point is its velocity at that point, and is therefore eſtimated by the ſpace which it would deſcribe uniformly in a given time by the velocity at that point.

The firſt letters in the alphabet are uſed to repreſent invariable quantities; the letters x, y, z, variable quantities; and the ſame letters with points over them $\dot{x}, \dot{y}, \dot{z}$, repreſent their fluxions.

Plate 28. fig. 1. Let $AB = a$, and $BF = x$; Ff, the fluxion of BF, $= \dot{x}$; then Fe, the fluxion of AF, $= a\dot{x}$.

If the rectangle be ſuppoſed generated by the uniform motion of FG towards CD, at the ſame time that HG moves uniformly towards AD, the point G keeping always on the diagonal, the lines FG, HG will flow uniformly; for while Bf receives the increment Ff, and HB the increment HK, FG will deſcribe the ſpace bg, and HG the ſpace bg, and they will deſcribe

equal ſpaces in equal ſucceſſive times. But the parallelogram will flow with an accelerated motion; for while F flows to f, and H to K, it is increaſed by the gnomon KGf; but while F and H flow through the equal ſpaces fm, KL, it is increaſed by the gnomon Lgm greater than KGf.

The fluxion of the parallelogram BHGF is meaſured by the two parallelograms KG and Gf; for, ſuppoſing it to be divided into two parts BGF, BGH, the ſpace deſcribed by FG moving uniformly with velocity at F is Gf, and by HG is KG; therefore the ſpace that would be deſcribed by the lines HG and GF, if they proceeded with the velocities at H and F, are KG and Gf; therefore the fluxion of the parallelogram is meaſured by theſe areas.

If the ſides of a parallelogram be x and y, their fluxions will be $\dot{x}\,\dot{y}$; and the fluxion of the parallelogram $y\dot{x} + x\dot{y}$: and if $x = y$, that is, if the figure be a ſquare, the fluxion of x^2 will be $2x\dot{x}$.

Fig. 2. Let the triangle ABC be deſcribed by the uniform motion of DE from A towards B, the point E moving in the line DF, ſo as always to touch the lines AC, CB; while D moves from A to F, DE is uniformly increaſed, and the increaſe of the triangle is uniformly accelerated. When DE is in the poſition FC, it is a maximum. As D moves from F to B, the line FC decreaſes, and the triangle increaſes, but with a motion uniformly retarded.

Fig. 3. If the ſemicircle AFB be generated by the uniform motion of CD from A towards B, while C moves from A to G, the line CD will increaſe, but with a retarded motion; the circumference alſo increaſes with a retarded motion, and the circular ſpace increaſes with an accelerated motion, but not uniformly, the degrees of acceleration growing leſs as CD approaches to the poſition GF. When C moves from G to B, it decreaſes with a motion continually accelerated, the circumference increaſes with a motion continually accelerated, and the area increaſes with a motion continually retarded, and more quickly retarded as CD approaches to B.

The fluxion of a quantity which decreaſes is to be conſidered as negative.

When a quantity does not flow uniformly, its fluxion may be repreſented by a variable quantity, or a line of a variable length; the fluxion of ſuch a line is called the *ſecond fluxion of the quantity whoſe fluxion that line is:* and if it be variable, a third fluxion may be deduced from it, and higher orders from theſe in the ſame manner: the ſecond fluxion is repreſented by two points, as $\ddot{x}$.

DIRECT METHOD.

Any flowing Quantity being given, to find its Fluxion.

Rule I. To find the fluxion of any power of a quantity, multiply the fluxion of the root by the exponent of the power, and the product by a power of the ſame root leſs by unity than the given exponent.

The fluxion of x^3 is $3x^2\dot{x}$, of x^n, $nx^{n-1}\dot{x}$; for the root of x^n is x, whoſe fluxion is $\dot{x}$; which multiplied by the exponent n, and by a power of x leſs by unity than n, gives the above fluxion.

If x receive the increment a, it becomes $x + a$; raiſe both to the power of n, and x^n becomes $x^n + nx^{n-1}a + \frac{n.\overline{n-1}}{2}x^{n-2}a^2 +$, &c.; $\therefore$ the increment of x : inc. x^n :: $a : nx^{n-1}a + n.\frac{n-1}{2}x^{n-2}a^2 +$ &c. but the increment $nx^{n-1}a + n.\frac{n-1}{2}x^{n-2}a^2 +$ &c. is not generated by an uniform velocity, and therefore cannot meaſure a fluxion. The ſmaller a is, the nearer will this latter increment be to the meaſure of the fluxion; therefore the limiting ratio of $a : nx^{n-1}a + n.\frac{n-1}{2}x^{n-2}a^2 +$ &c. is the ratio of the fluxion of x to the fluxion of x^n. The limiting ratio is $a : nx^{n-1}a$, or $1 : nx^{n-1}$. If therefore $\dot{x}$ is the fluxion of x, $nx^{n-1}\dot{x}$ is that of x^n; the fluxion of $\overline{a^2+z^2}|^{\frac{3}{2}}$ is $\frac{3}{2} \times 2z\dot{z} \times \overline{a^2+z^2}|^{\frac{1}{2}}$; for put $x = a^2 + z^2$, we have $\dot{x} = 2z\dot{z}$; and the fluxion of $x^{\frac{3}{2}}$, which is equal to the propoſed fluent, is $\frac{3}{2}x^{\frac{1}{2}}\dot{x}$; for which ſubſtituting the values of z and $\dot{z}$, we have the above fluxion.

Rule II. To find the fluxion of the product of ſeveral variable quantities multiplied together, multiply the fluxion of each by the product of the reſt of the quantities, and the ſum of the products thus ariſing will be the fluxion ſought.

Thus the fluxion of xy, is $\dot{x}y + y\dot{x}$; that of xyz is $xy\dot{z} + xz\dot{y} + yz\dot{x}$; and that of $xyzu$, is $xyz\dot{u} + xyu\dot{z} + xzu\dot{y} + yzu\dot{x}$.

Rule III. To find the fluxion of a fraction. From the fluxion of the numerator multiplied by the denominator, ſubtract the fluxion of the denominator multiplied by the numerator, and divide the remainder by the ſquare of the denominator.

Thus, the fluxion of $\frac{x}{y}$ is $\frac{y\dot{x} - x\dot{y}}{y^2}$; that of $\frac{x}{x+y}$ is $\frac{\dot{x} \times \overline{x+y} - \overline{\dot{x}+\dot{y}} \times x}{\overline{x+y}|^2} = \frac{y\dot{x} - x\dot{y}}{\overline{x+y}|^2}$.

Rule IV. In complex caſes, let the particulars be collected from the ſimple rules, and combined together.

The fluxion of $\frac{x^2y^2}{z}$ is $\frac{\overline{2x^2y\dot{y}+2y^2x\dot{x}} \times z - x^2y^2\dot{z}}{z^2}$; for the fluxion of x^2 is $2x\dot{x}$, and of y^2 is $2y\dot{y}$, therefore the fluxion of x^2y^2 is $2x^2y\dot{y} + 2y^2x\dot{x}$; which multiplied by z, and ſubtracting from it the fluxion of the denominator z, multiplied by the numerator, and dividing the whole by the ſquare of the denominator, gives the above fluxion.

Rule V. The ſecond fluxion is derived from the firſt, in the ſame manner as the firſt from the flowing quantity.

Thus the fluxion of x^3 is $3x^2\dot{x}$; its ſecond, $6x\dot{x}^2 + 3x^2\ddot{x}$; and ſo on: but if $\dot{x}$ be invariable, $\ddot{x} = 0$, and the ſecond fluxion of $x^3 = 6x\dot{x}^2$.

Prob. I. *To determine maxima and minima.*

When a quantity increaſes, its fluxion is poſitive; when it decreaſes, it is negative; therefore when it is juſt betwixt increaſing and decreaſing, its fluxion is $= 0$.

Rule. Find the fluxion, make it $= 0$, whence an equation will reſult giving an anſwer to the queſtion.

Examp. To determine the dimentions of a cylindric meaſure ABCD, (fig. 4.) open at the top, which ſhall contain a given quantity under the leaſt internal ſuperficies poſſible.

Let the diameter AB $= x$, and the altitude AC $= y$; moreover, let p (3,14159. &c.) denote the periphery of the circle whoſe diameter is unity, and let c be the given content of the cylinder. Then $1 : p :: x : (px)$ the circumference of the baſe; which, multiplied by the altitude y, gives pxy for the concave ſuperficies of the cylinder. In like manner, the area of the baſe, by multiplying the ſame expreſſion into $\frac{1}{4}$ of the diameter x, $= \frac{px^2}{4}$; which drawn into the altitude y, gives $\frac{px^2y}{4}$ for the ſolid content of the cylinder; which being made $= c$, the concave ſurface $pxy = \frac{4c}{x}$, and conſequently the whole ſur-

face $= \frac{4c}{x} + \frac{px^2}{4}$: whofe fluxion, $-\frac{4c\dot{x}}{x^2} + \frac{px\dot{x}}{2}$ being put $=0$, $px^3 = 8c$ ∴ $x = 2\sqrt[3]{\frac{c}{p}}$ Since $px^3 = 8c$, and $px^2y = 4c$, $x = 2y$; whence y is alfo known, and the diameter of the bafe muft be juft double of the altitude.

Fig. 7. To find the longeft and fhorteft ordinates of any curve, DEF, whofe equation is known.

Make AC the abfciffa x, and CE the ordinate $=y$; take a value y in terms of x, and find its fluxion; which making $=0$, an equation will refult whofe roots give the value of x when y is a maximum or a minimum.

To determine when it is a maximum and when a minimum, take the value of y, when x is a little more than the root of the equation fo found, and it may be perceived whether it increafes or decreafes.

Prob. II. *To draw a tangent to any curve.*

Fig. 5. When the abfciffa CS of a curve moves uniformly from A to B, the motion of the curve will be retarded if it be concave, and accelerated if convex towards AB; for a ftraight line TC is defcribed by an uniform motion, and the fluxion of the curve at any point is the fame as the fluxion of the tangent, becaufe it would defcribe the tangent if it continued to move equally from that point. Now if S*s* or C*e* be the fluxion of the bafe, C*d* will be the fluxion of the tangent, and *de* of the ordinate. And becaufe the triangles TSC, C*ed*, are equiangular, *de* : *ce* :: CS : ST, wherefore,

Rule. Find a fourth proportional to the fluxion of the ordinate valued in terms of the abfciffa, the fluxion of the abfciffa, and the ordinate, and it determines the line ST, which is called the *fub-tangent*, and TC joined is a tangent to the curve.

Examp. To draw a right line CT, (fig. 6.) to touch a given circle BCA in a point C.

Let CS be perpendicular to the diameter AB, and put AB $= a$, BS $= x$, and SC $= y$: then, by the property of the circle, y^2 (CS^2) $=$ BS × AS ($= x \times \overline{a-x}$) $= ax - x^2$; ∴ $2y\dot{y} = a\dot{x} - 2x\dot{x}$; and $\frac{\dot{x}}{\dot{y}} = \frac{2y}{a-2x} = \frac{y}{\frac{1}{2}a - x}$; ∴ $\frac{y\dot{x}}{\dot{y}} = \frac{y^2}{\frac{1}{2}a - x} =$ the fubtangent ST. Whence (O being the centre) OS ($\frac{1}{2}a - x$) : CS (y) :: CS (y) : ST; which we alfo know from other principles.

Prob. III. *To determine points of contrary flexure in curves.*

Fig. 7. Suppofing C to move uniformly from A to B, the curve DEF will be convex towards A B when the fluxion of the ordinate increafes, and concave when it decreafes; therefore at the point where it ceafes to be convex and begins to be concave, CE will have no fecond fluxion. Therefore,

Rule. Find the fecond fluxion of the ordinate in terms of the abfciffa, and make it $=0$; and the value of the abfciffa from this equation determines the point of contrary flexure.

Ex. Let the nature of the curve ARS be defined by the equation $ay = a^{\frac{3}{2}}x^{\frac{1}{2}} + x^2$. Then $\dot{y} = \frac{1}{2}a^{\frac{3}{2}}x^{-\frac{1}{2}}\dot{x} + 2x\dot{x}$: whofe fluxion, or that of $\frac{1}{2}a^{\frac{3}{2}}x^{-\frac{1}{2}} + 2x$ (becaufe a and $\dot{x}$ are conftant) muft be equal to nothing; that is, $-\frac{1}{4}a^{\frac{3}{2}}x^{-\frac{3}{2}}\dot{x} + 2\dot{x} = 0$: Whence $a^{\frac{3}{2}}x^{-\frac{3}{2}} = 8$, $a^{\frac{3}{2}} = 8x^{\frac{3}{2}}$. ∴ $64x^3 = a^3$, and $x = \frac{1}{4}a = $ AF; therefore FG ($= \frac{a^{\frac{3}{2}}x^{\frac{1}{2}} + xx}{a}$) $= \frac{9}{16}a$: From which the pofition of the point G is given.

Prob. IV. *To find the radii of curvature.*

The curvature of a circle is uniform in every point, that of every other curve continually varying: and it is meafured at any point by that of a circle whofe radius is of fuch a length as to coincide with it in curvature in that point.

All curves that have the fame tangent have the fame firft fluxion, becaufe the fluxion of a curve and its tangent are the fame. If it moved uniformly on from the point of contact, it would defcribe the tangent. The deflection from the tangent is owing to the acceleration or retardation of its motion, which is meafured by its fecond fluxion: and confequently two curves which have not only the fame tangent, but the fame curvature at the point of contact, will have both their firft and fecond fluxions equal. It is eafily proved from thence, that the radius of curvature is $= \frac{\dot{z}^3}{-\dot{x}\ddot{y}}$, x, y, and z reprefenting the abfciffa, ordinate and curve refpectively.

Examp. Let the given curve be the common parabola, whofe equation is $y = a^{\frac{1}{2}}x^{\frac{1}{2}}$: Then will $\dot{y} = \frac{a^{\frac{1}{2}}\dot{x}}{2x^{\frac{1}{2}}}$, and (making $\dot{x}$ conftant) $\ddot{y} = \frac{-a^{\frac{1}{2}}\dot{x}^2}{4x^{\frac{3}{2}}}$: Whence $\dot{z}$ ($\sqrt{\dot{x}^2 + \dot{y}^2}$) $= \frac{\dot{x}}{2}\sqrt{\frac{4x+a}{x}}$, and the radius of curvature $\left(\frac{\dot{z}^3}{-\dot{x}\ddot{y}}\right) = \frac{\overline{a+4x}|^{\frac{3}{2}}}{2\sqrt{a}}$: Which at the vertex, where $x=0$, will be $=\frac{1}{2}a$.

INVERSE METHOD.

From a given fluxion to find a fluent.

This is done by tracing back the fteps of the direct method. The fluxion of x is $\dot{x}$; and therefore the fluent of $\dot{x}$ is x: but as there is no direct method of finding fluents univerfally, this branch of the art is imperfect. We can affign the fluxion of every fluent; but we cannot affign the fluent of a fluxion, unlefs it be fuch a one as may be produced by fome rule in the direct method from a known fluent.

General Rule. Divide by the fluxion of the root, add unity to the exponent of the power, and divide by the exponent fo increafed.

For, dividing the fluxion $nx^{n-1}\dot{x}$ by $\dot{x}$ (the fluxion of the root x) it becomes nx^{n-1}; and, adding 1 to the exponent (n-1), we have nx^n; which, divided by n, gives x^n, the true fluent of $nx^{n-1}\dot{x}$.

Hence (by the fame rule) the

Fluent of $3x^2\dot{x}$ will be $= x^3$;

That of $8x^2\dot{x} = \frac{8x^3}{3}$;

That of $y^{\frac{1}{2}}\dot{y} = \frac{2}{3}y^{\frac{3}{2}}$

Sometimes the fluent fo found requires to be corrected. The fluxion of x is $\dot{x}$, and the fluxion of $a+x$ is alfo $\dot{x}$; becaufe a is invariable, and has therefore no fluxion.

When the fluent of $\dot{x}$ is required, it muft be determined, from the nature of the problem, whether any invariable part, as a, muft be added to the variable part x.

Prob. I. *To find the area of any curve.*

Rule. Multiply the ordinate by the fluxion of the abfciffa, and the product gives the fluxion of the figure, whofe fluent is the area of the figure.

Examp. 1. Fig. 8. Let the curve ARMH be the common parabola. Let u represent the area, and $\dot{u}$ its fluxion, $y = a^{\frac{1}{2}}x^{\frac{1}{2}}$; therefore $\dot{u} = \mathrm{R}m\mathrm{HB}\ (= y\dot{x}) = a^{\frac{1}{2}}x^{\frac{1}{2}}\dot{x}$: whence $u = \frac{2}{3} \times a^{\frac{1}{2}}x^{\frac{3}{2}} = \frac{2}{3}a^{\frac{1}{2}}x^{\frac{1}{2}} \times x = \frac{2}{3}yx = \frac{2}{3} \times \mathrm{AB} \times \mathrm{BR}$: hence a parabola is $\frac{2}{3}$ of a rectangle of the same base and altitude.

Examp. 2. Let the proposed curve CSDR (fig. 9) be of such a nature, that (supposing AB unity) the sum of the areas CSTBC and CDGBC answering to any two proposed abscissas AT and AG, shall be equal to the area CRNBC, whose corresponding abscissa AN is equal to AT × AG, the product of the measures of the two former abscissas.

First, in order to determine the equation of the curve (which must be known before the area can be found), let the ordinates GD and NR move parallel to themselves towards HF; and then having put GD $= y$, NR $= z$, AT $= a$, AG $= s$, and AN $= u$, the fluxion of the area CDGB will be represented by $y\dot{s}$, and that of the area CRNB by $z\dot{u}$: which two expressions must, by the nature of the problem, be equal to each other; because the latter area CRNB exceeds the former CDGB by the area CSTB, which is here considered as a constant quantity: and it is evident, that two expressions, that differ only by a constant quantity, must always have equal fluxions.

Since, therefore, $y\dot{s}$ is $= z\dot{u}$, and $u = as$, by hypothesis, it follows, that $\dot{u} = a\dot{s}$, and that the first equation (by substituting for $\dot{u}$) will become $y\dot{s} = az\dot{s}$, or $y = az$, or lastly $ys = zas$, that is, GD × AG = NR × AN: therefore, GD : NR : : AN : AG; whence it appears, that every ordinate of the curve is reciprocally as its corresponding abscissa.

Now, to find the area of the curve so determined, put AB $= 1$, BC $= b$, and BG $= x$: then, since AG $(1 + x)$: AB (1) : : BC (b) : GD (y) we have $y = \frac{b}{1+x}$, consequently $\dot{u}\ (= y\dot{x}) = \frac{b\dot{x}}{1+x} = b \times \dot{x} - x\dot{x} + x^2\dot{x} - x^3\dot{x} +$, &c. Whence BGDC, the area itself will be $= b \times x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5}$, &c. which was to be found.

Hence it appears, that as these areas have the same properties as logarithms, this series gives an easy method of computing logarithms; and the fluent may be found by means of a table of logarithms; and every fluxion whose fluent agrees with any known logarithmic expression, may be found the same way.

Prob. 2. *To determine the length of curves.*

Fig. 5. Because Cde is a right-angle triangle, Cd^2 = Ce^2 + de^2; wherefore the fluxions of the abscissa and ordinate being squared, their sum gives the square of the fluxion of the curve; whose root being extracted, and the fluent taken, gives the length of the curve.

Examp. To find the length of a circle from its tangent. Make the radius AO (fig. 5.) $= a$, the tangent of AC $= t$, and its secant $= s$, the curve $= z$, and its fluxion $= \dot{z}$; because the triangles OTC, OCS, are similar, OT : OC : : OC : : OS; whence OS $= \frac{a^2}{s}$, and SA $= a - \frac{a^2}{s} = a - \frac{a^2}{\sqrt{a^2+t^2}}$; whose fluxion is $\frac{a^2t\dot{t}}{\overline{a^2+t^2}|^{\frac{3}{2}}}$: and because the triangles OTC, dCe are similar, TC $(= t)$: TO $(= \sqrt{a^2+t^2})$: : Ce $= \left(\frac{a^2t\dot{t}}{\overline{a^2+t^2}|^{\frac{3}{2}}}\right)$: Cd $= \frac{a^2\dot{t}}{a^2+t^2}$ = fluxion of the curve. Now by converting this into an infinite series we have the fluxion of the curve $= \dot{t} - \frac{t^2\dot{t}}{a^2} + \frac{t^4\dot{t}}{a^4} - \frac{t^6\dot{t}}{a^6}$, &c. and consequently $z = t - \frac{t^3}{3a^2} + \frac{t^5}{5a^4} - \frac{t^7}{7a^6} + \frac{t^9}{9a^8}$, &c. = AR.

Other series may be deduced from the versed sine and secant; and these are of use for finding fluents which cannot be expressed in finite terms.

Prob. 3. *To find the contents of a solid.*

Let the surface of the generating plane be multiplied by the space it passes through in any time, the product will give a solid which is the fluxion of the solid required: the surface must therefore be computed in terms of x, which represents the line or axis on which it moves, and by its motion on which the fluxion is to be measured, and the fluent found will give the contents of the solid.

Examp. Let it be proposed to find the content of a cone ABC, fig. 10.

Put the given altitude (AD) of the cone $= a$, and the semidiameter (BD) of its base $= b$, the solid $= s$, its fluxion $= \dot{s}$, and the area of a circle, whose radius is unity, $= p$: then the distance (AF) of the circle EG, from the vertex A, being denoted by x, we have, by similar triangles, as $a : b : : x$: EF (y) $= \frac{bx}{a}$. Whence in this case, $\dot{s}\ (= py^2\dot{x}) = \frac{pb^2x^2\dot{x}}{a^2}$; and consequently $s = \frac{pb^2x^3}{3a^2}$; which, when $x = a$ (= AD) gives $\frac{pb^2a}{3}$ $(= p \times \mathrm{BD}^2 \times \frac{1}{3}\mathrm{AD})$ for the content of the whole cone ABC: which appears from hence to be just $\frac{1}{3}$ of a cylinder of the same base and altitude.

Prob. 4. *To compute the surface of any solid body.*

The fluxion of the surface of the solid is equal to the periphery of the surface, by whose motion the solid is generated, multiplied by its velocity on the edge of the solid, and the computation is made as in the foregoing.

Examp. Let it be proposed to determine the convex superficies of a cone ABC, fig. 11.

Then the semidiameter of the base (BD or CD) being put $= b$, the slanting line or hypothenuse AC $= c$, and FH (parallel to DC) $= y$, AG $= z$, the surface $= w$, its fluxion $= \dot{w}$, and $p =$ the periphery of a circle whose diameter is unity, we shall, from the similarity of the triangles ADC and Hmb, have $b : c : : \dot{y}\ (mb) : \dot{x}\ (\mathrm{H}b) = \frac{c\dot{y}}{b}$: whence $\dot{w}\ (2py\dot{z}) = \frac{2pcy\dot{y}}{b}$; and consequently $w = \frac{pcy^2}{b}$. This, when $y = b$, becomes $= pcb = p \times \mathrm{DC} \times \mathrm{AC} =$ the convex superficies of the whole cone ABC: which therefore is equal to a rectangle under half the circumference of the base and the slanting line.

The method of fluxions is also applied to find the centres of gravities, and oscillation of different bodies; to determine the paths described by projectiles and bodies acted on by central forces, the resistances to motions in resisting medii, the attractions of bodies under different forms, the direction of wind which has the greatest effect on an engine, and to solve many other curious and useful problems. The writers whose works may be consulted with advantage on this subject, are Newton, Leibnitz, Cotes, Bernouilli, Clairaut, D'Alembert, Euler, Hayes, Rowe, Paccassi, Maclaurin, Lyons, Simpson and Emerson.

FLY, in zoology, a large order of infects, the diftinguifhing characteriftic of which is, that their wings are tranfparent. By this they are diftinguifhed from beetles, butterflies, grafshoppers, &c. Flies are fubdivided into thofe which have four, and thofe which have two wings. Of thofe with four wings there are feveral genera or kinds; as the ant, apis, ichneumon, &c. See APIS, FORMICA, &c. Of thofe with two wings, there are likewife feveral kinds, as the gad fly, gnat, &c. See GAD-*Fly*, &c. Thofe who defire a more particular account of the anatomy, generation, ftructure, and manifold fubdivifions of flies, may confult Reaumur's Hiftory of Infects, tom. 4. See alfo the article ENTOMOLOGY.

Houfe FLY. See MUSCA.

FLY, in mechanics, a crofs with leaden weights at its ends; or elfe a heavy wheel, at right angles to the axis of a windlafs, jack, or the like; by means of which, the force of the power, whatever it be, is not only preferved, but equally diftributed in all parts of the revolution of the machine. See MECHANICS.

FLIES *for Fifhing*. See FISHING-*Fly*.

Vegetable FLY, a very curious natural production, chiefly found in the Weft Indies. "Excepting that it has no wings, it refembles the drone both in fize and colour more than any other Britifh infect. In the month of May it buries itfelf in the earth, and begins to vegetate. By the latter end of July, the tree is arrived at its full growth, and refembles a coral branch; and is about three inches high, and bears feveral little pods, which dropping off become worms, and from thence flies, like the Britifh caterpillar." Such was the account originally given of this extraordinary production. But feveral boxes of thefe flies having been fent to Dr. Hill for examination, his report was this: "There is in Martinique a fungus of the clavaria kind, different in fpecies from thofe hitherto known. It produces foboles from its fides; I call it therefore *clavaria fobolifera*. It grows on putrid animal bodies, as our *fungus ex pede equino* from the dead horfe's hoof. The cicada is common in Martinique, and in its nympha ftate, in which the old authors call it *tettigometra*: it buries itfelf under dead leaves to wait its change; and when the feafon is unfavourable, many perifh. The feeds of the clavaria find a proper bed in this dead infect, and grow. The tettigometra is among the cicadæ in the Britifh mufeum; the clavaria is juft now known. This is the fact, and all the fact; though the untaught inhabitants fuppofe a fly to vegetate, and though there is a Spanifh drawing of the plants growing into a trifoliate tree, and it has been figured with the creature flying with this tree upon its back." Edwards has taken notice of this extraordinary production in his Gleanings of Natural Hiftory, from which the figures in plate 30 are taken.

FLY-*Boat*, or *Flight*, a large flat-bottomed Dutch veffel, whofe burden is generally from 600 to 1200 tons. It is diftinguifhed by a ftern remarkably high, refembling a Gothic turret, and by very broad buttocks below.

FLY-*Catcher*, in zoology. See MUSCICAPA.

FLY-*Trap*, in botany, a newly difcovered fenfitive plant. See DIONÆA *Mufcipula*.

FLY-*Tree*, in natural hiftory, a name given by the common people of America to a tree, whofe leaves, they fay, at a certain time of the year produce *flies*. On examining thefe leaves about the middle of fummer, the time at which the flies ufe to be produced, there are found on them a fort of bags of a tough matter, of about the fize of a filbert, and of a dufky greenifh colour. On opening one of thefe bags with a knife, there is ufually found a fingle full grown fly, of the gnat kind, and a number of fmall worms, which in a day or two more have wings and fly away in the form of their parent. The tree is of the mulberry kind, and its leaves are ufually very largely ftocked with thefe infect-bags; and the generality of them are found to contain the infects in their worm-ftate: when they become winged, they foon make their way out. The bags begin to appear when the leaves are young, and afterwards grow with them; but they never rumple the leaf or injure its fhape. They are of the kind of leaf-galls, and partake in all refpects, except fize, of a fpecies we find frequently on the large maple, or, as it is called, the *fycamore*.

FLYERS, in architecture, fuch ftairs as go ftraight, and do not wind round, nor have the fteps made tapering; but the fore and back part of each ftair and the ends refpectively parallel to one another: fo that if one flight do not carry you to your defigned height, there is a broad half fpace; and then you fly again, with fteps every where of the fame breadth and length as before.

FLYERS, the performers in a celebrated exhibition among the Mexicans, which was made on certain great feftivals, and is thus defcribed by Clavigero in his hiftory of that people. "They fought in the woods for an extremely lofty tree, which, after ftripping it of its branches and bark, they brought to the city, and fixed in the centre of fome large fquare. They cafed the point of the tree in a wooden cylinder, which, on account of fome refemblance in its fhape, the Spaniards called a *mortar*. From this cylinder hung four ftrong ropes, which ferved to fupport a fquare frame. In the fpace between the cylinder and the frame, they fixed four other thick ropes, which they twifted as many times round the tree as there were revolutions to be made by the flyers. Thefe ropes were drawn through four holes, made in the middle of the four planks of which the frame confifted. The four principal flyers, difguifed like eagles, herons, and other birds, mounted the tree with great ability, by means of a rope which was laced about it from the ground up to the frame; from the frame they mounted one at a time fucceffively upon the cylinder, and after having danced there a little, they tied themfelves round with the ends of the ropes, which were drawn through the holes of the frame, and launching with a fpring from it, began their flight with their wings expanded. The action of their bodies put the frame and the cylinder in motion; the frame by its revolutions gradually untwifted the cords by which the flyers fwung; fo that as the ropes lengthenened, they made fo much the greater circles in their flight. Whilft thefe four were flying, a fifth danced upon the cylinder, beating a little drum, or waving a flag, without the fmalleft apprehenfion of the danger he was in of being precipitated from fuch a height. The others who were upon the frame (there having been 10 or 12 perfons generally who mounted), as foon as they faw the flyers in their laft revolution, precipitated themfelves by the fame ropes, in order to reach the ground at the fame time, amidft the acclamations of the populace. Thofe who precipitated themfelves in this manner by the ropes, that they might make a ftill greater difplay of their agility, frequently paffed from one rope to another, at that part where, on account of the little diftance between them, it was poffible for them to do fo. The moft effential point of this performance confifted in proportioning fo juftly the height of the tree with the length of the ropes, that the flyers fhould reach the ground with 13 revolutions, to reprefent by fuch number their century of 52 years, compofed in the manner we have already mentioned. This celebrated diverfion is ftill in ufe in that kingdom; but no particular attention is paid to the number of the revolutions or the flyers; as the frame is commonly fexagonal or octagonal, and the flyers 6 or 8 in number. In fome places they put a rail round the frame, to prevent accidents, which were frequent after the conqueft; as the Indians became much given to drinking, and ufed to mount the tree when intoxicated with wine or brandy, and were unable to keep their ftation on fo great a height, which was ufually 60 feet." See plate 27.

FLYING, the progreffive motion of a bird, or other winged animal, in the air. The parts of birds chiefly concerned in flying are the wings and tail: by the firft, the bird fuftains and wafts himfelf along; and by the fecond, he is affifted in afcending and defcending, to keep his body poifed and upright, and to obviate the vacillations thereof. It is by the largenefs and ftrength of the pectoral mufcles, that birds are fo well difpofed for quick, ftrong, and continued flying. Thefe mufcles, which in men are fcarce a 70th part of the mufcles of the body, in birds exceed and outweigh all the other mufcles taken together; upon which Mr. Willughby makes this reflection, that if it be poffible for man to fly, his wings muft be fo contrived and adapted, that he may make ufe of his legs, and not his arms, in managing them. The tail, Meffrs. Willughby, Ray, and many others, imagine to be principally employed in fteering and turning the body in the air, as a rudder: but Borelli has put it beyond all doubt, that this is the leaft ufe of it, which is chiefly to affift the bird in its afcent and defcent in the air, and to obviate the vacillations of the body and wings: for, as to turning to this or that fide, it is performed by the wings and inclination of the body, and but very little by the help of the tail. The flying of a bird, in effect, is quite a different thing from the rowing of a veffel. Birds do not vibrate their wings towards the tail, as oars are ftruck towards the ftern, but waft them downwards; nor does the tail of the bird cut the air at right angles, as the rudder does the water; but is difpofed horizontally, and preferves the fame fituation what way foever the bird turns. In effect, as a veffel is turned about on its centre of gravity to the right, by a brifk application of the oars to the left; fo a bird, in beating the air with its right wing alone towards the tail, will turn its fore-part to the left. Thus pigeons, changing their courfe to the left, would labour with their right wing, keeping the other almoft at reft. Birds with long necks alter their courfe by the inclinations of the head and neck; which altering the courfe of gravity, the bird will proceed in a new direction.

The manner of flying is thus: The bird firft bends his legs, and fprings with a violent leap from the ground; then opens and expands the joints of his wings, fo as to make a right line perpendicular to the fides of his body: thus the wings, with all the feathers therein, conftitute one continued lamina. Being now raifed a little above the horizon, and vibrating the wings with great force and velocity perpendicularly againft the fubject air, that fluid refifts thofe fucceffions, both from its natural inactivity and elafticity, by means of which the whole body of the bird is elevated. The refiftance the air makes to the withdrawing of the wings, and confequently the progrefs of the bird, will be fo much the greater, as the waft or ftroke of the fan of the wing is longer: but as the force of the wing is continually diminifhed by this refiftance, when the two forces continue to be *in equilibrio*, the bird will remain fufpended in the fame place; for the bird only afcends fo long as the arch of air the wing defcribes makes a refiftance equal to the excefs of the fpecific gravity of the bird above the air. If the air, therefore, be fo rare as to give way with the fame velocity as it is ftruck withal, there will be no refiftance, and confequently the bird can never mount. Birds never fly upwards in a perpendicular line, but always in a parabola. In a direct afcent, the natural and artificial tendency would oppofe and deftroy each other, fo that the progrefs would be very flow. In a direct defcent they would aid one another, fo that the fall would be too precipitate.

Artificial FLYING, that kind of flight above the earth which has been attempted by men, with the affiftance of machines. The art of flying has been attempted by feveral perfons in all ages. The Leucadians, out of fuperftition, are reported to have had a cuftom of precipitating a man from a high cliff into the fea, firft fixing feathers, varioufly expanded, round his body, in order to break the fall. Friar Bacon, who lived near 500 years ago, not only affirms the art of flying poffible, but affures us, that he himfelf knew how to make an engine wherein a man fitting might be able to convey himfelf through the air like a bird; and further adds, that there was then one who had tried it with fuccefs. The fecret confifted in a couple of thin hollow copper-globes, exhaufted of air; which, being much lighter than air, would fuftain a chair whereon a perfon might fit. Fa. Francifco Lano, in his *Prodromo*, propofes the fame thing, as his own thought. He computes, that a round veffel of plate-glafs, 14 feet in diameter, weighing three ounces the fquare foot, will only weigh 1848 ounces; whereas a quantity of air of the fame bulk will weigh $2155\frac{2}{3}$ ounces; fo that the globe will not only be fuftained in the air, but will carry with it a weight of $373\frac{2}{3}$ ounces; and by increafing the bulk of the globe, without increafing the thicknefs of the metal, he adds, a veffel might be made to carry a much greater weight. But the fallacy is obvious: a globe of the dimenfions he defcribes, Dr. Hook fhows, would not fuftain the preffure of the air, but be crufhed inwards. Befides, in whatever ratio the bulk of the globe were increafed, in the fame muft the thicknefs of the metal, and confequently the weight, be increafed: fo that there would be no advantage in fuch an augmentation. See AEROSTATION. The fame author defcribes an engine for flying, invented by the Sieur Befnier, a fmith of Sable, in the county of Main. *Vide Philofoph. Collect.* N° 1. The philofophers of king Charles the fecond's reign were mightily bufied about this art. The famous bifhop Wilkins was fo confident of fuccefs in it, that he fays, he does not queftion but in future ages it will be as ufual to hear a man call for his wings, when he is going a journey, as it is now to call for his boots.

FLYING-*Bridge*. See BRIDGE.

FLYING *Fifh*, a name given by the Englifh writers to feveral fpecies of fifh, which, by means of their long fins, have a method of keeping themfelves out of water a confiderable time. See EXOCOETUS.

FLYING-*Pinion*, is part of a clock, having a fly or fan whereby to gather air, and fo bridle the rapidity of the clock's motion, when the weight defcends in the ftriking part.

FO, or FOE; an idol of the Chinefe. He was originally worfhipped in the Indies, and tranfported from thence to China, together with the fables with which the Indian books were filled. He is faid to have performed wonderful things, which the Chinefe have defcribed in feveral volumes, and reprefented by cuts.

FO-*Kien*. See FOKIEN.

FOAL, or COLT and FILLY; the young of the horfe kind. The word *colt*, among dealers, is underftood of the male, as *filly* is of the female. See HORSE.

FOCUS, in geometry and conic fections, is applied to certain points in the parabola, ellipfis, and hyperbola, where the rays reflected from all parts of thefe curves concur and meet. See CONIC *Sections*.

FOCUS, in optics, a point in which any number of rays, after being reflected or refracted, meet.

FODDER, any kind of meat for horfes or other cattle. In fome places, hay and ftraw, mingled together, is peculiarly denominated *fodder*.

FODDER, in the civil law, is ufed for a prerogative that the prince has, to be provided with corn and other meat for his horfes by the fubjects, in his warlike expeditions.

FODDER, in mining, a meafure containing 22 hundred and an half weight, though in London it is no more than 20 hundred weight.

FŒNUGREEK, in botany. See TRIGONELLA.

FŒNUS NAUTICUM. Where money was lent to a mer-

chant, to be employed in a beneficial trade, with condition to be repaid, with extraordinary intereſt, in caſe ſuch voyage was ſafely performed, the agreement was ſometimes called *fœnus nauticum*, ſometimes *uſura maritima*. But, as this gave an opening for uſurious and gaming contracts, 19 Geo. II. c. 37. enacts, that all money lent on bottomry, or at *reſpondentia*, on veſſels bound to or from the Eaſt Indies, ſhall be expreſsly lent only upon the ſhip or merchandiſe: the lender to have the benefit of ſalvage, &c. *Blackſt. Com.* II. 459. *Mol. de Jur. Mar.* 361.

FŒSIUS (Anutius), a very learned and celebrated phyſician of the faculty of Paris, born at Mentz in 1528. He tranſlated into Latin the whole works of Hippocrates, judiciouſly correcting the Greek text as he went along; and compoſed a kind of dictionary from him, intitled *Oeconomia Hippocratis*. He tranſlated, beſide, the Commentaries of Galen upon the ſecond book of Hippocrates; and was the author of ſome other works. After practiſing phyſic a long time with great ſucceſs and reputation, at Lorrain and other places, he died in the year 1596.

FŒTOR, in medicine, ſtinking or fetid effluvia ariſing from the body or any diſeaſed part.

FŒTUS, the young of all viviparous animals whilſt in the womb, and of oviparous animals before being hatched: the name is transferred by botaniſts to the *embryos of vegetables*. Strictly, the name is applied to the young after it is perfectly formed; till which time it is more properly called *Embryo*. See Midwifery. In the human fœtus there exiſt ſeveral peculiarities not to be found in the adult: 1. The arteries of the navel-ſtring, which are continuations of the hypograſtics, are after the birth ſhrivelled up, and form the lower umbilical ligament. 2. The veins of the navel-ſtring are formed by the union of all the venous branches in the placenta, and, paſſing into the abdomen, become the falciform ligament of the liver. 3. The lungs, before being inflated with air, are compact and heavy; but after one inſpiration they become light, and as it were ſpongy: and it may be noted here, that the notion of the lungs ſinking in water before the child breathes, and of their ſwimming after the reception of air, are no certain proofs that the child had or had not breathed, much leſs that it was murdered: for the uninflated lungs become ſpecifically lighter than water, as ſoon as any degree of putrefaction takes place in them; and this ſoon happens after the death of the child: beſides, where the utmoſt care has been taken to preſerve the child, it has breathed once or twice, and then died. 6. The thymus gland is very large in the fœtus, but dwindles away in proportion as years advance. 7. The foramen ovale in the heart of a fœtus is generally cloſed in an adult.

FOG, or Mist, a meteor, conſiſting of groſs vapours, floating near the ſurface of the earth. Miſts, according to lord Bacon, are imperfect condenſations of the air, conſiſting of a large proportion of the air, and a ſmall one of the aqueous vapour: and theſe happen in the winter, about the change of the weather from froſt to thaw, or from thaw to froſt; but in the ſummer, and in the ſpring, from the expanſion of the dew. If the vapours, which are raiſed plentifully from the earth and waters, either by the ſolar or ſubterraneous heat, do at their firſt entrance into the atmoſphere meet with cold enough to condenſe them to a conſiderable degree, their ſpecific gravity is by that means increaſed, and ſo they will be ſtopped from aſcending; and either return back in form of dew or of drizzling rain, or remain ſuſpended ſome time in the form of a fog. Vapours may be ſeen on the high grounds as well as the low, but more eſpecially about marſhy places. They are eaſily diſſipated by the wind, as alſo by the heat of the ſun. They continue longeſt in the loweſt grounds, becauſe thoſe places contain moſt moiſture, and are leaſt expoſed to the action of the wind. Hence we may eaſily conceive, that fogs are only low clouds, or clouds in the loweſt region of the air; as clouds are no other than fogs raiſed on high. See Cloud. When fogs ſtink, then the vapours are mixed with ſulphureous and offenſive exhalations. Objects viewed through fogs appear larger and more remote than through the common air. Mr. Boyle obſerves that, upon the coaſt of Coromandel, and moſt maritime parts of the Eaſt Indies, there are, notwithſtanding the heat of the climate, annual fogs, ſo thick, as to occaſion people of other nations who reſide there, and even the more tender ſort of the natives, to keep their houſes cloſe ſhut up. Fogs are commonly pretty ſtrongly electrified, as appears from Mr. Cavallo's experiments upon them.

FOGAGE, in the foreſt-law, is rank graſs not eaten up in ſummer.

FOGLIETA (Oberto or Hubert), a Genoeſe prieſt, and one of the moſt learned writers of the 16th century. He had a ſhare in the diſturbances that were raiſed at Genoa, for which he was baniſhed; and died at Rome in 1581, aged 63. He wrote a hiſtory of Genoa in Italian, which is highly eſteemed; and many works in Latin.

FOGO, or Fuego. See Fuego.

FOHI. See the article Fe.

FOIBLE, a French term, frequently uſed alſo in our language. It literally ſignifies *weak;* and in that ſenſe is applied to the body of an animal and the parts thereof, as *foible* reins, *foible* ſight, &c. being derived from the Italian *fievole*, of the Latin *flebilis*, to be "lamented, pitied." But it is chiefly uſed with us ſubſtantively, to denote a defect or flaw in the moral character. Thus we ſay, Every perſon has his foible; and the great ſecret conſiſts in hiding it artfully: Princes are gained by flattery, that is their foible: The foible of young people is pleaſure; the foible of old men is avarice; the foible of the great and learned is vanity; the foible of women and girls, coquetry, or an affectation of having gallants: You ſhould know the forte and the foible of a man before you employ him: We ſhould not let people perceive that we know their foible; &c.

FOIL, in fencing, denotes a blunt ſword, or one that has a button at the end covered with leather, uſed in learning the art of fencing.

Foil, among glaſs grinders, a thin ſheet of tin, which, with quickſilver, is laid on the back of a looking-glaſs, to make it reflect. See Foliating.

Foil, among jewellers, a thin leaf of metal placed under a precious ſtone, in order to make it look tranſparent, and give it an agreeable variety of colour, either deep or pale: thus, if you want a ſtone to be of a pale colour, put a foil of that colour under it; or if you would have it deep, lay a dark one under it. Theſe foils are made either of copper, gold, or gold and ſilver together. The copper foils are commonly known by the name of *Nuremberg* or *German foils*; and are prepared as follows: Procure the thinneſt copper-plates you can get: beat theſe plates gently upon a well-poliſhed anvil, with a poliſhed hammer, as thin as poſſible; and placing them between two iron-plates as thin as writing-paper, heat them in the fire; then boil the foil in a pipkin, with equal quantities of tartar and ſalt, conſtantly ſtirring them till by boiling they become white; after which, taking them out and drying them, give them another hammering, till they are made fit for your purpoſe: however, care muſt be taken not to give the foils too much heat, for fear of melting; nor muſt they be too long boiled, for fear of attracting too much ſalt. The manner of poliſhing theſe foils is as follows: Take a plate of the beſt copper, one foot long and about five or ſix inches wide, poliſhed to the greateſt perfection; bend this to a long convex, faſten it upon a half roll, and fix it to a bench or table; then take ſome chalk, waſhed as clean as poſſible, and ſtrained through a fine linen cloth, till it be as fine

as you can make it; and having laid ſome of it on the roll, and wetted the copper all over, lay your ſoils on it, and with a poliſhing ſtone and the chalk poliſh your foils till they are as bright as a looking-glaſs; after which they muſt be dried, and laid up ſecure from duſt.

FOKIEN, a province of China in Aſia, commodiouſly ſituated for navigation and commerce, part of it bordering on the ſea, in which they catch large quantities of fiſh, which they ſend ſalted to other parts of the empire. Its ſhores are very uneven, by reaſon of the number and variety of its bays; and there are many forts built thereon to guard the coaſt. The air is hot, but pure and wholeſome. The mountains are almoſt every where diſpoſed into a kind of amphitheatres, by the labour of the inhabitants, with terraces placed one above another. The fields are watered with rivers and ſprings, which iſſue out of the mountains, and which the huſbandmen conduct in ſuch a manner as to overflow the fields of rice when they pleaſe, becauſe it thrives beſt in watery ground. They make uſe of pipes of bamboe for this purpoſe. They have all commodities in common with the reſt of China; but more particularly muſk, precious ſtones, quickſilver, ſilk, hempen cloth, callico, iron, and all ſorts of utenſils wrought to the greateſt perfection. From other countries they have cloves, cinnamon, pepper, ſandal-wood, amber, coral, and many other things. The capital city is Foutcheou Fou; or, as others would have it written, Fucherofu. But as for Fokien, which moſt geographers make the capital, Groſier informs us there is no ſuch place.

FOLARD (Charles), an eminent Frenchman, famous for his ſkill and knowledge in the military art, was born at Avignon in 1669, of a noble family, but not a rich one. He diſcovered an early turn for the ſciences, and a ſtrong paſſion for arms; which laſt was ſo inflamed by reading Cæſar's Commentaries, that he enliſted at 16 years of age. His father got him off, and ſhut him in a monaſtery; but he made his eſcape in about two years after, and entered himſelf a ſecond time, in quality of cadet. His inclination for military affairs, and the great pains he took to accompliſh himſelf in that way, recommending him to notice, he was admitted into the friendſhip of the firſt-rate officers, and diſtinguiſhed himſelf greatly on many occaſions. In 1718 he followed Charles XII. in his expedition to Norway, and ſerved under him at the ſiege of Frederickſhall, where that prince was killed. He made his laſt campaign in 1719 in France, under the duke of Berwick, in quality of colonel. From that time he applied himſelf intenſely to the ſtudy of the military art as far as it could be ſtudied at home; and built his theories upon the foundation of his experience. He contracted an intimacy with count Saxe, who, as he then declared, would one day prove a very great general. He was choſen a fellow of the Royal Society at London in 1749; and in 1751 made a journey to Avignon, where he died in 1752, aged 83 years. He was the author of ſeveral works, the principal of which are, 1. Commentaries upon Polybius, in ſix volumes, 4to. 2. A Book of new Diſcoveries in War. 3. A Treatiſe concerning the Defence of Places, &c. in French. Thoſe who would know more of this eminent ſoldier may conſult a French work, intitled, *Mémoires pour ſervir à l'Hiſtoire de M. le Chevalier de Folard. Ratiſbone*, 1753, 12mo.

FOLC-LANDS, (Sax.) copy-hold lands ſo called in the time of the Saxons, as charter-lands were called *boc-lands*, Kitch. 174. *Folkland* was *terra vulgi* or *popularis*; the land of the vulgar people, who had no certain eſtate therein, but held the ſame, under the rents and ſervices accuſtomed or agreed, at the will only of their lord the thane; and it was therefore not put in writing, but accounted *prædium ruſticum et ignobile*. Spelm. of Feuds, *c.* 5.

FOLCMOTE, or FOLKMOTE, (Sax. *Folcgemot*, i. e. *conventus populi*), is compounded of *folk*, *populus*, and *mote*, or *gemote*, *convenire*; and ſignified originally, as Somner in his Saxon Dictionary informs us, a general aſſembly of the people, to conſider of and order matters of the commonwealth. And Sir Henry Spelman ſays, the *folcmote* was a ſort of annual parliament, or convention of the biſhops, thanes, aldermen, and freemen, upon every May-day yearly; where the laymen were ſworn to defend one another and the king, and to preſerve the laws of the kingdom; and then conſulted of the common ſafety. But Dr. Brady infers from the laws of the Saxon kings of England, that it was an inferior court, held before the king's *reeve* or ſteward, every month, to do *folk* right, or compoſe ſmaller differences, from whence there lay appeal to the ſuperior courts; *Gloſſ.* p. 48. Squire ſeems to think the *folcmote* not diſtinct from the *ſhiremote*, or common general meeting of the county. See his *Angl. Sax. Gov.* 155. *n.*

Manwood mentions *folcmote* as a court holden in London, wherein all the *folk* and people of the city did complain of the mayor and aldermen, for miſgovernment within the ſaid city; and this word is ſtill in uſe among the Londoners, and denotes *celebrem ex tota civitate conventum. Stow's Survey.* According to Kennet, the *folcmote* was a common-council of all the inhabitants of a city, town, or borough, convened often, by ſound of bell, to the *Mote-Hall*, or *Houſe*; or, it was applied to a larger congreſs of all the freemen within a county, called the *ſhire-mote*, where formerly all knights and military tenants did fealty to the king, and elected the annual ſheriff on the 1ſt of October; till this popular election, to avoid tumults and riots, devolved to the king's nomination, anno 1315, 3 Edw. I. After which, the city *folcmote* was ſwallowed up in a ſelect committee or common-council, and the county *folcmote* in the ſheriff's tourn and aſſiſes. The word *folkmote* was alſo uſed for any kind of popular or public meeting; as of all the tenants at the *court-leet*, or *court-baron*, in which ſignification it was of a leſs extent. *Paroch. Antiq.* 120.

FOLENGIO (Theophilus), of Mantua, known alſo by the title of *Merlin Coccaye*, an Italian poet, remarkable for giving to a poem a name, which has been adopted ever ſince for all trifling performances of the ſame ſpecies, conſiſting of buffoonery, puns, anagrams, wit without wiſdom, and humour without good ſenſe. His poem was called *The Macaroni*, from an Italian cake of the ſame name, which is ſweet to the taſte, but has not the leaſt alimentary virtue, on the contrary palls the appetite and cloys the ſtomach. Theſe idle poems, however, became the reigning taſte in Italy and in France. They gave birth to macaroni academies; and, reaching England, to macaroni clubs; till, in the end, every thing inſipid, contemptible, and ridiculous, in the character, dreſs, or behaviour, of both men and women, was ſummed up in the deſpicable appellation of *a macaroni*. Folengio died in 1544.

FOLIA, among botaniſts, particularly ſignify the leaves of plants; thoſe of flowers being expreſſed by the word *petals*. See LEAF.

FOLIAGE, a cluſter or aſſemblage of flowers, leaves, branches, &c. The term is particularly uſed for the repreſentations of ſuch flowers, leaves, branches, rinds, &c. whether natural or artificial, as are uſed for enrichments on capitals, friezes, pediments, &c.

FOLIATING *of* LOOKING-GLASSES, the ſpreading the plates over, after they are poliſhed, with quickſilver, &c. in order to reflect objects. It is performed thus: A thin blotting paper is ſpread on the table, and ſprinkled with fine chalk; and then a fine lamina or leaf of tin, called *foil*, is laid over the paper; upon this is poured mercury, which is to be diſtributed equally over the leaf with a hare's-foot or cotton: over this is laid a clean paper, and over that the glaſs-plate, which is preſſed down with the right-hand, and the paper drawn gently out with the left: this being done, the plate is covered with a

thicker paper, and loaded with a greater weight, that the superfluous mercury may be driven out, and the tin adhere more closely to the glass. When it is dried, the weight is removed, and the looking-glass is complete. Some add an ounce of marcasite, melted by the fire; and, lest the mercury should evaporate, they pour it into cold water; and, when cooled, squeeze it through a cloth, or through leather. Some add a quarter of an ounce of tin and lead to the marcasite, that the glass may dry the sooner.

Foliating *of Globe Looking Glasses*, is done as follows: Take five ounces of quicksilver and one ounce of bismuth; of lead and tin, half an ounce each: first get the lead and tin into fusion, then put in the bismuth; and when you perceive that in fusion too, let it stand till it is almost cold, and pour the quicksilver into it: after this, take the glass globe, which must be very clean, and the inside free from dust: make a paper-funnel, which put into the hole of the globe, as near the glass as you can, so that the amalgam, when you pour it in, may not splash, and cause the glass to be full of spots; pour it in gently, and move it about, so that the amalgam may touch every part. If you find the amalgam begin to be curdly and fixed, then hold it over a gentle fire, and it will easily flow again; and if you find the amalgam too thin, add a little more lead, tin, and bismuth to it. The finer and clearer your globe is, the better will the looking-glass be. Dr. Shaw observes, that this operation has considerable advantages, as being performable in the cold; and not attended with the danger of poisonous fumes: besides, how far it is applicable to the more commodious foliating of the common looking-glasses, and other speculums, he thinks, may deserve to be well considered.

FOLIO, in merchants' books, denotes a page, or rather both the right and left-hand pages, these being expressed by the same figure, and corresponding to each other. See Book-keeping.

Folio, among printers and booksellers, the largest form of books, when each sheet is so printed that it must be folded up in two leaves only.

FOLIS. See Follis.

FOLIUM, or Leaf, in botany. See Leaf.

FOLKES (Martin), an English antiquary, mathematician, and philosopher, was born at Westminster about 1690; and was greatly distinguished as a member of the Royal Society in London, and of the Academy of Sciences at Paris. He was admitted into the former at 24 years of age; made one of their council two years after; named by Sir Isaac Newton himself as vice-president; and, after Sir Hans Sloane, became president. There are numerous Memoirs of his in the Philosophical Transactions. Coins, ancient and modern, were a great object with him; and his last production was a book upon the English Silver Coin, from the Conquest to his own times. He died at London in 1754. Dr. Birch had drawn up materials for a life of Mr. Folkes, which are preserved at large in the Anecdotes of Bowyer, p. 562 *et seq.*

FOLKSTONE, a town of Kent, with a market on Thursday. It was once a flourishing town, of large extent, containing five parish churches, which are now reduced to one small church, and three meeting-houses. It is a member of the port of Dover, and governed by a mayor and 12 jurats. The inhabitants are chiefly employed in fishing. It is seated on the English Channel, eight miles S. W. of Dover, and 72 E. by S. of London. E. lon. 1. 14. N. lat. 51. 5.

FOLKLAND, and Folkmote. See Folc-lands.

FOLLICULUS, from *follis*, "a bag," a species of seed-vessel first mentioned by Linnæus in his *Delineatio plantæ*, generally consisting of one valve, which opens from bottom to top on one side, and has no suture for fastening or attaching the seeds within it.

FOLLICULI are likewise defined by the same author to be small glandular vessels distended with air, which appear on the surface in some plants; as at the root of water-milfoil, and on the leaves of aldrovanda. In the former, the vessels in question are roundish, and furnished with an appearance like two horns; in the latter, pot-shaped and semicircular.

FOLLIS, or Folis, anciently signified a little bag or purse; whence it came to be used for a sum of money, and very different sums were called by that name: thus the scholiast on the Basilics mentions a follis of copper which was worth but the 24th part of the miliarensis; the glossæ nomicæ, quoted by Gronovius and others, one of 125 miliarenses, and another of 250 denarii, which was the ancient sestertium; and three different sums of eight, four, and two pounds of gold, were each called *follis*. According to the account of the scholiast, the ounce of silver, which contained 5 miliarenses of 60 in the pound, was worth 120 folles of copper. The glossographer, describing a follis of 250 denarii, says it was equal to 312 pounds 6 ounces of copper; and as the denarius of that age was the 8th part of an ounce, an ounce of silver must have been worth 120 ounces of copper; and therefore the scholiast's follis was an ounce of copper, and equal to the glossographer's nummus. But as Constantine's copper money weighed a quarter of a Roman ounce, the scholiast's follis and the glossographer's nummus contained four of them, as the ancient nummus contained four asses.

FOLLY, according to Mr. Locke, consists in the drawing of false conclusions from just principles; by which it is distinguished from madness, which draws just conclusions from false principles. But this seems too confined a definition; *folly*, in its most general acceptation, denoting a weakness of intellect or apprehension, or some partial absurdity in our sentiments or conduct.

FOMAHANT, in astronomy, a star of the first magnitude in the constellation Aquarius.

FOMENTATION, in medicine, is a fluid externally applied, usually as warm as the patient can conveniently bear it, and in the following manner. Two flannel cloths are dipped into the heated liquor, one of which is wrung as dry as the necessary speed will admit, then immediately applied to the part affected; it lies on until the heat begins to go off, and the other is in readiness to apply at the instant in which the first is removed: thus these flannels are alternately applied, so as to keep the affected part constantly supplied with them warm. This is continued 15 or 20 minutes, and repeated two or three times a-day. Every intention of relaxing and soothing by fomentations may be answered as well by warm water alone as when the whole tribe of emollients are boiled in it; but when discutients or antiseptics are required, such ingredients must be called in as are adapted to that end. Of these there are various kinds mentioned in the Pharmacopœia Chirurgica. The degree of heat should never exceed that of producing a pleasing sensation; great heat produces effects very opposite to that intended by the use of a fomentation.

FONG-yang, a city of China, in the province of Kiang-*Nan*. It is situated on a mountain, which hangs over the yellow river, and incloses with its walls several fertile little hills. Its jurisdiction is very extensive, for it comprehends 18 cities; 5 of which are of the second, and 13 of the third class. As this was the birth-place of the emperor Hong-vou, chief of the preceding dynasty, this prince formed a design of rendering it a famous and magnificent city, in order to make it the seat of the empire. After having expelled the western Tartars, who had taken possession of China, he transferred his court hither, and named the city *Fong-yang*; that is to say, "The place of the Eagle's Splendour." His intention, as we have said, was to beautify and enlarge it; but the inequality of the ground, the

ſcarcity of freſh water, and, above all, the vicinity of his father's tomb, made him change his deſign. By the unanimous advice of his principal officers, this prince eſtabliſhed his court at NANKING, a more beautiful and commodious place. When he had formed this reſolution, a ſtop was put to the intended works: the imperial palace which was to have been incloſed by a triple wall, the walls of the city to which a circumference of nine leagues was aſſigned, and the canals that were begun, all were abandoned; and nothing was finiſhed but three monuments, which ſtill remain. The extent and magnificence of theſe ſufficiently ſhow what the beauty of this city would have been, had the emperor purſued his original deſign.

FONT, among eccleſiaſtical writers, a large baſon in which water is kept for the baptizing of infants or adult perſons.

FONT, in the art of printing, denotes a complete aſſortment of letters, accents, &c. uſed in printing. See FOUNT.

FONTAINE (John), the celebrated French poet, and one of the firſt-rate geniuſes of his age, was born at Chateau Thierri in Champagne, the 8th of July 1621, of a good extraction. At the age of 19 he entered amongſt the Oratorians, but quitted that order 18 months after. He was 22 years of age before he knew his own talent for poetry; but hearing an ode of Malherbe read, upon the aſſaſſination of Henry IV, he was ſo ſeized with admiration of it, that the poetical fire, which had before lain dormant within him, ſeemed to be enkindled from that of the other great poet. He applied himſelf to read, to meditate, to repeat, in fine, to imitate, the works of Malherbe. The firſt eſſays of his pen he confined to one of his relations, who made him read the beſt Latin authors, Horace, Virgil, Terence, Quintilian, &c. and then the beſt compoſitions in French and Italian. He applied himſelf likewiſe to the ſtudy of the Greek authors, particularly Plato and Plutarch. Some time afterwards his parents made him marry a daughter of a lieutenant-general, a relation of the great Racine. This young lady, beſides her very great beauty, was remarkable for the delicacy of her wit; and Fontaine never compoſed any work without conſulting her. But, as her temper was none of the beſt, to avoid diſſenſion, he ſeparated himſelf from her company as often as he well could. The famous ducheſs of Bouillon, niece to cardinal Mazarine, being exiled to Chateau Thierri, took particular notice of Fontaine. Upon her recall he followed her to Paris; where, by the intereſt of one of his relations, he got a penſion ſettled upon him. He met with great friends and protectors amongſt the moſt diſtinguiſhed perſons of the court; but madam de la Sabliere was the moſt particular. She took him to live at her houſe; and it was then that Fontaine, diveſted of domeſtic concerns, led a life conformable to his diſpoſition, and cultivated an acquaintance with all the great men of the age. It was his cuſtom, after he was fixed at Paris, to go every year, during the month of September, to his native place of Chateau-Thierri, and pay a viſit to his wife, carrying with him Racine, Deſpreaux, Chapelle, or ſome other celebrated writers. When he has ſometimes gone thither alone by himſelf, he has come away without remembering even to call upon her; but ſeldom omitted ſelling ſome part of his lands, by which means he ſquandered away a conſiderable fortune. After the death of madame de la Sabliere, he was invited into England, particularly by madame Mazarin, and by St. Evremond, who promiſed him all the ſweets and comforts of life; but the difficulty of learning the Engliſh language, and the liberality of the duke of Burgundy, prevented his voyage.

About the end of the year 1692 he was taken dangerouſly ill; and, as is cuſtomary upon theſe occaſions in the Romiſh church, he made a general confeſſion of his whole life to P. Poguet, an oratorian; and, before he received the ſacrament, he ſent for the gentlemen of the French academy, and in their preſence declared his ſincere compunction for having compoſed his Tales; a work he could not reflect upon without the greateſt repentance and deteſtation; promiſing, that if it ſhould pleaſe God to reſtore his health, he would employ his talents only in writing upon matters of morality or piety. He ſurvived this illneſs two years, living in the moſt exemplary and edifying manner, and died the 13th of March 1695, being 74 years of age. When they ſtripped his body, they found next his ſkin a hair-ſhirt; which gave room for the following expreſſion of the younger Racine: "*Et l'auteur de Jaconde eſt orné d'un cilice.*"

Fontaine's character is remarkable for a ſimplicity, candour, and probity, ſeldom to be met with. He was of an obliging diſpoſition; cultivating a real friendſhip with his brother poets and authors; and, what is very rare, beloved and eſteemed by them all. His converſation was neither gay nor brilliant, eſpecially when he was not among his intimate friends. One day being invited to dinner at a farmer-general's, he ate a great deal, but did not ſpeak. Riſing up from table very early, under pretext of going to the academy, one of the company repreſented to him that it was not yet a proper time: "Well (ſays he), if it is not I will ſtay a little longer." He had one ſon by his wife in the year 1660. At the age of 14 he put him into the hands of M. de Harley, the firſt preſident, recommending to him his education and fortune. It is ſaid, that having been a long time without ſeeing him, he happened to meet him one day viſiting, without recollecting him again, and mentioned to the company that he thought that young man had a good deal of wit and underſtanding. When they told him it was his own ſon, he anſwered in the moſt tranquil manner, "Ha! truly I am glad on't." An indifference, or rather an abſence of mind, influenced his whole conduct, and rendered him often inſenſible to the inclemency of the weather. Madame de Bouillon, going one morning to Verſailles, ſaw him, abſtracted in thought, ſitting in an arbour; returning at night, ſhe found him in the ſame place, and in the ſame attitude, although it was very cold, and had rained almoſt the whole day. He carried this ſimplicity ſo far, that he was ſcarce ſenſible of the bad effects ſome of his writings might occaſion, particularly his tales. In a great ſickneſs, his confeſſor exhorting him to prayer and alms deeds: "As for alms deeds (replied Fontaine), I am not able, having nothing to give; but they are about publiſhing a new edition of my Tales, and the bookſeller owes me a hundred copies; you ſhall have them to ſell, and diſtribute their amount amongſt the poor." Another time P. Poguet exhorting him to repent of his faults, "If he has committed any (cried the nurſe), I am ſure it is more from ignorance than malice, for he has as much ſimplicity as an infant." One time having compoſed a tale, wherein he made a profane application of thoſe words of the Goſpel, "Lord, five talents thou didſt deliver to me," he dedicated it, by a moſt ingenious prologue, to the celebrated Arnauld, telling him it was to ſhow poſterity the great eſteem he had for the learned doctor. He was not ſenſible of the indecency of the dedication, and the profane application of the text, till Boileau and Racine repreſented it to him. He addreſſed another, by a dedication in the ſame manner, to the archbiſhop of Paris. His Fables are an immortal work, exceeding every thing in that kind both ancient and modern, in the opinion of the learned. People of taſte, the oftener they read them, will find continually new beauties and charms, not to be met with elſewhere. The deſcendants of this great poet were exempted in France from all taxes and impoſitions; a privilege which at leaſt was continued to them till the revolution happened, and may ſtill.

FONTAINEBLEAU, a town of France in the department of Seine and Marne, and late province of the Iſle of France, remarkable for its fine palace, which was a hunting ſeat of the late kings of France. It was firſt embelliſhed by Francis I.;

and each ſucceſſive king added ſomething to it; inſomuch that it was one of the fineſt pleaſure-houſes in the world. It ſtands in the midſt of a foreſt, 35 miles S. E. of Paris. E. lon. 2. 47. N. lat. 48. 25.

FONTAINES (Peter Francis), a French critic, was born of a good family at Rouen in 1685. At 15 he entered into the ſociety of the Jeſuits, and at 30 quitted it for the ſake of returning to the world. He was a prieſt, and had a cure in Normandy; but left it, and was, as a man of wit and letters, ſome time with the cardinal d'Auvergne. Having excited ſome attention at Paris by certain critical productions, the Abbé Bignon in 1724 committed to him the *Journal des Sçavans.* He acquitted himſelf well in this department, and was peaceably enjoying the applauſes of the public, when his enemies, whom by critical ſtrictures in his Journal he had made ſuch, formed an accuſation againſt him of a moſt abominable crime, and procured him to be impriſoned. By the credit of powerful friends, he was ſet at liberty in 15 days: the magiſtrate of the police took upon himſelf the trouble of juſtifying him in a letter to the Abbé Bignon; and this letter having been read amidſt his fellow-labourers in the Journal, he was unanimouſly re-eſtabliſhed in his former credit. This happened in 1725. But with whatever repute he might acquit himſelf in this Journal, frequent diſguſts made him frequently abandon it. He laboured mean while in ſome new periodical works, from which he derived his greateſt fame. In 1731 he began one under the title of *Nouvelliſte du Parnaſſe, ou Reflexions ſur les Ouvrages nouveaux:* but only proceeded to two volumes; the work having been ſuppreſſed by authority, from the inceſſant complaints of authors ridiculed therein. About three years after, in 1735, he obtained a new privilege for a periodical production, intitled, *Obſervations ſur les Ecrits Modernes*; which, after continuing to 33 volumes, was ſuppreſſed again in 1743. Yet the year following, 1744, he publiſhed another weekly paper, called *Jugements ſur les Ouvrages nouveaux,* and proceeded to 11 volumes: the two laſt being done by other hands. In 1745 he was attacked with a diſorder in the breaſt, which ended in a dropſy that proved fatal in five weeks. Beſides the periodical works mentioned above, he was the author of many others: his biographer gives us no leſs than 17 articles; many of them critical, ſome hiſtorical, and ſome tranſlations from Engliſh writers.

FONTANELLA, in anatomy, denotes the quadrangular aperture found betwixt the os frontis and oſſa ſincipitis, in children juſt born; which alſo uſed to be called *fons pulſatilis,* from the pulſation occaſioned there by the veſſels of the brain. Fontanella is alſo a term in ſurgery, denoting an artificial opening or drain formed in the ſkin, more generally known by the name of an *Iſſue.*

FONTARABIA, a ſea-port of Spain, in Biſcay, ſeated on a peninſula on the ſea-ſhore, and on the river Bidaſſoa. It is ſmall, but is well fortified both by nature and art; and has a good harbour, though dry at low water. It is built in the form of an amphitheatre, on the declivity of a hill, and ſurrounded on the land ſide by the Pyrenean mountains. It is a very important place, being accounted the key of Spain on that ſide. It is 22 miles S. W. of Bayonne, and 62 E. of Bilboa. W. lon. 1. 33. N. lat. 43. 23.

FONTENAY (John Baptiſt Blain de), a very famous painter of fruit and flowers, was born at Caen in 1654. Louis XIV. gave him a penſion, and an apartment in the galleries of the Louvre; and he was nominated counſellor of the Academy of Painting. His fruit and flowers have all the freſhneſs and beauty of nature; the very dew ſeems to trickle down their ſtalks, with all the luſtre and tranſparency of the diamond, while the inſects upon them ſeem perfectly alive and animated. This ingenious painter died at Paris in 1715.

FONTENELLE (Bernard de), a celebrated French author, was born in 1657, and died in 1756, when he was near 100 years old. He diſcharged the truſt of perpetual ſecretary to the Academy of Sciences above 40 years with univerſal applauſe; and his Hiſtory of the Academy of Sciences throws a great light upon their memoirs, which are very obſcure. The eloges which he pronounced on the deceaſed members of the academy have this peculiar merit, that they excite a reſpect for the ſciences as well as for the author. In his poetical performances, and the Dialogues of the Dead, the ſpirit of Voiture was diſcernible, though more extended and more philoſophical. His Plurality of Worlds is a work ſingular in its kind; the deſign of which was to preſent that part of philoſophy to view in a gay and pleaſing dreſs. In his more advanced years, he publiſhed comedies, which, though they ſhewed the elegance of Fontenelle, were little fitted for the ſtage; and An Apology for Des Cartes's Vortices. M. de Voltaire, who declares him to have been the moſt univerſal genius the age of Louis XIV. produced, ſays, "We muſt excuſe his comedies, on account of his great age; and his Carteſian opinions, as they were thoſe of his youth, when they were univerſally received all over Europe."

FONTENOY, a village of Auſtrian Hainault, remarkable for a battle between the Allies and the French in 1745, in which the former were worſted. It is four miles S. W. of Tournay. E. lon. 3. 26. N. lat. 50. 32.

FONTENOY, a village of France, in the department of Yonne and late province of Burgundy, remarkable for a battle fought here in 841, between the Germans and the French, in which were killed above 100,000 men; and the Germans were defeated. It is 20 miles S. E. of Auxerre. E. lon. 3. 48. N. lat. 47. 28.

FONTEVRAUD, or FRONTEVAUX (Order of), in eccleſiaſtical hiſtory, a religious order inſtituted by Robert d'Arbriſſel about the latter end of the 11th century, and taken under the protection of the holy ſee by pope Paſcal II. in 1106, confirmed by a bull in 1113, and inveſted by his ſucceſſors with very extraordinary privileges. The chief of this order is a female, who is appointed to inſpect both the monks and nuns. The order is divided into four provinces, which are thoſe of France, Aquitaine, Auvergne, and Bretagne, in each of which they have ſeveral priories.

FONTINALIA, or FONTANALIA, in antiquity, a religious feaſt held among the Romans in honour of the deities who preſided over fountains. Varro obſerves, that it was the cuſtom to viſit the wells on thoſe days, and to caſt crowns into fountains. Scaliger, in his conjectures on Varro, takes this not to be a feaſt of fountains in general, as Feſtus inſinuates, but of the fountain which had a temple at Rome, near the Porta Capena, called alſo *Porta Fontinalis:* he adds, that it is of this fountain Cicero ſpeaks in his ſecond book *De legibus.* The fontinalia were held on the 13th of October.

FONTINALIS, WATER MOSS, in botany; a genus of the natural order of muſci, belonging to the cryptogamia claſs of plants. The anthera is hooded; the calyptra, or covering of the anthera, ſeſſile, incloſed in a perichætium or empalement of leaflets different from thoſe of the reſt of the plant. There are four ſpecies, all of them natives of Britain. They grow on the brinks of rivulets, and on the trunks of trees. The moſt remarkable is the antipyretica, with purple ſtalks. The Scandinavians line the inſides of their chimneys with this moſs, to defend them againſt the fire; for, contrary to the nature of all other moſs, this is ſcarcely capable of burning.

FOOD, in the moſt extenſive ſignification of the word, implies whatever aliments are taken into the body, whether ſolid or fluid; but, in common language, it is generally uſed to ſignify only the ſolid part of our aliment.

We are told, that, in the firſt ages, men lived upon acorns,

berries, and ſuch fruits as the earth ſpontaneouſly produces; then they proceeded to eat the fleſh of wild animals taken in hunting: but the number of theſe decreaſing and mankind multiplying, neceſſity taught them the art of cultivating the ground, ſowing corn, &c. By and by they began to aſſign to each other, by general conſent, portions of land to produce them their ſupply of vegetables: after this, reaſon ſuggeſted the expedient of domeſticating certain animals, both to aſſiſt them in their labours and ſupply them with food. Hogs were the firſt animals of the domeſtic kind that appeared upon their tables; they held it to be ungrateful to devour the beaſts that aſſiſted them in their labours. When they began to make a free uſe of domeſtic animals, they roaſted them only; boiling was a refinement in cookery which for ages they were ſtrangers to; and fiſh, living in an element men were unuſed to, were not eaten till the world became civilized. Menelaus complains, in the Odyſſey, that they had been conſtrained to feed upon them.

The moſt remarkable diſtinction of foods, in a medical view, is into thoſe which are already aſſimilated into the animal nature, and ſuch as are not. Of the firſt kind are animal ſubſtances in general; which if not entirely ſimilar are nearly ſo, to our nature. The ſecond comprehends vegetables, which are much more difficultly aſſimilated. But as the nouriſhment of all animals, even thoſe which live on other animals, can be traced originally to the vegetable kingdom, it is plain, that the principle of all nouriſhment is in vegetables.

Though there is perhaps no vegetable which does not afford nouriſhment to ſome ſpecies of animal or other; yet, with regard to mankind, a very conſiderable diſtinction is to be made. Thoſe vegetables, which are of a mild, bland, agreeable taſte, are proper nouriſhment; while thoſe of an acrid, bitter, and nauſeous nature, are improper. We uſe, indeed, ſeveral acrid ſubſtances as food; but the mild, the bland, and palatable, are in the largeſt proportion in almoſt every vegetable. Such as are very acrid, and at the ſame time of an aromatic nature, are not uſed as food, but as ſpices or condiments, which anſwer the purpoſes of medicine rather than any thing elſe. Sometimes, indeed, acrid and bitter vegetables ſeem to be admitted as food. Thus celeri and endive are uſed in common food, though both are ſubſtances of conſiderable acrimony; but it muſt be obſerved, that when we uſe them they are previouſly blanched, which almoſt totally deſtroys their acrimony. Or, if we employ other acrid ſubſtances, we generally, in a great meaſure, deprive them of their acrimony by boiling. In different countries the ſame plants grow with different degrees of acrimony. Thus, garlic here ſeldom enters our food; but in the ſouthern countries, where the plants grow more mild, they are frequently uſed for that purpoſe. The plant which furniſhes caſſada, being very acrimonious, and even poiſonous in its recent ſtate, affords an inſtance of the neceſſity of preparing acrid ſubſtances even in the hot countries: and there are other plants, ſuch as arum-root, which are ſo exceedingly acrimonious in their natural ſtate, that they cannot be ſwallowed with ſafety; yet, when deprived of that acrimony, will afford good nouriſhment.

The moſt remarkable properties of different vegetable ſubſtances as food, are taken notice of under their different names: here we ſhall only trace the curious enquiry made by Dr. Cullen into the queſtion, *What proportion of animal and vegetable food ought to be mixed?*

1. *Animal* food certainly gives moſt ſtrength to the ſyſtem. It is a known aphoriſm of Sanctorins, that *pondus addit robur*; which may be explained from the impletion of the blood-veſſels, and giving a proper degree of tenſion for the performance of ſtrong oſcillations. Now animal food not only goes a greater way in ſupplying fluid, but alſo gives a fluid more denſe and elaſtic. The art of giving the utmoſt ſtrength to the ſyſtem is beſt underſtood by thoſe who breed fighting-cocks. Theſe people raiſe the cocks to a certain weight, which muſt bear a certain proportion to the other parts of the ſyſtem, and which at the ſame time is ſo nicely proportioned, as that, on loſing a few ounces of it, their ſtrength is very conſiderably impaired. Dr. Robinſon of Dublin has obſerved, that the force and weight of the ſyſtem ought to be determined by the largeneſs of the heart, and its proportion to the ſyſtem: for a large heart will give large blood-veſſels, while at the ſame time the viſcera are leſs, particularly the liver; which laſt being increaſed in ſize, a greater quantity of fluid is determined into the cellular texture, and leſs into the ſanguineous ſyſtem. Hence we ſee how animal food gives ſtrength, by filling the ſanguiferous veſſels. What pains we now beſtow on cocks, the ancients did on the Athletæ, by proper nouriſhment bringing them to a great degree of ſtrength and agility. It is ſaid that men were at firſt fed on figs, a proof of which we have from their nutritious quality: however, in this reſpect they were ſoon found to fall far ſhort of animal food; and thus we ſee that men, in ſome meaſure, will work in proportion to the quality of their food. The Engliſh labour more than the Scots; and, wherever men are expoſed to hard labour, their food ſhould be animal. Animal food, although it gives ſtrength, yet loads the body; and Hippocrates long ago obſerved, that the athletic habit, by a ſmall increaſe, was expoſed to the greateſt hazards. Hence it is only proper for bodily labours, and entirely improper for mental exerciſes; for whoever would keep his mind acute and penetrating, will exceed rather on the ſide of vegetable food. Even the body is oppreſſed with animal food; a full meal always produces dulneſs, lazineſs, and yawning; and hence the feeding of gameſters, whoſe mind muſt be ready to take advantage, is always performed by avoiding a large quantity of animal food. Farther, with regard to the ſtrength of the body, animal food in the firſt ſtage of life is hardly neceſſary to give ſtrength: in manhood, when we are expoſed to active ſcenes, it is more allowable; and even in the decline of life, ſome proportion of it is neceſſary to keep the body in vigour. There are ſome diſeaſes which come on in the decay of life, at leaſt aggravated by it; among theſe the moſt remarkable is the gout. This, when it is in the ſyſtem, and does not appear with inflammation in the extremities, has pernicious effects there, attacking the lungs, ſtomach, head, &c. Now to determine this to the extremities, a large proportion of animal food is neceſſary, eſpecially as the perſon is commonly incapable of much exerciſe.

Animal food, although it gives ſtrength, is yet of ſome hazard to the ſyſtem, as it produces plethora and all its conſequences. As a ſtimulus to the ſtomach and to the whole ſyſtem, it excites fever, urges the circulation, and promotes the perſpiration. The ſyſtem, however, by the repetition of theſe ſtimuli, is ſoon worn out; and a man who has early uſed the athletic diet is either early carried off by inflammatory diſeaſes, or, if he takes exerciſe ſufficient to render that diet ſalutary, ſuch an accumulation is made of putreſcent fluids, as in his after life lays a foundation for the moſt inveterate chronic diſtempers. Therefore it is to be queſtioned, whether we ſhould deſire this high degree of bodily ſtrength, with all the inconveniences and dangers attending it. Thoſe who are chiefly employed in mental reſearches, and not expoſed to too much bodily labour, ſhould always avoid an exceſs of animal food. There is a diſeaſe which ſeems to require animal food, viz. the hyſteric or hypochondriac; and which appears to be very much a-kin to the gout, affecting the alimentary canal. All people affected with this diſeaſe are much diſpoſed to aceſcency; which ſometimes goes ſo far, that no other vegetable but bread can be taken in, without occaſioning the worſt conſequences. Here then we are obliged to preſcribe an animal diet, even to thoſe of very weak organs; for it generally obviates the ſymptoms. However, ſeveral inſtances of ſcurvy in exceſs have been produced by a

long-continued use of this diet, which it is always unlucky to be obliged to prescribe; and when it is absolutely necessary to prescribe, it should be joined with as much of the vegetable as possible, and when a cure is performed we should gradually recur to that again.

2. Next, let us consider the *vegetable* diet. The chief inconvenience of this is difficulty of assimilation; which, however, in the vigorous and exercised, will not be liable to occur. In warm climates, the assimilation of vegetable aliment is more easy, so that *there* it may be more used, and, when joined to exercise, gives a pretty tolerable degree of strength and vigour; and though the general rule be in favour of *animal* diet, for giving strength, yet there are many instances of its being remarkably produced from vegetable. Vegetable diet has this advantage, that it whets the appetite, and that we can hardly suffer from a full meal of it. Besides the disorders it is liable to produce in the *primæ viæ*, and its falling short to give strength, there seem to be no bad consequences it can produce in the blood-vessels; for there is no instance where its peculiar acrimony was ever carried there, and it is certainly less putrifiable than animal food; nor, without the utmost indolence, and a sharp appetite, does it give plethora or any of its consequences: so that we cannot here but conclude, that a large proportion of vegetable food is useful for the generality of mankind.

There is no error in this country more dangerous or more common than the neglect of bread: for it is the safest of vegetable aliment, and the best corrector of animal food; and, by a large proportion of this alone, its bad consequences, when used in a hypochondriac state, have been obviated. The French apparently have as much animal food on their tables as the English; and yet, by a greater use of bread and the dried acid fruits, its bad effects are prevented; and therefore bread should be particularly used by the latter, as they are so voracious of animal food. Vegetable food is not only necessary to secure health, but long life: and, as we have said, in infancy and youth we should be confined to it mostly; in manhood, and decay of life, animal food is better; and, near the end, vegetable again.

There is another question much agitated, continues the Doctor, viz. *What are the effects of variety in food?* Is it necessary and allowable, or universally hurtful? Variety of a certain kind seems necessary; as vegetable and animal foods have their mutual advantages, tending to correct each other. Another variety, which is very proper, is that of liquid and solid food, which should be so managed as to temper each other; for liquid food, especially of the vegetable kind, is too ready to pass off before it is properly assimilated, while solid food makes a long stay. But this does not properly belong to the question, whether variety of the same kind is necessary or proper, as in animal-foods, beef, fish, fowl, &c. It doth not appear that there is any inconvenience arising from this mixture or difficulty of assimilation, provided a moderate quantity be taken. When any inconvenience does arise, it probably proceeds from this, that one of the particular substances in the mixture, when taken by itself, would produce the *same effects;* and indeed it would appear, that this effect is not *heightened* by the mixture, but properly *obviated* by it. There are few exceptions to this, if any, *e. g.* taking a large proportion of acescent substances with milk. The coldness, &c. acidity, flatulency, &c. may appear; and it is possible that the coagulum, from the acescency of the vegetables, being somewhat stronger induced, may give occasion to too long retention in the stomach, and to acidity in too great degree. Again, the mixture of fish and milk often occasions inconvenience. The theory of this is difficult, though, from universal consent, it must certainly be just. Can we suppose that fish gives occasion to such a coagulum as runnet? If it does so, it may produce bad effects. Besides, fishes approach somewhat to vegetables, in giving little stimulus; and are accused of the same bad effects as these, viz. bringing on the cold fit of fever.

Thus much may be said for variety. But it also has its disadvantages, provoking to gluttony; this and the art of cookery making men take in more than they properly can digest: and hence, perhaps very justly, physicians have universally almost preferred simplicity of diet; for, in spite of rules, man's eating will only be measured by his appetite, and satiety is sooner produced by *one* than by *many* substances. But this is so far from being an argument against variety, that it is one for it, as the only way of avoiding a full meal of animal-food, and its bad effects, is by introducing a quantity of vegetables. Another means of preventing the bad effects of animal-food is to take a large proportion of liquid; and hence the bad effects of animal-food are less felt in Scotland, on account of their drinking much with it, and using broths, which are at once excellent correctors of animal-food and preventives of gluttony.

We shall conclude this article with some passages from a late ingenious Essay on Food, and the means of supplying cheap nourishment for the poor, by Count Rumford, who, in chap. I. observes: "There is, perhaps, no operation of nature, which falls under the cognizance of our senses, more surprising, or more curious, than the nourishment and growth of plants and animals; and there is certainly no subject of investigation more interesting to mankind. As providing subsistence is, and ever must be, an object of the first concern in all countries, any discovery or improvement by which the procuring of good and wholesome food can be facilitated, must contribute very powerfully to increase the comforts and promote the happiness of society.

"That our knowledge in regard to the science of nutrition is still very imperfect, is certain; but I think there is reason to believe, that we are upon the eve of some very important discoveries relative to that mysterious operation. Since it has been known that water is not a simple element, but a *compound*, and capable of being decomposed, much light has been thrown upon many operations of nature which formerly were wrapped up in obscurity. In vegetation, for instance, it has been rendered extremely probable, that water acts a much more important part than was formerly assigned to it by philosophers; that it serves not merely as the *vehicle* of nourishment, but constitutes at least one part, and probably an essential part, of the *food* of plants; that it is decomposed by them, and contributes *materially* to their growth; and that manures serve rather to prepare the water for decomposition, than to form of themselves, substantially and directly, the nourishment of the vegetables.

"Now a very clear analogy may be traced, between the vegetation and growth of plants, and the digestion and nourishment of animals; and as water is indispensably necessary in both processes, and as in one of them (vegetation) it appears evidently to serve as *food*, why should we not suppose it may serve as food in the other? There is, in my opinion, abundant reason to suspect that this is really the case; and I shall now briefly state the grounds upon which this opinion is founded. Having been engaged for a considerable length of time in providing food for the poor at Munich, I was naturally led, as well by curiosity as motives of economy, to make a great variety of experiments upon that subject; and I had not proceeded far in my opinions, before I began to perceive that they were very important; even much more so than I had imagined.

"The difference in the apparent goodness, or the palatableness, and apparent nutritiousness of the same kinds of food, when prepared or cooked in different ways, struck me very forcibly; and I constantly found that the richness or *quality* of a soup depended more upon a proper choice of the ingredients, and a proper management of the fire in the combination of those ingredients, than upon the quantity of solid nutritious

matter employed; much more upon the art and skill of the cook, than upon the amount of the sums laid out in the market.

"I found likewise, that the nutritiousness of a soup, or its power of satisfying hunger, and affording nourishment, appeared always to be in proportion to its apparent richness or palatableness. But what surprised me not a little was, the discovery of the very small quantity of *solid food*, which, when properly prepared, will suffice to satisfy hunger, and support life and health; and the very trifling expence at which the stoutest and most laborious man may, in any country, be fed.

"After an experience of more than five years in feeding the poor at Munich, during which time every experiment was made that could be devised, not only with regard to the choice of the articles used as food, but also in respect to their different combinations and proportions; and to the various ways in which they could be prepared or cooked; it was found that the *cheapest*, most *savoury*, and most *nourishing* food that could be provided, was a soup composed of *pearl barley, pease, potatoes, cuttings of fine wheaten bread*, vinegar, salt and water, in certain proportions. The method of preparing this soup is as follows: The water and the pearl barley are first put together into the boiler, and made to boil; the pease are then added, and the boiling is continued over a gentle fire about two hours; the potatoes are then added, (having been previously peeled with a knife, or having been boiled, in order to their being more easily deprived of their skins,) and the boiling is continued for about one hour more, during which time the contents of the boiler are frequently stirred about with a large wooden spoon or ladle, in order to destroy the texture of the potatoes, and to reduce the soup to one uniform mass. When this is done, the vinegar and the salt are added; and last of all, at the moment it is to be served up, the cuttings of bread.

"The soup should never be suffered to boil, or even to stand long before it is served up, after the cuttings of bread are put to it. It will, indeed, for reasons which will hereafter be explained, be best never to put the cuttings of bread into the boiler at all, but (as is always done at Munich) to put them into the tubs in which the soup is carried from the kitchen into the dining-hall; pouring the soup hot from the boiler upon them, and stirring the whole well together with the iron ladles used for measuring out the soup to the poor in the hall. It is of more importance than can well be imagined, that this bread, which is mixed with the soup, should not be boiled. It is likewise of use that it should be cut as fine or thin as possible; and if it be dry and hard, it will be so much the better.

"The bread we use in Munich is what is called *semel* bread, being small loaves, weighing from two to three ounces; and as we receive this bread in donations from the bakers, it is commonly dry and hard, being that which, not being sold in time, remains on hand, and becomes stale and unsaleable; and we have found by experience, that this hard and stale bread answers for our purpose much better than any other, for it renders mastication necessary; and mastication seems very powerfully to assist in promoting digestion: it likewise *prolongs the duration of the enjoyment of eating*, a matter of very great importance indeed, and which has not hitherto been sufficiently attended to.

"The quantity of this soup furnished to each person at each meal, or one portion of it (the cuttings of bread included), is just *one Bavarian pound* in weight; and as the Bavarian pound is to the pound avoirdupois as 1,123842 to 1,—it is equal to about nineteen ounces and nine-tenths avoirdupois. Now, to those who know that a full pint of soup weighs no more than about sixteen ounces avoirdupois, it will not, perhaps at the first view, appear very extraordinary, that a portion weighing near twenty ounces, and consequently making near *one pint and a quarter* of this rich, strong, savoury soup, should be found sufficient to satisfy the hunger of a grown person; but when the matter is examined narrowly, and properly analysed, and it is found that the whole quantity of *solid food* which enters into the composition of one of these portions of soup does not amount to quite *six ounces*, it will then appear to be almost impossible that this allowance should be sufficient. That it is *quite sufficient*, however, to make a good meal for a strong healthy person, has been abundantly proved by long experience. I have even found that a soup composed of nearly the same ingredients, except the potatoes, but in different proportions, was sufficiently nutritive, and very palatable, in which only about *four ounces and three quarters* of solid food entered into the composition of a portion weighing twenty ounces.

"But this will not appear incredible to those who know, that one single spoonful of *salope*, weighing less than one quarter of an ounce, put into a pint of boiling water, forms the thickest and most nourishing soup that can be taken; and that the quantity of solid matter which enters into the composition of another very nutritive food, *hartshorn jelly*, is not much more considerable. The *barley* in my soup seems to act much the same part as the *salope* in this famous restorative; and no substitute that I could ever find for it, among all the variety of corn and pulse of the growth of Europe, ever produced half the effect; that is to say, half the nourishment at the same expence. Barley may therefore be considered as the rice of Great Britain.

"It requires, it is true, a great deal of boiling; but when it is properly managed, it thickens a vast quantity of water; and, as I suppose, *prepares it for decomposition*. It also gives the soup into which it enters as an ingredient, a degree of richness which nothing else can give. It has little or no taste in itself, but when mixed with other ingredients which are savoury, it renders them peculiarly grateful to the palate.

"It is a maxim, as ancient, I believe, as the time of Hippocrates, that "*whatever pleases the palate, nourishes*;" and I have often had reason to think it perfectly just. Could it be clearly ascertained and demonstrated, it would tend to place *cookery* in a much more respectable situation among the arts than it now holds.

"That the manner in which food is prepared is a matter of real importance; and that the water used in that process acts a much more important part than has hitherto been generally imagined, is, I think, quite evident; for it seems to me to be impossible, upon any other supposition, to account for the appearances. If the very small quantity of solid food which enters into the composition of a portion of some very nutritive soup were to be prepared differently, and taken under some other form, that of bread, for instance; so far from being sufficient to satisfy hunger, and afford a comfortable and nutritive meal, a person would absolutely starve upon such a slender allowance; and no great relief would be derived from drinking *crude* water to fill up the void in the stomach.

"But it is not merely from an observation of the apparent effects of cookery upon those articles which are used as food for man, that we are led to discover the importance of these culinary processes. Their utility is proved in a manner equally conclusive and satisfactory, by the effects which have been produced by employing the same process in preparing food for brute animals. It is well known, that boiling the potatoes with which hogs are fed renders them much more nutritive; and, since the introduction of the new system of feeding horned cattle, that of keeping them confined in the stables all the year round (a method which is now coming fast into common use in many parts of Germany), great improvements have been made in the art of providing nourishment for those animals; and particularly by preparing their food, by operations similar to those of cookery; and to these improvements it is most probably owing, that stall-feeding has, in that country, been so universally successful.

"It has long been a practice in Germany for those who fatten bullocks for the butcher, or feed milch-cows, to give them fre-

quently what is called a *drank* or *drink*; which is a kind of pottage, prepared differently in different parts of the country, and in the different ſeaſons, according to the greater facility with which one or other of the articles occaſionally employed in the compoſition of it may be procured; and according to the particular fancies of individuals. Many feeders make a great ſecret of the compoſition of their *drinks*, and ſome have, to my knowledge, carried their refinement ſo far as actually to mix brandy in them, in ſmall quantities; and pretend to have found their advantage in adding this coſtly ingredient. The articles moſt commonly uſed are, bran, oatmeal, brewers' grains, maſhed potatoes, maſhed turnips, rye meal, and barley meal, with a large proportion of water; ſometimes two or three or more of theſe articles are united in forming a *drink*; and of whatever ingredients the drink is compoſed, a large proportion of ſalt is always added to it.

"There is, perhaps, nothing new in this method of feeding cattle with liquid mixtures, but the manner in which theſe drinks are now prepared in Germany is, I believe, quite new; and ſhows what I wiſh to prove, that *cooking renders food really more nutritive*. Theſe drinks were formerly given cold, but it was afterwards diſcovered that they were more nouriſhing when given warm; and of late their preparation is, in many places, become a very regular culinary proceſs. Kitchens have been built, and large boilers provided and fitted up, merely for cooking for the cattle in the ſtables; and I have been aſſured by many very intelligent farmers, who have adopted this new mode of feeding (and have alſo found by my own experience), that it is very advantageous indeed; that the drinks are evidently rendered much more nouriſhing and wholeſome by being boiled; and that the expence of fuel, and the trouble attending this proceſs, are amply compenſated by the advantages derived from the improvement of the food. We even find it advantageous to continue the boiling a conſiderable time, two or three hours, for inſtance; as the food goes on to be ſtill farther improved, the longer the boiling is continued.

"Theſe facts ſeem evidently to ſhow, that there is ſome very important ſecret with regard to nutrition, which has not yet been properly inveſtigated; and it ſeems to me to be more than probable, that the number of inhabitants who may be ſupported in any country, upon its internal produce, depends almoſt as much upon the ſtate of *the art of cookery*, as upon that of *agriculture*. The Chineſe, perhaps, underſtand both theſe arts better than any other nation. Savages underſtand neither of them.

"But, if cookery be of ſo much importance, it certainly deſerves to be ſtudied with the greateſt care; and it ought particularly to be attended to in times of general alarm on account of a ſcarcity of proviſions; for the relief which may in ſuch caſes be derived from it is immediate and effectual, while all other reſources are diſtant and uncertain."

After anticipating ſome objections to his plan, Count Rumford concludes the chapter from whence we extract, by recommending "the eſtabliſhment of *public kitchens* in all towns and large villages throughout the kingdom; whence not only the poor might be fed *gratis*, but alſo all the induſtrious inhabitants of the neighbourhood might be furniſhed with food at ſo cheap a rate, as to be a very great relief to them at all times; and in times of general ſcarcity, this arrangement would alone be ſufficient to prevent thoſe public and private calamities, which never fail to accompany that moſt dreadful of all viſitations, a famine."

Our author purſues this important ſubject, very much in detail, through ſeven chapters, abounding with ingenious matter. In the courſe of his obſervations he recommends *barley* as the moſt nutritive ſubſtance that can be employed in *ſoups*, and *Indian wheat* as the moſt profitable and palatable, when cooked after a certain way, for *puddings*. In this place, however, we can only give inſertion to the following articles.

General directions for preparing cheap Soup.—1. Each portion of ſoup ſhould conſiſt of *one pint* and a *quarter*, which, if the ſoup be rich, will afford a good meal to a grown perſon. Such a portion will in general weigh about *one pound* and a *quarter*, or *twenty ounces* avoirdupois. 2. The baſis of each portion of ſoup ſhould conſiſt of *one ounce* and a *quarter* of barley meal, boiled with *one pint* and a *quarter of water* till the whole be reduced to the uniform conſiſtency of a thick jelly. All other additions to the ſoup do little elſe than ſerve to make it more palatable; or by rendering a long maſtication neceſſary, to increaſe and prolong the pleaſure of eating; both theſe objects are however of very great importance, and too much attention cannot be paid to them: but both of them may, with proper management, be attained without much expence.

"Were I aſked to give a receipt for the cheapeſt food which, in my opinion, it would be poſſible to provide in this country, (England) it would be the following:

"*Receipt for a very cheap ſoup.*—Take of water eight gallons, and mixing it with 5lb. of barley-meal, boil it to the conſiſtency of a thick jelly. Seaſon it with ſalt, pepper, vinegar, ſweet herbs, and four red herrings, pounded in a mortar. Inſtead of bread, add to it 5lb. of Indian corn made into *ſamp*, and ſtirring it together with a ladle, ſerve it up immediately in portions of 20 ounces.

"*Samp*, which is here recommended, is a diſh ſaid to have been invented by the ſavages of North America, who have no corn-mills. It is Indian corn deprived of its external coat by ſoaking it ten or twelve hours in a lixivium of water and wood-aſhes. This coat, or huſk, being ſeparated from the kernel, riſes to the ſurface of the water, while the grain, which is ſpecifically heavier than water, remains at the bottom of the veſſel; which grain, thus deprived of its hard coat of armour, is boiled, or rather ſimmered, for a great length of time, two days for inſtance, in a kettle of water placed near the fire.—When ſufficiently cooked, the kernels will be found to be ſwelled to a great ſize and burſt open; and this food, which is uncommonly ſweet and nouriſhing, may be uſed in a great variety of ways; but the beſt way of uſing it is to mix it with milk, and with ſoups, and broths, as a ſubſtitute for bread. It is even better than bread for theſe purpoſes; for beſides being quite as palatable as the very beſt bread, as it is leſs liable than bread to grow too ſoft when mixed with theſe liquids, without being diſagreeably hard, it requires more maſtication, and conſequently tends more to increaſe and prolong the pleaſure of eating.

"The ſoup which may be prepared with the quantities of ingredients mentioned in the foregoing receipt will be ſufficient for 64 portions, and the coſt of theſe ingredients will be as follows:

	Pence.
For 5lb. of barley-meal, at $1\frac{1}{2}$ pence, the barley being reckoned at the preſent very high price of it in this country, viz. 5s. 6d. *per* buſhel	$7\frac{1}{2}$
5lb. of Indian corn, at $1\frac{1}{4}$ pence the pound	$6\frac{1}{4}$
4 red herrings	3
Vinegar	1
Salt	1
Pepper and ſweet herbs	2
Total	$20\frac{3}{4}$

"This ſum, ($20\frac{3}{4}$ pence), divided by 64, the number of portions of ſoup, gives ſomething leſs than *one third of a penny* for the coſt of each portion. But at the medium price of barley in Great Britain, and of Indian corn as may be afforded here, I am perſuaded that this ſoup may be provided at *one farthing* the portion of 20 ounces."

Food *of Plants*. See the articles Compost, Husbandry, and Plants.

FOOL. See Folly.

Fool-*Stones*, in botany. See Orchis.

FOOSHT, an iſland in the Red Sea; ſituated, according to the obſervations of Mr. Bruce, in N. lat. 15° 59′ 43″. It is deſcribed by him as about five miles in length from north to ſouth, though only *nine* in circumference. It is low and ſandy in the ſouthern part, but the north riſes in a black hill of inconſiderable height. It is covered with a kind of bent-graſs, which never arrives at any great length, by reaſon of want of rain and the conſtant browſing of the goats. There are great appearances of the black hill having once been a volcano; and near the north cape the ground ſounds hollow like the Solfaterra in Italy. The inhabitants of Fooſht are poor fiſhermen of a ſwarthy colour; going naked, excepting only a rag about the waiſt.

FOOT, a part of the body of moſt animals whereon they ſtand, walk, &c. See Anatomy, p. 168.

Foot, in the Latin and Greek poetry, a metre or meaſure, compoſed of a certain number of long and ſhort ſyllables. Theſe feet are commonly reckoned 28: of theſe ſome are ſimple, as conſiſting of two or three ſyllables, and therefore called *diſſyllabic* or *triſyllabic feet*; others are compound, conſiſting of four ſyllables, and are therefore called *tetraſyllabic feet*. The diſſyllabic feet are four in number, *viz.* the pyrrhichius, ſpondeus, iambus, and trocheus. See Pyrrhichius, &c. The triſyllabic feet are eight in number, *viz.* the dactylus, anapæſtus, tribrachys, moloſſus, amphibrachys, amphimacer, bacchius, and antibacchius. See Dactyl, &c. The tetraſyllabic are in number 16, *viz.* the procleuſmaticus, diſpondeus, choriambus, antiſpaſtus, diiambus, dichoreus, ionicus a majore, ionicus a minore, epitritus primus, epitritus ſecundus, epitritus tertius, epitritus quartus, pæon primus, pæon ſecundus, pæon tertius, and pæon quartus. See Procleusmaticus, &c.

Foot is alſo a long meaſure conſiſting of 12 inches. Geometricians divide the foot into 10 digits, and the digit into 10 lines.

Foot-*Halt*, the name of a particular diſorder incident to ſheep. It ariſes from an inſect, which, when it comes to a certain maturity, reſembles a worm of two, three, or four inches in length. The firſt appearance of the malady is, when the ſheep gives ſigns of being lame, which increaſes ſo far as to prevent his grazing; when, what with want of ſufficient food, and pain, the poor animal ſuffers greatly, and lingers till it dies a natural death, if not properly attended to by extracting the inſect; which is very eaſily done.

As ſoon as the lameneſs is perceived, let the foot that is lame be examined between the cloſe of the claws, and it will be found that in the ſkin where the cloſe ſeparates is a ſmall hole (not natural), through which the inſect, when yet ſmall, gets its entrance, and by degrees has worked itſelf upwards along the leg, between the outward ſkin and bone, and obtains its largeſt magnitude. Proportionally it finds its nouriſhment, and is left undiſturbed. This worm muſt be extracted by moving the claws backward and forward in contrary directions; and it will not be long before the under part of the worm makes its appearance at the above-mentioned ſmall hole; and continuing the ſame operation of moving the claws, the whole worm will work itſelf out; which is better than when at its firſt appearance it ſhould be drawn out with danger of breaking off, and part of it ſhould remain in the ſheep's leg, and by its rotting there may be hurtful. This eaſy and ſimple operation will be found effectual without any other kind of application whatever, nature herſelf curing the channel which the worm had made along the leg.

It is obſerved, this malady is in ſome years more prevalent than in others, particularly in wet ſeaſons. It has been obſerved to begin rather in ſpring and autumn than in ſummer and winter. In high healthy grounds, the ſheep are alſo leſs liable to it than in low marſhy and meadow grounds.

Foot *Square*, is the ſame meaſure both in breadth and length, containing 144 ſquare or ſuperficial inches.

Cubic or *Solid* Foot, is the ſame meaſure in all the three dimenſions, length, breadth, and depth or thickneſs, containing 1728 cubic inches.

Foot *of a Horſe*, in the manege, the extremity of the leg, from the coronet to the lower part of the hoof. See Farriery, p. 441, and plate 22.

Foot-*Level*, among artificers, an inſtrument that ſerves as a foot-rule, a ſquare, and a level. See Level, Rule, and Square.

FOOTE (Samuel, Eſq.), the modern Ariſtophanes, was born at Truro in Cornwall, and was deſcended from a very ancient family. His father was member of parliament for Tiverton in Devonſhire, and enjoyed the poſt of commiſſioner of the prize-office and fine-contract. His mother was heireſs of the Dinely and Goodere families. In conſequence of a fatal miſunderſtanding between her two brothers, Sir John Dinely Goodere, Bart. and Samuel Goodere, Eſq. captain of his majeſty's ſhip the Ruby, which ended in the death of both, a conſiderable part of the Goodere eſtate, which was better than 5000l. *per annum*, deſcended to Mr. Foote.

He was educated at Worceſter college, Oxford, which owed its foundation to Sir Thomas Cookes Winford, Bart. a ſecond couſin of our author's. On leaving the univerſity, he commenced ſtudent of law in the Temple; but, as the dryneſs of this ſtudy did not ſuit the livelineſs of his genius, he ſoon relinquiſhed it. He married a young lady of a good family and ſome fortune; but their tempers not agreeing, a perfect harmony did not long ſubſiſt between them. He now launched into all the faſhionable follies of the age, gaming not excepted; and in a few years ſpent his whole fortune. His neceſſities led him to the ſtage, and he made his firſt appearance in the character of Othello. He next performed Fondlewife with much more applauſe; and this, indeed, was ever after one of his capital parts. He attempted Lord Foppington likewiſe, but prudently gave it up. But as Mr. Foote was never a capital actor in the plays of others, his ſalary was very unequal to his gay and extravagant turn; and he contracted debts which forced him to take refuge within the verge of the court.

In 1747 he opened the little theatre in the Hay-market, taking upon himſelf the double character of author and performer; and appeared in a dramatic piece of his own compoſing, called the *Diverſions of the Morning*. This piece conſiſted of nothing more than the exhibition of ſeveral characters well known in real life; whoſe manner of converſation and expreſſion this author very happily hit off in the diction of his drama, and ſtill more happily repreſented on the ſtage, by an exact and moſt amazing imitation, not only of the manner and tone of voice, but even of the very perſons, of thoſe whom he intended to take off. In this performance, a certain phyſician, Dr. L—n, well known for the oddity and ſingularity of his appearance and converſation, and the celebrated Chevalier Taylor, who was at that time in the height of his popularity, were made objects of Foote's ridicule; the latter, indeed, very deſervedly; and, in the concluding part of his ſpeech, under the character of a theatrical director, Mr. Foote took off, with great humour and accuracy, the ſeveral ſtyles of acting of every principal performer on the Engliſh ſtage. This performance at firſt met with ſome oppoſition from the civil magiſtrates of Weſtminſter, under the ſanction of the act of parliament for limiting the number of playhouſes, as well as from the jealouſy of one of the managers of Drury-lane playhouſe; but the author being patronized by many of the principal nobility, and other perſons of diſtinction, this oppoſition was over-ruled:

and, having altered the title of his performance, Mr. Foote proceeded, without further moleftation, to give *Tea in a Morning* to his friends, and reprefented it through a run of 40 mornings to crowded and fplendid audiences. The enfuing feafon he produced another piece of the fame kind, which he called *An Auction of Pictures*. In this performance he introduced feveral new and popular characters; particularly Sir Thomas de Veil, then the acting juftice of peace for Weftminfter, Mr. Cock the celebrated auctioneer, and the equally famous orator Henley. This piece alfo had a very great run. His *Knights*, which was the produce of the enfuing feafon, was a performance of fomewhat more dramatic regularity: but ftill, although his plot and characters feemed lefs immediately perfonal, it was apparent that he kept fome particular real perfons ftrongly in his eye in the performance; and the town took upon themfelves to fix them where the refemblance appeared to be the moft ftriking. Thus Mr. Foote continued from time to time to felect, for the entertainment of the public, fuch characters, as well general as individual, as feemed moft likely to engage their attention. His dramatic pieces, exclufive of the interlude called *Piety in Pattens*, are as follow: Tafte, The Knights, The Author, The Englifhman in Paris, The Englifhman returned from Paris, The Mayor of Garrat, The Liar, The Patron, The Minor, The Orators, The Commiffary, The Devil upon Two Sticks, The Lame Lover, The Maid of Bath, The Nabob, The Cozeners, The Capuchin, The Bankrupt, and an unfinifhed comedy called The Slanderer. All thefe works are only to be ranked among the *petites pieces* of the theatre. In the execution they are fomewhat loofe, negligent, and unfinifhed; the plots are often irregular, and the cataftrophes not always conclufive: but, with all thefe deficiencies, they contain more ftrength of character, more ftrokes of keen fatire, and more touches of temporary humour, than are to be found in the writings of any other modern dramatift. Even the language fpoken by his characters, incorrect as it may fometimes feem, will on a clofer examination be found entirely dramatical; as it abounds with thofe natural minutiæ of expreffion which frequently form the very bafis of character, and which render it the trueft mirror of the converfation of the times in which he wrote.

In the year 1766, being on a party of pleafure with the late duke of York, lord Mexborough, and Sir Francis Delaval, Mr. Foote had the misfortune to break his leg, by a fall from his horfe; in confequence of which, he was compelled to undergo an amputation. This accident fo fenfibly affected the duke, that he made a point of obtaining for Mr. Foote a patent for life; whereby he was allowed to perform, at the little theatre in the Haymarket, from the 15th of May to the 15th of September every year.

He now became a greater favourite of the town than ever: his very laughable pieces, with his more laughable performance, conftantly filled his houfe; and his receipts were fome feafons almoft incredible. Parfimony was never a vice to be afcribed to Mr. Foote; his hofpitality and generofity were ever confpicuous; he was vifited by the firft nobility, and he was fometimes honoured even by royal guefts.

The attack made upon his character by one of his domeftics, whom he had difmiffed for mifbehaviour, is too well known to be particularized here. Suffice it to fay, he was honourably acquitted of that charge: but it is believed by fome, that the fhock which he received from it accelerated his death; others pretend, that his literary altercation with a certain *then* duchefs, or rather her agents, much affected him, and that from that time his health declined. It is probable, however, that his natural volatility of fpirits could fcarcely fail to fupport him againft all impreffions from either of thefe quarters.

Mr. Foote, finding his health decline, entered into an agreement with Mr. Colman, for his patent of the theatre, according to which, he was to receive from Mr. Colman 1600l. *per annum*, befides a ftipulated fum whenever he chofe to perform. Mr. Foote made his appearance two or three times in fome of the moft admired characters; but being fuddenly affected with a paralytic ftroke one night whilft upon the ftage, he was compelled to retire. He was advifed to bathe; and accordingly repaired to Brighthelmftone, where he apparently recovered his former health and fpirits, and was what is called the *fiddle of the company* who reforted to that agreeable place of amufement. A few weeks before his death, he returned to London; but, by the advice of his phyficians, fet out with an intention to fpend the winter at Paris and in the fouth of France. He had got no farther than Dover, when he was fuddenly attacked by another ftroke of the palfy, which in a few hours terminated his exiftence. He died on the 21ft of October 1777, in the 56th year of his age, and was privately interred in the cloifters of Weftminfter abbey.

FOP, probably derived from the *vappa* of Horace, applied in the firft fatire of his firft book to the wild and extravagant Nævius, is ufed among us to denote a perfon who cultivates a regard to adventitious ornament and beauty to excefs.

FORAMEN, in anatomy, a name given to feveral apertures or perforations in various parts of the body; as, 1. The external and internal foramina of the cranium or fkull. 2. The foramina in the upper and lower jaw. 3. Foramen lachrymale. 4. Foramen membranæ tympani. The *Foramen Ovale* is an oval aperture or paffage through the heart of a fœtus, which clofes up after birth. It arifes from the coronal vein, near the right auricle, and paffes directly into the left auricle of the heart, ferving for the circulation of the blood in the fœtus, till fuch time as the infant breathes, and the lungs are open; it being generally reckoned one of the temporary parts of the fœtus, wherein it differs from an adult; although almoft all anatomifts, Mr. Chefelden excepted, affure us, that the foramen ovale has fometimes been found in adults. See Fœtus.

FORCE, in philofophy, denotes the caufe of the change in the ftate of a body, when, being at reft, it begins to move, or has a motion which is either not uniform or not direct. While a body remains in the fame ftate, either of reft or of uniform and rectilinear motion, the caufe of its remaining in fuch a ftate is in the nature of the body, and it cannot be faid that any extrinfic force has acted on it. This internal caufe or principle is called *inertia*.

Mechanical forces may be reduced to two forts; one of a body at *reft*, the other of a body in *motion*. The force of a body at reft, is that which we conceive to be in a body lying ftill on a table, or hanging by a rope, or fupported by a fpring, &c. and this is called by the names of *preffure, tenfion, force*, or *vis mortua, folicitatio, conatus movendi, conamen*, &c. To this clafs alfo of forces we muft refer centripetal and centrifugal forces, though they refide in a body in motion; becaufe thefe forces are homogeneous to weights, preffures, or tenfions of any kind.

The force of a body in motion is a power refiding in that body fo long as it continues its motion; by means of which it is able to remove obftacles lying in its way; to leffen, deftroy, or overcome the force of any other moving body, which meets it in an oppofite direction; or to furmount any dead preffure or refiftance, as tenfion, gravity, friction, &c. for fome time; but which will be leffened or deftroyed by fuch refiftance as leffens or deftroys the motion of the body. This is called *moving force, vis motrix*, and by fome late writers *vis viva*, to diftinguifh it from the *vis mortua* fpoken of before; and by thefe appellations, however different, the fame thing is underftood by all mathematicians; namely, that power of difplacing, of withftanding oppofite moving forces, or of overcoming any dead refiftance, which refides in a moving body, and which, in whole

or in part, continues to accompany it, ſo long as the body moves. See Mechanics.

We have ſeveral curious as well as uſeful obſervations in Deſaguliers's Experimental Philoſophy, concerning the comparative forces of men and horſes, and the beſt way of applying them. A horſe draws with the greateſt advantage when the line of direction is level with his breaſt; in ſuch a ſituation, he is able to draw 200 lb. eight hours a-day, walking about two miles and an half an hour. And if the ſame horſe is made to draw 240 lb. he can work but ſix hours a-day, and cannot go quite ſo faſt. On a carriage, indeed, where friction alone is to be overcome, a middling horſe will draw 1000 lb. But the beſt way to try a horſe's force is, by making him to draw up out of a well, over a ſingle pulley or roller; and in ſuch a caſe, one horſe with another will draw 200 lb. as already obſerved. Five men are found to be equal in ſtrength to one horſe, and can with as much eaſe puſh round the horizontal beam of a mill, in a walk 40 feet wide; whereas three men will do it in a walk only 19 feet wide. The worſt way of applying the force of a horſe is to make him carry or draw up hill: for if the hill be ſteep, three men will do more than a horſe, each man climbing up faſter with a burden of 100 lb. weight, than a horſe that is loaded with 300 lb.; a difference which is owing to the poſition of the parts of the human body being better adapted to climbing than thoſe of a horſe. On the other hand, the beſt way of applying the force of a horſe is an horizontal direction, wherein a man can exert leaſt force: thus a man, weighing 140 lb. and drawing a boat along by means of a rope coming over his ſhoulders, cannot draw above 27 lb. or exert above one-ſeventh part of the force of a horſe employed to the ſame purpoſe.

The very beſt and moſt effectual poſture in a man is that of rowing; wherein he not only acts with more muſcles at once for overcoming the reſiſtance than in any other poſition, but, as he pulls backwards, the weight of his body aſſiſts by way of lever. See Deſaguliers, Exp. Phil. vol. i. p. 241 and 267.

Force, in law, ſignifies any unlawful violence offered to things or perſons, and is divided into ſimple and compound. *Simple force* is what is ſo committed, that it has no other crime attending it; as where a perſon by force enters on another's poſſeſſion, without committing any other unlawful act. *Compound force* is where ſome other violence is committed with ſuch an act, which of itſelf alone is criminal; as if one enters by force into another's houſe, and there kills a perſon or raviſhes a woman. There is likewiſe a force implied in law, as in every treſpaſs, reſcue, or diſſeiſin, and an actual force with weapons, number of perſons, &c. Any perſon may lawfully enter a tavern, inn, or victualling-houſe; ſo may a landlord his tenant's houſe, to view repairs, &c. But if, in theſe caſes, the perſon that enters commits any violence or force, the law will preſume that he entered for that purpoſe.

FORCEPS, in ſurgery, &c. an inſtrument reſembling, in ſhape, a pair of ſciſſars. Their uſe is to lay hold of any fleſhy or membranous parts of the body, as occaſion requires. See Surgery.

FORCIBLE entry, is a violent and actual entry into houſes or lands; and a forcible detainer, is where one by violence with-holds the poſſeſſion of lands, &c. ſo that the perſon who has a right of entry is barred or hindered therefrom. At common law, any perſon that had a right to enter into lands, &c. might retain poſſeſſion by force. But this liberty being abuſed, to the breach of the peace, it was therefore found neceſſary that the ſame ſhould be reſtrained: though, at this day, he who is wrongfully diſpoſſeſſed of goods may by force retake them. By ſtatute, no perſons ſhall make an entry on any lands or tenements, except where it is given by law, and in a peaceable manner, even though they have title of entry, on pain of impriſonment: and where a forcible entry is committed, juſtices of peace are authorized to view the place, and enquire of the force by a jury, ſummoned by the ſheriff of the county; and they may cauſe the tenements, &c. to be reſtored, and impriſon the offenders till they pay a fine. Likewiſe a writ of forcible entry lies, where a perſon ſeiſed of freehold is by force put out of it.

Forcible *Marriage*, of a woman of eſtate, is felony. For by the ſtatute 3 H. 7. c. 2. it is enacted, "That if any perſons ſhall take away any woman having lands or goods, or that is heir-apparent to her anceſtor, by force, and againſt her will, and *marry* or *defile* her; the takers, procurers, abettors, and receivers, of the woman taken away againſt her will, and knowing the ſame, ſhall be deemed principal felons; but as to procurers and acceſſories, they are, before the offence be committed, to be excluded the benefit of clergy, by 39 Eliz. c. 9. The indictment on the ſtatute 3 H. 7 is expreſsly to ſet forth, that the woman taken away had lands or goods, or was heir apparent; and alſo that ſhe was married or defiled, becauſe no other caſe is within the ſtatute; and it ought to allege that the taking was for lucre. It is no excuſe that the woman at firſt was taken away with her conſent: for if ſhe afterwards refuſe to continue with the offender, and be forced againſt her will, ſhe may from that time properly be ſaid to be taken againſt her will; and it is not material whether a woman ſo taken away be at laſt married or defiled with her own conſent or not, if ſhe were under force at the time; the offender being in both caſes equally within the words of the act.

Thoſe perſons who, after the fact, receive the offender, are but acceſſories after the offence, according to the rules of common law; and thoſe that are only privy to the damage, but not parties to the forcible taking away, are not within the act. H. P. C. 119. A man may be indicted for taking away a woman by force in another country; for the continuing of the force in any country amounts to a forcible taking there. *Ibid.* Taking away any woman-child, under the age of 16 years and unmarried, out of the cuſtody and without the conſent of the father or guardian, &c. the offender ſhall ſuffer fine and impriſonment; and if the woman agrees to any contract of matrimony with ſuch perſon, ſhe ſhall forfeit her eſtate during life to the next of kin to whom the inheritance ſhould deſcend, &c. Stat. 4 & 5 P and M. c. 8. This is a force againſt the parents: and an information will lie for ſeducing a young man or woman from their parents, againſt their conſents, in order to marry them, &c. See Marriage.

FORCING, in gardening, a method of producing ripe fruits from trees before their natural ſeaſon. The method of doing it is this: A wall ſhould be erected ten feet high; a border muſt be marked out on the ſouth ſide of it, of about four feet wide, and ſome ſtakes muſt be faſtened into the ground all along the edge of the border; theſe ſhould be four inches thick. They are intended to reſt the glaſs lights upon, which are to ſlope backwards to the wall, to ſhelter the fruit as there ſhall be occaſion; and there muſt be at each end a door to open either way, according as the wind blows. The frame ſhould be made moveable along the wall, that when a tree has been forced one year the frame may be removed to another, and ſo on, that the trees may each of them be forced only once in three years, at which rate they will laſt a long time. They muſt be always well-grown trees that are choſen for forcing; for young ones are ſoon deſtroyed, and the fruit that is produced from them is never ſo well taſted. The fruits moſt proper for this management are the avant or ſmall white nutmeg, the albemarle, the early Newington, and the brown nutmeg peaches; Mr. Fairchild's early, and the elrugo and Newington nectarines; the maſculine apricot, and the may-duke and may-cherry. For grapes, the white and black ſweet-water are the propereſt; and of gooſe-

berries the Dutch white, the Dutch early green, and the walnut goofeberry; and the large Dutch white and large Dutch red currants.

The dung, before it is put to the wall, fhould be laid together in a heap for five or fix days, that it may heat uniformly through; and when thus prepared it muft be laid four feet thick at the bafe of the wall, and go floping up till it is two feet thick at the top. It muft be laid at leaft within three or four inches of the top of the wall; and when it finks, as it will fink two or three feet, more dung muft be laid on; for the firft heat will do little more than juft fwell the bloffom-buds. The covering the trees with glaffes is of great fervice; but they fhould be taken off to admit the benefit of gentle fhowers to the trees, and the doors at the ends fhould be either left entirely open, or one or both of them opened, and a mat hung before them, at once to let the air circulate and keep off the frofts. The dung is never to be applied till towards the end of November; and three changes of it will be fufficient to ripen the cherries, which will be very fine in February. With regard to the apricots, grapes, nectarines, peaches, and plums, if the weather be milder, the glaffes are to be opened to let in funfhine or gentle fhowers. If a row or two of fcarlet ftrawberries be planted at the back of the frame, they will ripen in February or the beginning of March; the vines will bloffom in April, and the grapes will be ripe in June.

It fhould be carefully obferved not to place early and late ripening fruits together, becaufe the heat neceffary to force the late ones will be of great injury to the early ones after they have fruited. The mafculine apricot will be ripe in the beginning of April, the early nectarines will be ripe about the fame time, and the forward fort of plums by the latter end of that month. Goofeberries will have fruit fit for tarts in January or February, and will ripen in March; and currants will have ripe fruit in April. The trees need not be planted fo diftant at thefe walls as at others, for they do not fhoot fo freely as in the open air: nine feet afunder is fufficient. They fhould be pruned about three weeks before the heat is applied.

Forcing, in the wine trade, a term ufed by the wine-coopers, for the fining down wines, and rendering them fit for immediate draught. The principal inconvenience of the common way of fining down the white-wines by ifinglafs, and the red by whites of eggs, is the flownefs of the operation; thefe ingredients not performing their office in lefs than a week, or fometimes a fortnight, according as the weather proves favourable, cloudy or clear, windy or calm: this appears to be matter of conftant obfervation. But the wine-merchant frequently requires a method that fhall with certainty make the wines fit for tafting in a few hours. A method of this kind there is, but it is kept in a few hands a valuable fecret. Perhaps it depends upon a prudent ufe of a tartarized fpirit of wine, and the common forcing, as occafion is, along with gypfum, as the principal; all which are to be well ftirred about in wine, for half an hour before it is fuffered to reft.

FORDOUN (John of), the father of Scottifh hiftory, flourifhed in the reign of Alexander III. towards the end of the 13th century. But of his life there is nothing known with certainty, though there was not a monaftery that poffeffed not copies of his work. The firft five books of the hiftory which bears his name were written by him: the reft were fabricated from materials left by him, and from new collections by different perfons. A manufcript in vellum of this hiftorian is in the library of the univerfity of Edinburgh.

FORDWICH, a member of the town and port of Sandwich in Kent, feated on the river Stour, and governed by a mayor, jurats, and commonalty. It is noted for its excellent trouts, and lies three miles N. E. of Canterbury, and eight W. of Sandwich.

FORDYCE (David), an elegant and learned writer of the prefent age, was profeffor of philofophy in the Marifchal-college, Aberdeen. He was originally defigned for the miniftry; to prepare himfelf for which was the whole aim of his ambition, and for a courfe of years the whole purpofe of his ftudies. How well he was qualified to appear in that character, appears from his "Theodorus, a dialogue concerning the art of preaching." After having finifhed this work, he went abroad on his travels, in order to obtain frefh ftores of knowledge: but after a fuccefsful tour through feveral parts of Europe, he was unfortunately caft away in a ftorm on the coaft of Holland. Befides the above work, he wrote Dialogues on Education, 8vo, and a Treatife of Moral Philofophy, publifhed in the Preceptor. The third edition of his Theodorus was publifhed in London, after his untimely death, by his brother the Rev. Mr. James Fordyce, an eminent diffenting minifter, in 1755.

FORE, applied to a fhip, denotes all that part of a fhip's frame and machinery which lies near the ftem.

Fore *and aft* is ufed for the whole fhip's length, or from end to end.

FORECASTLE *of a* Ship, that part where the foremaft ftands. It is divided from the reft by a bulk-head.

FOREIGN, fomething extraneous, or that comes from abroad. The word is formed from the Latin *fores*, "doors;" or *foris*, "out of doors;" or *forum*, "market," &c. Foreign minifter, foreign prince, goods, &c. are thofe belonging to other nations. See Minister, &c. *Foreign to the purpofe*, fignifies a thing remote or impertinent.

Foreign *Attachment*, in law, is an attachment of the goods of foreigners found within a city or liberty, for the fatisfaction of fome citizen to whom the foreigner is indebted; or it fignifies an attachment of a foreigner's money in the hands of another perfon.

Foreign *Kingdom*, a kingdom under the dominion of a foreign prince. At the inftance of an ambaffador or conful, any offender againft the laws here may be fent for hither from a foreign kingdom to which he hath fled. And where a ftranger of Holland, or any foreign country, buys goods at London, for inftance, and there gives a note under his hand for payment, and then goes away privately into Holland; in that cafe, the feller may have a certificate from the lord mayor, on the proof of the fale and delivery of fuch goods, whereupon a procefs will be executed on the party in Holland.

Foreign *Oppofer*, or *Appofer*, an officer in the exchequer that oppofes or makes a charge on all fheriffs, &c. of their green wax; that is to fay, fines, iffues, amerciaments, recognizances, &c.

Foreign *Plea*, fignifies an objection to the judge of the court, by refufing him as incompetent, becaufe the matter in queftion is not within his jurifdiction.

Foreign *Seamen*, ferving two years on board Britifh fhips, whether of war, trade, or privateers, during the time of war, fhall be deemed natural-born fubjects.

FOREIGNER, the natural-born fubject to fome foreign prince. Foreigners, though made denizens, or naturalized, are difabled to bear any office in government, to be of the privy council, or members of parliament, &c. This is by the acts of the fettlement of the crown. Such perfons as are not freemen of a city or corporation are alfo called *foreigners*, to diftinguifh them from the members of the fame.

FOREJUDGER, in law, fignifies a judgment whereby one is deprived or put by a thing in queftion. To be *forejudged the court*, is where an officer or attorney of any court is expelled the fame for malpractice, or for not appearing to an action on a bill filed againft him, &c. And where an attorney of the common-pleas is fued, the plaintiff's attorney delivers the bill to one of the criers of the court, who calls the attorney de-

fendant, and solemnly proclaims aloud, that, if he does not appear thereto, he will be forejudged: likewise a rule is given by the secondary for his appearance: and if the attorney appears not in four days, then the clerk of the warrants strikes such an attorney off the roll of attorneys; after which he becomes liable to be arrested like any other person: but when an attorney is forejudged, he may be restored on clearing himself from his contumacy, and making satisfaction to the plaintiff, &c.

FORELAND, or Foreness, in navigation, a point of land jutting out into the sea.

North Foreland, a promontory, which is the N. E. point of the Isle of Thanet in Kent. It is also the most southern part of the port of London, which is thence extended N. in a right line to the point called the Nase, in Essex, and forms the mouth of the Thames. Here is a round brick tower, near 80 feet high, erected by the Trinity House, for a seamark.

South Foreland, a headland, forming the E. part of the coast of Kent, and called South, in respect to its bearing from the other Foreland, which is about six miles to the N. Between these two capes is the noted road called the Downs, to which they are a great security.

FORE-LOCKS, in the sea-language, little flat wedges made with iron, used at the ends of bolts, to keep them from flying out of their holes.

FORE-MAST of a Ship, a large round piece of timber, placed in her fore-part or fore-castle, and carrying the fore-sail and fore-top-sail yards. Its length is usually $\frac{8}{9}$ of the main-mast, and the fore-top-gallant-mast is $\frac{1}{2}$ the length of the fore-top.

Foremast-*Men*, are those on board a ship that take in the top-sails, sling the yards, furl the sails, bowse, trice, and take their turn at the helm, &c.

FOREST, in geography, a huge wood; or, a large extent of ground covered with trees. The word is formed of the Latin *foresta*, which first occurs in the capitulars of Charlemagne, and which itself is derived from the German *frost*, signifying the same thing. Spelman derives it from the Latin *foris restat*, by reason forests are out of towns. Others derive *foresta* from *feris*, q. d *Foresta, quoad sit tuta statio ferarum*, as being a safe station or abode for wild beasts. The Caledonian and Hercynian forests are famous in history. The first was a celebrated retreat of the ancient Picts and Scots: the latter anciently occupied the greatest part of Europe; particularly Germany, Poland, Hungary, &c. In Cæsar's time it extended from the borders of Alsatia and Switzerland to Transylvania, and was computed 60 days journey long, and 9 broad: some parts or cantons thereof are still remaining. The ancients adored forests, and imagined a great part of their gods to reside therein: temples were frequently built in the thickest forests; the gloom and silence whereof naturally inspire sentiments of devotion, and turn men's thoughts within themselves. For the like reason, the Druids made forests the place of their residence, performed their sacrifices, instructed their youth, and gave laws therein.

Forest, in law, is defined by Manwood a certain territory of woody grounds and fruitful pastures, privileged for wild beasts and fowls of forest, chase, and warren, to rest and abide under the protection of the king, for his princely delight; bounded with unremoveable marks and meres, either known by matter of record or prescription; replenished with wild beasts of venery or chase, with great coverts of vert for the said beasts; for preservation and continuance whereof, the vert and venison, there are certain particular laws, privileges, and officers. Forests are of such antiquity in England, that, excepting the New-Forest in Hampshire, erected by William the Conqueror, and Hampton-Court, erected by Henry VIII. it is said, that there is no record or history which makes any certain mention of their erection, though they are mentioned by several writers and in several of our laws and statutes. Ancient historians tell us, "that New-forest was raised by the destruction of 22 parish-churches, and many villages, chapels, and manors, for the space of 30 miles together, which was attended with divers judgments on the posterity of William I. who erected it: for William Rufus was there shot with an arrow, and before him Richard the brother of Henry I.; and Henry nephew to Robert, the eldest son of the Conqueror, did hang by the hair of the head in the boughs of the forest, like unto Absalom." *Blount.* Besides the New-Forest, there are 68 other forests in England, 13 chases, and more than 700 parks: the four principal forests are New-forest on the sea, Snirewood-forest on the Trent, Dean-forest on the Severn, and Windsor-forest on the Thames. A forest in the hands of a subject is properly the same thing with a Chase; being subject to the common law, and not to the forest-laws. But a chase differs from a forest, in that it is not inclosed; and likewise, that a man may have a chase in another man's ground as well as his own; being indeed the liberty of keeping beasts of chase, or royal game therein, protected even from the owner of the land, with a power of hunting them thereon. See Park.

The manner of erecting a forest is thus: Certain commissioners are appointed under the great seal, who view the ground intended for a forest, and fence it round: this commission being returned into chancery, the king causeth it to be proclaimed throughout the county where the land lieth, that it is a forest; and prohibits all persons from hunting there without his leave. Though the king may erect a forest on his own ground and waste, he may not do it on the ground of other persons without their consent; and agreements with them for that purpose ought to be confirmed by parliament. A forest, strictly taken, cannot be in the hands of any but the king; for no person but the king has power to grant a commission to be justice in eyre of the forest: yet, if he grants a forest to a subject, and that on request made in the chancery, that subject and his heirs shall have justices of the forest, in which case the subject has a forest in law. A second property of a forest is, the courts thereof. See Forest-*Courts*. A third property is the officers belonging to it, as the justices, warden, verderer, forester, agistor, regarder, keeper, bailiff, beadle, &c. See the articles Agistor, Bailiff, Forester, &c.

By the laws of the forest, the receivers of trespasses in hunting or killing of the deer, if they know them to be the king's property, are principal trespassers. Likewise, if a trespass be committed in a forest, and the trespasser dies, after his death it may be punished in the life-time of the heir, contrary to common law. Our Norman kings punished such as killed deer in any of their forests with great severity; also in various manners; as by hanging, loss of limbs, gelding, and putting out eyes. By *magna charta de foresta*, it is ordained, that no person shall lose life or member for killing the king's deer in forests, but shall be fined; and, if the offender has nothing to pay the fine, he shall be imprisoned a year and a day, and then be delivered, if he can give security not to offend for the future, &c. 9 Hen. III. c. 1. Before this statute, it was felony to hunt the king's deer; and by a late act, persons armed and disguised, appearing in any forest, &c. if they hunt, kill, or steal any deer, &c. are guilty of felony. 9 Geo. I. c. 22. He who has any licence to hunt in a forest or chase, &c. is to take care that he does not exceed his authority; otherwise he shall be deemed a trespasser from the beginning, and be punished for that fact, as if he had had no licence. See the articles Game and *Game*-Law.

Beasts of the Forest, are the hart, hind, buck, doe, boar, wolf, fox, hare, &c. The seasons for hunting them are as follow, *viz.* that of the hart and buck begins at the feast of St. John Baptist, and ends at Holy-rood day; of the hind and doe, be-

gins at Holy-rood, and continues till Candlemas; of the boar, from Chriſtmas to Candlemas; of the fox begins at Chriſtmas, and continues till Lady-day; of the hare at Michaelmas, and laſts till Candlemas.

Forest-*Courts*, courts inſtituted for the government of the king's foreſts in different parts of the kingdom, and for the puniſhment of all injuries done to the king's deer or veniſon, to the vert or greenſward, and to the covert in which ſuch deer are lodged. Theſe are the courts of Attachments, of Regard, of Sweinmote, and of Justice seat. 1. The court of attachments, wood-mote, or forty-days court, Judge Blackſtone obſerves, is to be held before the verderers of the foreſt once in every forty days; and is inſtituted to inquire into all offenders againſt vert and veniſon: who may be attached by their bodies, if taken with the mainour (or *mainœuvre, à manu)* that is, in the very act of killing veniſon, or ſtealing wood, or in the preparing ſo to do, or by freſh and immediate purſuit after the act is done; elſe they muſt be attached by their goods. And in this forty-days' court the foreſters or keepers are to bring in the attachments, or preſentments *de viridi et venatione*; and the verderers are to receive the ſame, and to enrol them, and to certify them under their ſeals to the court of juſtice-ſeat or ſweinmote: for this court can only inquire of, but not convict, offenders. 2. The court of regard, or ſurvey of dogs, is to be holden every third year for the lawing or expeditation of maſtiffs; which is done by cutting off the claws of the fore-feet, to prevent them from running after deer. No other dogs but maſtiffs are to be thus lawed or expeditated, for none other were permitted to be kept within the precincts of the foreſts; it being ſuppoſed that the keeping of theſe, and theſe only, was neceſſary for the defence of a man's houſe. 3. The court of ſweinmote is to be holden before the verderers, as judges, by the ſteward of the ſweinmote, thrice in every year; the ſweins or freeholders within the foreſt compoſing the jury. The principal juriſdiction of this court is, firſt, to inquire into the oppreſſions and grievances committed by the officers of the foreſt; "*de ſuper-oneratione foreſtarorium, et aliorum miniſtrorum foreſtæ; et de eorum oppreſſionibus populo regis illatis*:" and, ſecondly, to receive and try preſentments certified from the court of attachments againſt offences in vert and veniſon. And this court may not only inquire, but convict alſo; which conviction ſhall be certified to the court of juſtice-ſeat under the ſeals of the jury, for this court cannot proceed to judgment. But the principal court is, 4. The court of juſtice-ſeat, which is held before the chief juſtice in eyre, or chief itinerant judge, *capitalis juſtitiarius in itinere,* or his deputy; to hear and determine all treſpaſſes within the foreſt, and all claims of franchiſes, liberties, and privileges, and all pleas and cauſes whatſoever therein ariſing. It may alſo proceed to try preſentments in the inferior courts of the foreſts, and to give judgment upon conviction of the ſweinmote. And the chief juſtice may therefore, after preſentment made or indictment found, but not before, iſſue his warrant to the officers of the foreſt to apprehend the offenders. It may be held every third year; and 40 days notice ought to be given of its ſitting. This court may fine and impriſon for offences within the foreſt, it being a court of record: and therefore a writ of error lies from hence to the court of king's-bench, to rectify and redreſs any mal-adminiſtrations of juſtice; or the chief juſtice in eyre may adjourn any matter of law into the court of king's-bench.

Forest-*Laws*, are peculiar laws, different from the common law of England. Before the making of *Charta de Foreſta*, in the time of king John and his ſon Henry III. confirmed in parliament by 9 Henry III. offences committed therein were puniſhed at the pleaſure of the king in the ſevereſt manner. By this charter, many foreſts were diſafforeſted and ſtripped of their oppreſſive privileges, and regulations were made for the government of thoſe that remained; particularly, killing the king's deer was made no longer a capital offence, but only puniſhed by fine, impriſonment, or abjuration of the realm: yet even in the charter there were ſome grievous articles, which the clemency of later princes has ſince by ſtatute thought fit to alter *per aſſiſas foreſtæ*. And to this day, in treſpaſſes relating to the foreſt, *voluntas reputabitur pro facto*; ſo that if a man be taken hunting a deer, he may be arreſted as if he had taken a deer.

Forest-*Towns*, in geography, certain towns of Suabia in Germany, lying along the Rhine, and the confines of Switzerland, and ſubject to the houſe of Auſtria. Their names are *Rhinefield, Seckingen, Lauſenburg*, and *Waldſhut*.

FORE-staff, an inſtrument uſed at ſea for taking the altitudes of heavenly bodies. The fore-ſtaff, called alſo *croſs-ſtaff*, takes its denomination hence, that the obſerver, in uſing it, turns his face towards the object; in contradiſtinction to the back-ſtaff, where he turns his back to the object. The fore or croſs-ſtaff, repreſented in plate 25. conſiſts of a ſtraight ſquare ſtaff, A B, graduated like a line of tangents and four croſſes or vanes, F F, E E, D D, C C, which ſlide thereon. The firſt and ſhorteſt of theſe vanes, F F, is called the *ten-croſs*, or *vane*, and belongs to that ſide of the inſtrument whereon the diviſions begin at three degrees and end at ten. The next longer vane, E E, is called the *thirty-croſs*, belonging to that ſide of the ſtaff wherein the diviſions begin at ten degrees and end at thirty, called the *thirty-ſcale*. The next vane, D D, is called the *ſixty-croſs*, and belongs to the ſide where the diviſions begin at twenty degrees and end at ſixty. The laſt and longeſt, C C, called the *ninety-croſs*, belongs to the ſide whereon the diviſions begin at thirty degrees and end at ninety. The great uſe of this inſtrument is to take the height of the ſun and ſtars, or the diſtance of two ſtars: and the ten, thirty, ſixty, or ninety croſſes are to be uſed according as the altitude is greater or leſs; that is, if the altitude be leſs than ten degrees, the ten-croſs is to be uſed; if above ten, but leſs than thirty, the thirty-croſs is to be uſed, &c. For altitudes greater than thirty degrees, however, this inſtrument is not ſo convenient as a quadrant or ſemicircle.

To obſerve an altitude by this inſtrument, apply the flat end of the ſtaff to your eye, and look at the upper end of the croſs for the centre of the ſun or ſtar, and at the lower end for the horizon. If you ſee the ſky inſtead of the horizon, ſlide the croſs a little nearer the eye; and, if you ſee the ſea inſtead of the horizon, ſlide the croſs farther from the eye: and thus continue moving till you ſee exactly the ſun or ſtar's centre by the top of the croſs, and the horizon by the bottom of it. Then the degrees and minutes, cut by the inner edge of the croſs upon the ſide of the ſtaff peculiar to the croſs you uſe, give the altitude of the ſun or ſtar.

If it be the meridian altitude you want, continue your obſervation as long as you find the altitude increaſe, ſtill moving the croſs nearer to the eye. By ſubtracting the meridian altitude thus found from 90 degrees, you will have the zenith diſtance. To work accurately, an allowance muſt be made for the height of the eye above the ſurface of the ſea, viz. for one Engliſh foot, 1 minute; for 5 feet, $2\frac{1}{2}$; for 10 feet, $3\frac{1}{2}$; for 20 feet, 5; for 40 feet, 7, &c. Theſe minutes ſubtracted from the altitude obſerved, and added to the zenith diſtance obſerved, give the true altitude and zenith diſtance.

To obſerve the diſtance of two ſtars, or the moon's diſtance from a ſtar, by the fore-ſtaff, apply the inſtrument to the eye, and, looking to both ends of the croſs, move it nearer or farther from the eye till you ſee the two ſtars, the one on the one end and the other on the other end of the croſs; then the degrees and minutes cut by the croſs on the ſide proper to the vane in uſe give the ſtars' diſtance.

FORESTALLING, in law, buying or bargaining for any

corn, cattle, victuals, or merchandise, in the way as they come to fairs or markets to be sold, before they get thither, with an intent to sell the same again at a higher price. The punishment for this offence, upon conviction at the quarter-sessions by two or more witnesses, is, for the first time, two months imprisonment and the loss of the goods, or the value; for the second offence, the offender shall be imprisoned six months, and lose double the value of the goods; for the third offence, he shall suffer imprisonment during the king's pleasure, forfeit all his goods and chattels, and stand on the pillory: but the statute does not extend to maltsters buying barley, or to badgers who are licensed.

FORESTER, a sworn officer of the forest, appointed by the king's letters-patent, to walk the forest at all hours, and watch over the vert and venison; also to make attachments and true presentments of all trespasses committed within the forest. If a man co..es into a forest in the night, a forester cannot lawfully beat him before he makes some resistance; but in case such person resists the forester, he may justify a battery. And a forester shall not be questioned for killing a trespasser that, after the peace cried to him, will not surrender himself, if it be not done on any former malice; though, where trespassers in a forest, &c. do kill a person that opposes them, it is murder in all, because they were engaged in an unlawful act, and therefore malice is implied to the person killed.

FORFAR, the county town of the shire of Angus or Forfar, in Scotland. It contains many neat modern houses, and is situated in an extensive plain. Near the town was formerly a lake, now almost drained, on account of a stratum of rich marl found at its bottom. Forfar is 14 miles W. of Montrose. W. lon. 2. 54. N. lat. 56. 35.

FORFAR-*Shire*, a county of Scotland, of which Forfar is the capital. Including Angus, Glenila, Glenesk, and Glenpratlin, it extends 29 miles from east to west, and 16 where broadest, though in some places the breadth does not exceed five miles. On the north it is divided from the Brae of Mar by a ridge of the Binchinin mountains; it is bounded on the south by the Frith of Tay and the British ocean, on the east by Mearns, and on the west by Perthshire. Part of the Grampian mountains runs through this county, which is agreeably diversified with hill and dale.

FORFEITURE, originally signifies a transgression, or offence against some penal law. The word is formed of the base Latin *forisfactura*: whence *forfaitura* and *forfaictura*, and the French *forfait*. *Forisfactura* comes of *forisfacere*; which, according to Isidore, signifies to "hurt or offend," *facere contra rationem*; and which is not improbably derived of *foris* "out," and *facere*, "to do," q. d. an action out of rule, or contrary to the rules. Borel will have *forfait* derived from the using of force or violence: Lobineau in his glossary will have *forisfacta* properly to signify a mulct or amend, not a *forfeit*; which latter he derives from the base British *forfed*, "a penalty." But with us it is now more frequently used for the effect of such transgression; or the losing some right, privilege, estate, honour, office, or effects, in consequence thereof; than for the transgression itself. Forfeiture differs from *confiscation*, in that the former is more general; while confiscation is particularly applied to such things as become forfeited to the king's exchequer; and goods confiscated are said to be such as nobody claims. Forfeitures may be either in *civil* or *criminal* cases.

I. With respect to the first, a man that hath an estate for life or years may forfeit it many ways, as well as by treason or felony; such as alienation, claiming a greater estate than he hath, or affirming the reversion to be in a stranger, &c. When a tenant in tail makes leases not warranted by the statute, a copyholder commits waste, refuses to pay his rent, or do suit of court; and where an estate is granted upon condition, on non-performance thereof, &c. they will make a forfeiture. Entry for a forfeiture ought to be by him who is next in reversion, or remainder, after the estate forfeited. As if tenant for life or years commits a forfeiture, he who has the immediate reversion or remainder ought to enter; though he has the fee, or only an estate-tail.

II. Forfeiture in criminal cases is two-fold; namely, of *real* and *personal* estates.

1. As to real estates, by ATTAINDER in high-treason, a man forfeits to the king all his lands and tenements of inheritance, whether fee-simple or fee-tail; and all his rights of entry on lands and tenements, which he had at the time of the offence committed, or at any time afterwards, to be for ever vested in the crown; and also the profits of all lands and tenements, which he had in his own right for life or years, so long as such interest shall subsist. This forfeiture, says Blackstone, relates backwards to the time of the treason committed; so as to avoid all intermediate sales and incumbrances, but not those before the fact: and therefore a wife's jointure is not forfeitable for the treason of her husband; because settled upon her previous to the treason committed. But her dower is forfeited, by the express provision of statute 5 and 6 Edw. VI. c. 11. And yet the husband shall be tenant by the courtesy of the wife's lands, if the wife be attainted of treason: for that is not prohibited by the statute. But, though after attainder the forfeiture relates back to the time of the treason committed, yet it does not take effect unless an attainder be had, of which it is one of the fruits; and therefore, if a traitor dies before judgment pronounced, or is killed in open rebellion, or is hanged by martial law, it works no forfeiture of his lands: for he never was attainted of treason. But if the chief justice of the king's bench (the supreme coroner of all England) in person, upon the view of the body of him killed in open rebellion, records it and returns the record into his own court, both lands and goods shall be forfeited.

The natural justice of forfeiture or confiscation of property for treason is founded on this consideration: That he who hath thus violated the fundamental principles of government, and broken his part of the original contract between king and people, hath abandoned his connections with society, and hath no longer any right to those advantages which before belonged to him purely as a member of the community; among which *social* advantages, the right of transferring or transmitting property to others is one of the chief. Such forfeitures, moreover, whereby his posterity must suffer as well as himself, will help to restrain a man, not only by the sense of his duty and dread of personal punishment, but also by his passions and natural affections; and will interest every dependant and relation he has to keep him from offending: according to that beautiful sentiment of Cicero, "*Nec vero me fugit quam sit acerbum, parentum scelera filiorum pœnis lui: sed hoc præclare legibus comparatum est, ut caritas liberorum amiciores parentes reipublicæ redderet.*" And therefore Aulus Cascellius, a Roman lawyer in the time of the triumvirate, used to boast that he had two reasons for despising the power of the tyrants; his old age and his want of children: for children are pledges to the prince of the father's obedience. Yet many nations have thought that this posthumous punishment favours of hardship to the innocent; especially for crimes that do not strike at the very root and foundation of society, as treason against the government expressly does. And therefore, although confiscations were very frequent in the times of the earlier emperors, yet Arcadius and Honorius, in every other instance but that of treason, thought it more just, *ibi esse pœnam, ubi et noxa est*; and ordered, that "*peccata suos teneant auctores, nec ulterius progrediatur metus, quam reperiatur delictum*:" and Justinian also made a law to restrain the punishment of relations; which directs the for-

feiture to go, except in the caſe of *crimen majeſtatis*, to the next of kin to the delinquent. On the other hand, the Macedonian laws extended even the capital puniſhment of treaſon not only to the children, but to all the relations of the delinquent: and of courſe their eſtates muſt be alſo forfeited, as no man was left to inherit them. And in Germany, by the famous golden bull (copied almoſt *verbatim* from Juſtinian's code), the lives of the ſons of ſuch as conſpire to kill an elector are ſpared, as it is expreſſed, by the emperor's *particular bounty*. But they are deprived of all their effects and rights of ſucceſſion, and are rendered incapable of any honour eccleſiaſtical and civil: to the end that, being always poor and neceſſitous, they may for ever be accompanied by the infamy of their father, may languiſh in continual indigence, and may find (ſays this mercileſs edict) their puniſhment in living, and their relief in dying."

In England, forfeiture of lands and tenements to the crown for treaſon is by no means derived from the feodal policy, but was antecedent to the eſtabliſhment of that ſyſtem in this iſland; being tranſmitted from our Saxon anceſtors, and forming a part of the ancient Scandinavian conſtitution. But in certain treaſons relating to the coin (which ſeem rather a ſpecies of the *crimen falſi* than the *crimen læſæ majeſtatis*), it is provided by ſome of the modern ſtatutes which conſtitute the offence, that it ſhall work no forfeiture of lands, ſave only for the life of the offenders; and by all, that it ſhall not deprive the wife of her dower. And, in order to aboliſh ſuch hereditary puniſhment entirely, it was enacted by ſtatute 7 Ann. c. 21. that, after the deceaſe of the late pretender, no attainder for treaſon ſhould extend to the diſinheriting of any heir, nor to the prejudice of any perſon, other than the traitor himſelf. By which the law of forfeitures for high treaſon would by this time have been at an end, had not a ſubſequent ſtatute intervened to give them a longer duration. The hiſtory of this matter is ſomewhat ſingular, and worthy of obſervation. At the time of the union, the crime of treaſon in Scotland was, by the Scots law, in many reſpects different from that of treaſon in England; and particularly in its conſequence of forfeitures of entailed eſtates, which was more peculiarly Engliſh: yet it ſeemed neceſſary, that a crime ſo nearly affecting government ſhould, both in its eſſence and conſequences, be put upon the ſame footing in both parts of the united kingdoms. In new-modelling theſe laws, the Scots nation and the Engliſh houſe of commons ſtruggled hard, partly to maintain and partly to acquire a total immunity from forfeiture and corruption of blood: which the houſe of lords as firmly reſiſted. At length a compromiſe was agreed to, which is eſtabliſhed by this ſtatute, *viz.* that the ſame crimes, and no other, ſhould be treaſon in Scotland that are ſo in England: and that the Engliſh forfeitures and corruption of blood ſhould take place in Scotland till the death of the then pretender, and then ceaſe throughout the whole of Great Britain: the lords artfully propoſing this temporary clauſe, in hopes (it is ſaid) that the prudence of ſucceeding parliaments would make it perpetual. This has partly been done by the ſtatute 17 Geo. II. c. 39. (made in the year preceding the late rebellion), the operation of theſe indemnifying clauſes being thereby ſtill farther ſuſpended till the death of the ſons of the pretender.

In petit treaſon and felony, the offender alſo forfeits all his chattel intereſts abſolutely, and the profits of all freehold eſtates during life; and after his death all his lands and tenements in fee-ſimple (but not thoſe in tail) to the crown, for a very ſhort period of time: for the king ſhall have them for a year and a day, and may commit therein what waſte he pleaſes; which is called the king's *year, day*, and *waſte*. Formerly the king had only a liberty of committing waſte on the lands of felons, by pulling down their houſes, extirpating their gardens, ploughing their meadows, and cutting down their woods. And a puniſhment of a ſimilar ſpirit appears to have obtained in the oriental countries, from the decrees of Nebuchadnezzar and Cyrus in the books of Daniel and Ezra; which, beſides the pain of death inflicted on the delinquents there ſpecified, ordain, "that their houſes ſhall be made a dunghill." But this tending greatly to the prejudice of the public, it was agreed, in the reign of Henry I. in England, that the king ſhould have the profits of the land for one year and a day, in lieu of the deſtruction he was otherwiſe at liberty to commit: and therefore *magna charta* provides, that the king ſhall only hold ſuch lands for a year and a day, and then reſtore them to the lord of the fee, without any mention made of waſte. But the ſtatute 17 Edw. II. *de prerogativa regis*, ſeems to ſuppoſe that the king ſhall have his year, day, *and* waſte; and not the year and day *inſtead of* waſte: which Sir Edward Coke (and the author of the Mirror before him) very juſtly look upon as an encroachment, though a very ancient one, of the royal prerogative. This year, day, and waſte, are now uſually compounded for; but otherwiſe they regularly belong to the crown; and after their expiration the land would naturally have deſcended to the heir (as in gavelkind tenure it ſtill does), did not its feodal quality intercept ſuch deſcent, and give it by way of eſcheat to the lord. Theſe forfeitures for felony do alſo ariſe only upon attainder; and therefore a *felo de ſe* forfeits no lands of inheritance or freehold, for he never is attainted as a felon. They likewiſe relate back to the time the offence was committed as well as forfeitures for treaſon, ſo as to avoid all intermediate charges and conveyances. This may be hard upon ſuch as have unwarily engaged with the offender: but the cruelty and reproach muſt lie on the part, not of the law, but of the criminal; who has thus knowingly and diſhoneſtly involved others in his own calamities.

2. The forfeiture of *goods and chattels* accrues in every one of the high kinds of offence; in high treaſon, or miſpriſion thereof, petit treaſon, felonies of all ſorts whether clergyable or not, ſelf-murder or felony *de ſe*, petty larceny, ſtanding mute, &c. For flight alſo, on an accuſation of treaſon, felony, or even petit larceny, whether the party be found guilty or acquitted, if the jury find the flight, the party ſhall forfeit his goods and chattels: for the very flight is an offence, carrying with it a ſtrong preſumption of guilt, and is at leaſt an endeavour to elude and ſtifle the courſe of juſtice preſcribed by the law. But the jury very ſeldom find the flight; forfeiture being looked upon, ſince the vaſt increaſe of perſonal property of late years, as too large a penalty for an offence to which a man is prompted by the natural love of liberty.

There is a remarkable difference or two between the forfeiture of lands and of goods and chattels. (1.) Lands are forfeited upon *attainder*, and not before: goods and chattels are forfeited by *conviction*. Becauſe in many of the caſes where goods are forfeited, there never is any attainder; which happens only where judgment of death or outlawry is given: therefore, in thoſe caſes, the forfeiture muſt be upon conviction, or not at all; and, being neceſſarily upon conviction in thoſe, it is ſo ordered in all other caſes, for the law loves uniformity. (2.) The forfeiture of lands has relation to the time the fact was committed, ſo as to avoid all ſubſequent ſales and incumbrances: but the forfeiture of goods and chattels has no relation backwards; ſo that thoſe only which a man has at the time of conviction ſhall be forfeited. Therefore a traitor or felon may *bona fide* ſell any of his chattels, real or perſonal, for the ſuſtenance of himſelf and family between the fact and conviction: for perſonal property is of ſo fluctuating a nature, that it paſſes through many hands in a ſhort time; and no buyer could be ſafe, if he were liable to return the goods which he had fairly bought, provided any of the prior vendors had committed a treaſon or felony. Yet if they be colluſively and not *bona fide* parted with, merely to defraud the crown, the law (and parti-

cularly the statute 13 Eliz. c. 5.) will reach them; for they are all the while truly and substantially the goods of the offender: and as he, if acquitted, might recover them himself, as not parted with for a good consideration; so, in case he happens to be convicted, the law will recover them for the king.

FORFEX, in Roman antiquity, was a way of drawing up an army in the form of a pair of sheers. It was intended to receive the *cuneus* or wedge, if the enemy should make use of that figure. For when the forfex opened to admit the wedge, they had an opportunity of defeating their design, and cutting them in pieces.

FORFICULA, the EAR-WIG, in zoology, a genus of insects belonging to the order of coleoptera. The antennæ are bristly; the elytra are dimidiated; the wings are covered; and the tail is forked. There are two species, *viz.* the auricularia, or common ear-wig, with the tops of the elytra white; and the minor, with testaceous and unspotted elytra. This genus of insects is one of the best known, the forceps at the extremity of their abdomen forming a very distinctive character. It is this seeming weapon that has occasioned those insects to be called *forficulæ* in Latin; and the formidable name of *ear-wigs* has been given them in English, from a notion that the insect frequently introduces itself into the ears, causing great pain, and even death. Mr. Barbut, however, assures us, that the forceps which the ear-wig carries at his tail, and with which he seems provided for his defence, is not so formidable as it at first appears, being destitute of strength sufficient to produce the least sensible impression. The larva of the ear-wig differs very little from the perfect insect. Ear-wigs are very mischievous in gardens, especially where carnations are preserved; for they are so fond of these flowers, that, if care is not taken to prevent them, they will entirely destroy them, by eating off the sweet part at the bottom of the petals. To prevent this, most people have stands erected, which have a bason of earth or lead round each supporter, which is constantly kept filled with water. Some hang the heads of tobacco pipes, or the hollow claws of crabs and lobsters upon sticks in different parts of the garden, into which the ear-wigs get, and are then easily shaken out and destroyed.

FORGE, properly signifies a little furnace, wherein smiths and other artificers of iron or steel, &c. heat their metals red-hot, in order to soften them and render them more malleable and manageable on the anvil.

An ordinary forge is nothing but a pair of bellows, the nozzle of which is directed upon a smooth area, on which coals are placed. The nozzle of a pair of bellows may be also directed to the bottom of any furnace, to excite the combustion of the coals placed there, by which a kind of forge is formed. In laboratories, there is generally a small furnace consisting of one cylindrical piece, open at top, which has at its lower side a hole for receiving the nozzle of a double bellows. This kind of forge-furnace is very convenient for fusions, as the operation is quickly performed, and with few coals. In its lower part, two inches above the hole for receiving the nozzle of the bellows, may be placed an iron-plate of the same diameter, supported upon two horizontal bars, and pierced near its circumference with four holes diametrically opposite to each other. By this disposition, the wind of the bellows, pushed forcibly under this plate, enters at these four holes; and thus the heat of the fire is equally distributed, and the crucible in the furnace is equally surrounded by it. This contrivance is used in the forge-furnaces for melting copper, with this difference only, that these furnaces are square, which is a matter of no consequence.

As the wind of bellows strongly and rapidly excites the action of the fire, a forge is very convenient when a great heat is to be applied quickly: but it is not suitable when the heat is to be gradually increased. The forge, or blast of bellows, is used in several operations in small; as to fuse salts, metals, ores, &c. It is also much used in works in the great, which require strong heat without much management; and chiefly in the smelting of ores, and fusion of metallic bodies.

FORGE is also used for a large furnace, wherein iron-ore, taken out of the mine, is melted down: or it is more properly applied to another kind of furnace, wherein the iron-ore, melted down and separated in a former furnace, and then cast into sows and pigs, is heated and fused over again, and beaten afterwards with large hammers, and thus rendered more soft, pure, ductile, and fit for use.

FORGE, in the train of artillery, is generally called a *travelling forge*, and may not be improperly called a portable smith's shop. At this forge all manner of smiths' work is made, and it can be used upon a march as well as in camp. Formerly they were very ill contrived, with 2 wheels only, and wooden supporters to prop the forge for working when in the park. But of late years they are made with 4 wheels, which answers the purpose much better.

FORGE *for red-hot Balls*, is a place where the balls are made red-hot before they are fired off: it is built about five or six feet below the surface of the ground, of strong brick-work, and an iron grate, upon which the balls are laid, with a very large fire under them.

FORGERY, the fraudulent imitation of a name or alteration of a writing to the prejudice of another man's right. By statute 5 Eliz. c. 14. to forge or make, or knowingly to publish or give in evidence, any forged deed, court-roll, or will, with intent to affect the right of real property, either freehold or copyhold, is punished by a forfeiture to the party grieved of double costs and damages; by standing in the pillory, and having both his ears cut off, and his nostrils slit and seared; by forfeiture to the crown of the profits of his lands; and by perpetual imprisonment. For any forgery relating to a term of years or annuity, bond, obligation, acquittance, release, or discharge of any debt or demand of any personal chattels, the same forfeiture is given to the party grieved; and on the offender is inflicted the pillory, loss of one of his ears, and half a year's imprisonment: the second offence, in both cases, being felony without benefit of clergy.

Besides this general act, a multitude of others, since the revolution, when paper-credit was first established, have inflicted capital punishment on the forging, altering, or uttering as true when forged, of any bank bills or notes, or other securities; of bills of credit issued from the exchequer; of south-sea bonds, &c.; of lottery tickets or orders; of army or navy debentures; of East India bonds; of writings under seal of the London or royal-exchange assurance; of the hand of the receiver of the pre-fines, or of the accountant-general and certain other officers of the court of chancery; of a letter of attorney or other power to receive or transfer stock or annuities; and on the personating a proprietor thereof, to receive or transfer such annuities, stock, or dividends: also on the personating, or procuring to be personated, any seaman or other person, intitled to wages or other naval emoluments, or any of his personal representatives; and the taking, or procuring to be taken, any false oath in order to obtain a probate or letters of administration, in order to receive such payments; and the forging, or procuring to be forged, and likewise the uttering or publishing, as true, of any counterfeited seaman's will or power: to which may be added, though not strictly reducible to this head, the counterfeiting of Mediterranean passes, under the hands of the lords of the admiralty, to protect one from the piratical states of Barbary; the forging or imitating of any stamps to defraud the public revenue; and the forging of any marriage register or licence: all which are, by distinct acts of parliament, made felonies without benefit of clergy. By statutes 13 Geo. III. c. 52 & 59. forging or counterfeiting any stamp or mark, to denote the standard of gold and

filver plate, and certain other offences of the like tendency, are punifhed with tranfportation for 14 years. By ftatute 12 Geo. III. c. 48. certain frauds on the ftamp-duties, therein defcribed, principally by ufing the fame ftamps more than once, are made fingle felony, and liable to tranfportation for feven years. And the fame punifhment is inflicted by ftatute 13 Geo. III. c. 38. on fuch as counterfeit the common feal of the corporation for manufacturing plate-glafs (thereby erected), or knowingly demand money of the company by virtue of any writing under fuch counterfeit feal.

There are alfo two other general laws with regard to forgery; the one 2 Geo. II. c. 25. whereby the firft offence in forging or procuring to be forged, acting or affifting therein, or uttering or publifhing as true, any forged deed, will, bond, writing obligatory, bill of exchange, promiffory note, indorfement or affignment thereof, or any acquittance or receipt for money or goods, with intention to defraud any perfon (or corporation), is made felony without benefit of clergy. And by ftatute 7 Geo. II. c. 22. it is equally penal to forge, or caufe to be forged, or utter as true, a counterfeit acceptance of a bill of exchange, or the number of any accountable receipt for any note, bill, or any other fecurity for money, or any warrant or order for the payment of money, or delivery of goods. So that through the number of thefe general and fpecial provifions, there is now hardly a cafe poffible to be conceived, wherein forgery that tends to defraud, whether in the name of a real or fictitious perfon, is not made a capital crime.

FORGING, in fmithery, the beating or hammering iron on the anvil, after having firft made it red-hot in the forge, in order to extend it into various forms, and fafhion it into works. See FORGE. There are two ways of forging and hammering iron. One is by the force of the hand, in which there are ufually feveral perfons employed, one of them turning the iron and hammering likewife, and the reft only hammering. The other way is by the force of a water-mill, which raifes and works feveral huge hammers beyond the force of man; under the ftrokes whereof the workmen prefent large lumps or pieces of iron, which are fuftained at one end by the anvils, and at the other by iron-chains faftened to the cieling of the forge. See MILL. This laft way of forging is only ufed in the largeft works, as anchors for fhips, &c. which ufually weigh feveral thoufand pounds. For the lighter works, a fingle man ferves to hold, heat, and turn with one hand, while he hammers with the other. Each purpofe the work is defigned for requires its proper heat; for if it be too cold, it will not feel the weight of the hammer, as the fmiths call it when it will not batter under the hammer; and if it be too-hot it will red-fear, that is, break or crack under the hammer. The feveral degrees of heat the fmiths give their iron are, firft, a blood-red heat; fecondly, a white-flame heat; and, thirdly, a fparkling or welding heat.

FORISFAMILIATION, in law. When a child, upon receiving a portion from his father, or otherwife, renounces his legal title to any further fhare of his father's fucceffion, he is faid to be *forisfamiliated*.

FORK, a well-known inftrument, confifting of a handle and blade, divided at the end into two or more points or prongs. The *pitch-fork* is a large utenfil of this conftruction, employed in hay-making, &c. The *table-fork*, an inftrument now fo indifpenfable, did not come into ufe in England till the reign of James I. as we learn from a remarkable paffage in Coryat. The reader will probably fmile at the folemn manner in which this important difcovery or innovation is related: "Here I will mention a thing that might have been fpoken of before in difcourfe of the firft Italian towns. I obferved a cuftom in all thofe Italian cities and townes through the which I paffed, that is not ufed in any other country that I faw in my travels, neither do I thinke that any other nation of Chriftendome doth ufe it, but only Italy. The Italian and alfo moft ftrangers that are commonant in Italy doe always at their meals ufe a little forke when they eat their meate; for while with their knife, which they hold in one hand, they cut the meate out of the difh, they faften the forke which they hold in the other hand upon the fame difh, fo that whatfoever he be, that fitting in the company of any others at meale, fhould unadvifedly touch the difh of meat with his fingers from which all the table doe cut, he will give occafion of offence unto the company as having tranfgreffed the lawes of good manners, in fo much that for his error he fhall be at leaft brow-beaten, if not reprehended, in wordes. This form of feeding I underftand is generally ufed in all parts of Italy, their forkes for the moft part being made of yronn, fteele, and fome of filver, but thofe are ufed only by gentlemen. The reafon of this their curiofity is, becaufe the Italian cannot by any means indure to have his difh touched with fingers, feeing all men's fingers are not alike cleane. Hereupon I myfelf thought good to imitate the Italian fafhion by this forked-cutting of meate, not only while I was in Italy, but alfo in Germany, and often times in England fince I came home: being once quipped for that frequently ufing my forke, by a certain learned gentleman a familiar friend of mine, Mr. Lawrence Whitaker; who in his merry humour doubted not to call me a table *Furcifer*, only for ufing a forke at feeding, but for no other caufe."

FORLI, an ancient and confiderable town of Italy, capital of a territory of the fame name, in Romagna, with a bifhop's fee. The public ftructures are very handfome, and it is feated in a fertile, healthy, and pleafant country, 10 miles S. E. of Fazena, and 40 N. E. of Florence. E. lon. 11. 44. N. lat. 44. 16.

FORLORN-HOPE, in the military art, fignifies men detached from feveral regiments, or otherwife appointed, to make the firft attack in day of battle; or, at a fiege, to ftorm the counterfcarp, mount the breach, or the like. They are fo called from the great danger they are unavoidably expofed to; but the word is old, and begins to be obfolete.

FORM, in phyfics, denotes the manner of being peculiar to each body; or that which conftitutes it fuch a particular body, and diftinguifhes it from every other.

Mr. Harris ufes the term *form* likewife in another fenfe, as an efficient animating principle; to which he fuppofes Ovid to refer in the firft lines of his Metamorphofis,

> *In nova fert animus mutatas dicere* formas
> *Corpora*——

Thefe animating forms are of themfelves no objects either of the ear or the eye; but their nature or character is underftood in this, that were they never to exert their proper energies on their proper fubjects, the marble on which the fculptor exercifes his art would remain for ever fhapelefs, and the harp from which the harper calls forth founds would remain for ever filent.

Thus alfo the animating form of a natural body is neither its organization nor its figure, nor any other of thofe inferior forms which make up the fyftem of its vifible qualities; but it is the power, which is yet able to produce, preferve, and employ thefe. It is the power, which firft moves, and then conducts that latent procefs, by which the acorn becomes an oak, and the embryo becomes a man; by which digeftion is performed in plants and animals, and, which departing, the body ceafes to live, and its members putrefy; and by which every being produces another like itfelf, and every fpecies is continued. In animals, it is that higher faculty, which, by employing the organs of fenfe peculiar to them as animals, diftinguifhes them as fenfitive beings from vegetables; and it is alfo that

more noble faculty, which, by its own divine vigour, unaſſiſted perhaps with organs, makes and denominates him a being intellective and rational. So that Mr. Harris reckons two ſorts of forms; thoſe which are paſſive elements, and thoſe which are efficient cauſes. And all of them agree in this, that they give to every being its peculiar and diſtinctive character: and on the whole he concludes, that form appears in part to be an element, and in part an efficient cauſe, *i. e.* a cauſe which aſſociates the conſtituent elements of natural ſubſtance, and which employs them, when aſſociated, according to their various and peculiar characters.

The philoſophers generally allow two principles of bodies: *matter*, as the common baſis or ſubſtratum of all; and *form*, as that which ſpecifies and diſtinguiſhes each; and which, added to a quantity of common matter, determines or denominates it this or that; wood, or fire, or aſhes, &c.

Subſtantial forms ſeem to have been firſt broached by the followers of Ariſtotle, who thought matter, under different modes or modifications, not ſufficient to conſtitute different bodies; but that ſomething ſubſtantial was neceſſary to ſet them at a greater diſtance: and thus introduced ſubſtantial forms, on the footing of ſouls, which ſpecify and diſtinguiſh animals. What led to this erroneous notion was the circumſtances of life and death: for, obſerving that as ſoon as the ſoul was departed out of a man all motion, reſpiration, nutrition, &c. immediately ceaſed, they concluded that all theſe functions depended on the ſoul, and conſequently that the ſoul was the form of the animal body, or that which conſtituted it ſuch: that the ſoul was a ſubſtance, independent of matter, nobody doubted; and hence the forms of other bodies were concluded equally ſubſtantial. But to this it is anſwered, that though the ſoul be that by which a man is man, and conſequently is the form of the human body, as human; yet it does not follow, that it is properly the form of this body of ours, as it is a body; nor of the ſeveral parts thereof, conſidered as diſtinct from each other: for thoſe ſeveral parts have their proper forms ſo cloſely connected with their matter, that it remains inſeparable therefrom long after the ſoul has quitted the body: thus, fleſh has the form of fleſh, bone of bone, &c. long after the ſoul is removed as well as before. The truth is, the body does not become incapable of performing its accuſtomed functions becauſe the ſoul has deſerted it; but the ſoul takes its leave, becauſe the body is not in a condition to perform its functions.

The ancient and modern corpuſcular philoſophers, therefore, with the Carteſians, exclude the notion of ſubſtantial forms; and ſhow, by many arguments, that the form is only the modus or manner of the body it is inherent in. And as there are only three primary modes of matter, viz. figure, reſt, or motion, with two others ariſing therefrom, viz. magnitude and ſituation, the form of all bodies they hold to conſiſt therein; and ſuppoſe the variations theſe modes are capable of, ſufficient to preſent all the variety obſervable in bodies.

Forms are uſually diſtinguiſhed into *eſſential* and *accidental.*

Eſſential. Though the five modes above mentioned, generally taken, be adventitious: yet to this or that body, *e. g.* to fire or water, they are eſſential: thus, it is *accidental* to iron, to have this or that magnitude, figure, or ſituation, ſince it might exiſt in different ones; yet to a knife or hammer, the figure, magnitude, and poſition of parts, which conſtitute it a hammer or knife, are eſſential; and they cannot exiſt or be conceived without them. Hence it is inferred, that though there be no ſubſtantial, there are eſſential forms, whereby the ſeveral ſpecies of bodies become what they are, and are diſtinguiſhed from all others.

Accidental forms are thoſe really inherent in bodies, but in ſuch manner as that the body may exiſt in all its perfection without them. Such is whiteneſs in a wall, heat in water, a figure of a man in wax, &c.

Form is alſo uſed in a moral ſenſe, for the manner of being or doing a thing according to rules: thus we ſay, a form of government, a form of argument, &c.

Form, in law, the rules eſtabliſhed and requiſite to be obſerved in legal proceedings. The formal part of the law, or method of proceeding, cannot be altered but by parliament; for if once theſe outworks were demoliſhed, there would be an inlet to all manner of innovation in the body of the law itſelf.

Form, in carpentry, is uſed to denote the long ſeats or benches in the choirs of churches or in ſchools, for the prieſts, prebends, religious, or ſcholars, to ſit on. Du-Cange takes the name to be derived from hence, that the backs of the ſeats were anciently enriched with figures of painting and ſculpture, called in Latin *formæ et typi.* In the Life of St. William of Roſchild, we meet with *forma* as ſignifying a ſeat for an eccleſiaſtic, or religious, in a choir; and in that of St. Lupicin, we have formula in the ſame ſenſe. In the rule of the monaſtery of St. Cæſarea, the nun who preſides over the choir is called *primiceria, vel formari.*

At ſchools, the word *form* is frequently applied to what is otherwiſe called a *claſs.* See Class.

Form alſo denotes the external appearance or ſurface of a body, or the diſpoſition of its parts, as to the length, breadth, and thickneſs.

Form is alſo uſed among mechanics, for a ſort of mould whereon any thing is faſhioned or wrought.

Printer's Form, an aſſemblage of letters, words, and lines, ranged in order, and ſo diſpoſed into pages by the compoſitor; from which, by means of ink and a preſs, the printed ſheets are drawn. Every form is incloſed in an iron-chaſe, wherein it is firmly locked by a number of pieces of wood; ſome long and narrow, and others of the form of wedges. There are two forms required for every ſheet, one for each ſide; and each form conſiſts of more or fewer pages according to the ſize of the book.

Hatter's Form is a large block or piece of wood, of a cylindrical figure; the top thereof rounded, and the bottom quite flat. Its uſe is to mould or faſhion the crown of the hat, after the matter thereof has been beaten and fulled.

Paper-maker's Form is the frame or mould wherein the ſheets are faſhioned. See Paper.

FORMA pauperis, in law, is when a perſon has juſt cauſe of ſuit, but is ſo poor that he cannot defray the uſual charges of ſuing at law or in equity; in which caſe, on making oath that he is not worth 5l. in the world, on all his debts being paid, and producing a certificate from ſome lawyer that he has good cauſe of ſuit, the judge will admit him to ſue in *forma pauperis*; that is, without paying any fee to counſellors, attorneys, or clerk: the ſtatute 11 Hen. VII. c. 12. having enacted, that counſel and attorneys, &c. ſhall be aſſigned to ſuch poor perſons *gratis.* Where it appears that any pauper has ſold or contracted for the benefit of his ſuit whilſt it is depending in court, ſuch cauſe ſhall be thenceforth totally diſmiſſed; and a perſon ſuing *in forma pauperis* ſhall not have a new trial granted him, but is to acquieſce in the judgment of the court.

FORMALITY, as defined in the ſchools, is any manner wherein a thing is conceived; or a manner in any object, importing a relation to the underſtanding, whereby it may be diſtinguiſhed from another object. Thus, animality and rationality are formalities. The Scottiſts make great uſe of formalities, in oppoſition to the virtualities of the Thomiſts.

Formalities, in matters of law, are frequently uſed for the formulas themſelves, or the rules preſcribed for judiciary pro-

ceedings. In contracts of ſtrict law, all the formalities muſt be ſtrictly obſerved; an omiſſion of the leaſt formality may ruin the whole convention. The term is alſo uſed for a certain order or decorum to be obſerved.

FORMAN (Andrew), archbiſhop of St. Andrew's, earl of Pittenweem, and of Cottingham in England, one of the lords of the regency appointed by the States during the minority of king James V. of Scotland, legate a-latere, primate of all the kingdom of Scotland, and archbiſhop of Bourges in France, was deſcended from the family of the Formans of Hutton in the ſhire of Berwick, and is conſidered to have been one of the beſt ſtateſmen of the age in which he lived. Archbiſhop Forman died in 1521, and was buried at Dunfermline. Dempſter ſays that he wrote a book againſt Luther, a book concerning the Stoic Philoſophy, and a Collection out of the Decretals.

FORMATION, in grammar, ſignifies the manner of forming one word from another: thus *accountantſhip* is formed from *accountant*, and this laſt from *account*.

FORMEDON, in law, (breve *de forma donationis)*, a writ that lies for a perſon who has a right to lands or tenements, by virtue of any entail, ariſing from the ſtatute of Weſtm. 2 Ch. II. This writ is of three kinds, viz. a deſcender, remainder, and reverter. Formedon in *deſcender* lies where a tenant in tail infeoffs a ſtranger, or is diſſeiſed and dies, and the heir may bring this writ to recover the lands. Formedon in *remainder* lies where a man gives lands, &c. to a perſon in tail, and, for default of iſſue of his body, the remainder to another in tail: here, if the tenant in tail die without iſſue, and a ſtranger abates and enters into the land, he in remainder ſhall have this writ. Formedon in *reverter* lies where lands are entailed on certain perſons and their iſſue, with remainder over for want of iſſue; and, on that remainder failing, then to revert to the donor and his heirs: in this caſe, if the tenant in tail dies without iſſue, and alſo he in remainder, the donor and his heirs, to whom the reverſion returns, may have this writ for the recovery of the eſtate, though the ſame be alienated, &c.

FORMICA, or the Ant, in zoology (ſee plate 27); a genus of inſects belonging to the order of hymenoptera, the characters of which are theſe: There is a ſmall ſcale betwixt the breaſt and belly; and the joint is ſo deep, that the animal appears as if it were almoſt cut through the body. The females, and the neuters or working ants which have no ſexual characteriſtics, are furniſhed with a hidden ſting; and both the males and females have wings, but the neuters have none. There are 18 ſpecies, moſt of them diſtinguiſhed by their colours.

Theſe inſects keep together in companies like the bees, and maintain a ſort of republic. Their neſt is not exactly ſquare, but longer one way than the other; and in it there are a ſort of paths which lead to different magazines. Some of the ants are employed in making the ground firm, by mixing it with a ſort of glue, for fear it ſhould crumble and fall down upon them. They may be ſometimes ſeen to gather ſeveral twigs, which ſerve them for rafters, which they place over the paths to ſupport the covering; they lay others acroſs them, and upon them ruſhes, weeds, and dried graſs, which they heap up into a double declivity, which ſerves to turn off the water from their magazines. Some of theſe ſerve to lay up their proviſions in, and in others they lay their eggs.

As for the proviſions, they lay up every thing that is fit for them to eat; and you may often ſee one loaded with pippin or grain of fruit, another with a dead fly, and ſeveral together with the carcaſe of a may-bug or other inſect. If they meet with any they cannot bring away, they eat it upon the ſpot, or at leaſt ſo much of it as may reduce it to a bulk ſmall enough for them to carry. They do not run about where they pleaſe at all adventures: for ſome of them are ſent abroad to make diſcoveries; and if they bring back news that they have met with a pear, or a ſugar-loaf, or a pot of ſweetmeats, they will run from the bottom of the garden, as high as the third ſtory of a houſe, to come at it. They all follow each other in the ſame path, without wandering to the right or left; but in the fields they are more at their liberty, and are allowed to run about in ſearch of game. There is a ſort of green fly (the *aphis)* that does a great deal of miſchief among the flowers, and which curls up the leaves of peach and pear-trees: and theſe are ſurrounded with a ſort of glue or honey, which the ants hunt after very greedily; for they touch neither the plant nor the flies themſelves. Next to this, their greateſt paſſion is to lay up hoards of wheat and other corn; and for fear the corn ſhould ſprout by the moiſture of the ſubterraneous cells, they gnaw off the end which would produce the blade. The ants are often ſeen puſhing along grains of wheat or barley much larger than themſelves. It is remarkable, that if one ant meets another that is loaded, it always gives way to let it paſs freely, or will help if it be overburdened.

The ant lays eggs in the manner of the common flies; and from theſe eggs are hatched the larvæ, a ſort of ſmall maggots or worms without legs: theſe are ſharp at one end and blunt at the other; and are white, but ſo tranſparent that the inteſtines are ſeen through the ſkin. Theſe after a ſhort time change into large white aureliæ or chryſalids, which are what are uſually called *ants' eggs*. That end which is to be the tail is the largeſt, and that which is the head is ſomewhat tranſparent. The ants move theſe about at pleaſure with their forceps. It is well known, that when a neſt of theſe creatures is diſturbed, and the aureliæ ſcattered about, the ants are at infinite pains to get together all that are unhurt, and make a neſt for them again: nay, any ants will do this, and thoſe of one neſt will often take care of the aureliæ of another

The care theſe creatures take of their offspring is remarkable. Whenever a hill is diſturbed, all the ants are found buſied in conſulting the ſafety, not of themſelves, but of the eggs or thoſe larger bodies incloſing the maggot or young ant; they carry theſe down any way ſo as to get them out of ſight, and will do this over and over as often as they are diſturbed. They carry away the eggs and vermicles together in their confuſion; but, as ſoon as the danger is over, they carefully ſeparate them, and place each ſort in parcels by themſelves under ſhelter of different kinds, and at various depths, according to the different degrees of warmth and coverture the different ſtates require. In the warm ſeaſon of the year, they every morning bring up the *eggs*, as they are uſually called, to the ſurface, or nearly ſo; and from ten in the forenoon to five in the afternoon, or thereabouts, all theſe will be found juſt under the ſurface: and if the hills be examined toward eight in the evening, they will be found to have carried them all down; and if rainy weather be coming on, it will be neceſſary to dig a foot deep or more, in order to find them. All human precautions have not hitherto been able to ſupply that degree of warmth and minute attention, which the ants put in practice to forward the inſtant of their laſt metamorphoſis. The inſect, iſſuing forth to a new life, tears its white tranſparent veil; it is then a real ant, deſtitute of wings, if it has no ſex; winged, if it be male or female, always to be known by a ſmall erect ſcale placed on the thread which connects the body and thorax. Ants tranſact their amours in the air. The males, who are much ſmaller, ſeldom frequent the common habitation: but the females, much larger, repair to it to depoſit their eggs, which is all the labour they undergo; the winter's cold deſtroys them. As to the males, it is uncertain whether they fall victims to the ſeverity of winter, or are made over to the rage of the labouring ants. Theſe laſt paſs the winter in a torpid ſtate, as ſome other inſects do, till

ſpring reſtores them to their wonted activity: they have therefore no ſtores for winter, no conſumption of proviſions. What are commonly ſold in markets for ants' eggs are grubs newly hatched, of which pheaſants, nightingales, and partridges are very fond. The chief enemies to ants are the formica leo, magpies, and ſome other birds and beaſts.

In the hotter countries, as Italy, Spain, and the Weſt Indies, ants are the greateſt peſt of the fields. Trees, which they are ſaid to injure greatly, may be preſerved from them by encompaſſing the ſtem, for four fingers breadth, with a roll of wool, newly pulled from the ſheep's belly; or by laying ſaw-duſt all round the ſtump of it. Some anoint the tree with tar, which has the ſame effect. But, whatever harm they may do in paſture-lands, by making up hills for their habitation and impairing or drying up the graſs, their damaging fruit-trees appears to be an unjuſt reproach. On the contrary, in Switzerland they are made ſubſervient to the deſtruction of caterpillars. This is done by hanging a pouch filled with ants upon a tree; and they, making their eſcape through an aperture contrived on purpoſe, run over the tree without being able to reach down to the ground, becauſe care has been previouſly taken to beſmear the foot of the tree with wet clay or ſoft pitch; in conſequence of which, compelled by hunger, they fall upon the caterpillars and devour them. People pretend to ſay, that ants, taken inwardly, ſtimulate the urinary paſſages and the organs of generation. The red colour which they communicate to blue paper, when cruſhed upon it, proves that they contain an acid (ſee Chemistry, ſect. vii. page 470).

The large black-winged ants of America, to avoid the great rains which fall there at particular ſeaſons, make to themſelves large neſts on trees, with a covered way for them to go up and down on the lee ſide of the tree. Theſe neſts are roundiſh on the outſide, made of light brown earth, plaſtered ſmooth. They are larger than a buſhel; and in the inſide are many ſinuous caverns or lodgings communicating with one another. See plate 27. A, the ant's neſt; B, the tubular paſſage, made of the ſame materials.

As to thoſe inſects called *white ants*, which abound in Africa and the Eaſt Indies, they belong to a different genus; for which ſee the article Termes.

Formica-*Leo*, the *Ant-lion*, in zoology, an inſect ſo called from its devouring great numbers of ants. It is the caterpillar or worm of a fly much reſembling the libellæ or dragon-flies; and feeds chiefly upon ants, from which circumſtance it derives its name. It is ſomewhat of the nature of the ſpider in its way of taking its prey, its manner of ſpinning, and the figure and ſoftneſs of its body. It has, in its general figure, ſomewhat of the appearance of the millepes or wood-louſe, ſo that ſome have miſtaken it at firſt ſight for that animal. It is of a dirty greyiſh colour, marked with ſome black ſpots; and theſe are alſo compoſed of many points when viewed with a microſcope, which make it reſemble a hedge-hog or porcupine. Its body is compoſed of ſeveral rings, and has thence a wrinkled look. It has ſix legs; four are joined to the breaſt, and the other two to a longer part, which may be taken for its neck. Its head is ſmall and flat, and it has two remarkable horns: theſe are about a ſixth part of an inch long, and as thick as a hair: they are hard, hollow, and hooked at the end like the claws of a cat. At the origin of each of theſe horns, it has a clear and bright black eye, which ſees very diſtinctly, and gives the creature notice to eſcape on ſight of the ſmalleſt object. This creature is not able to hunt after its prey, nor to deſtroy large inſects; it can only draw into its ſnares ſuch as come near its habitation, and of theſe very few are ſuch as he can manage: all the winged kind are able to eſcape by flight; and the beetle kinds, and others that have hard ſhells upon their bodies, are of no uſe to him, as his horns cannot pierce them. The ſmallneſs of the ant, and the want of wings in the neuters, make them the deſtined prey of this devourer. The manner in which he catches his prey is as follows:

He uſually encamps under an old wall, that he may be ſheltered from the injuries of the weather; and he always chooſes a place where the ſoil is compoſed of a fine dry ſand. In this he makes a pit of the ſhape of a funnel, or an inverted hollow cone. If he intends the pit to be but ſmall, he thruſts down his hinder part into the ſand, and by degrees plunges himſelf backward into it; and when he has got to a certain depth, he toſſes out the looſe ſand which has run down with his head, artfully throwing it off beyond the edges of his pit. Thus he lies at the bottom of a ſmall hollow, which is wideſt at the top, and comes ſloping down to his body.

But if he is to make a larger pit, more pains are required to bring it to perfection. He firſt traces, in the ſurface of the ſand, a large circle, which is the erected baſe or mouth of the pit he is to make in form of an inverted cone. He then buries himſelf in the ſand near the edge of this circle, and carefully throws up the ſand above him, with his head toſſing it out beyond the circumference of the circle. Thus he continues his work, running down backwards in a ſpiral line all the way, and carefully throwing off the ſand from above him, till he is come to the place of his reſt, which is the point or reverted apex of the hollow cone he has formed by his paſſage. The length of his neck, and the flatneſs of his head, give him a power of uſing the whole as a ſpade, and throwing off the ſand with great eaſe; and his ſtrength in this part is ſo great, that he is able to throw off a quantity of it to ſix inches diſtance. This is a power he exerts oftener, however, in throwing away the remains of the animals he has fed upon, that his den may not become frightful to others of the ſame ſpecies, by ſeeing their fellow carcaſes hung about it.

When he has finiſhed his pit, he buries himſelf at the bottom of it among the ſand, leaving no part above ground but the tips of his two horns, which he expands to the two ſides of the pit. In this condition he lies and waits for his prey, and never comes up afterwards. When an ant or any other ſuch creature chances to walk over the edges of his pit, its ſteps throw down a little of the ſand, which, naturally running down to the bottom of the pit, gives the enemy notice of his prey; he then toſſes up the ſand which covers his head, to bury the ant, and bring him down with its returning force to the bottom; and as one ſuch attempt cannot be ſufficient to prevent the ant's eſcape, he throws more and more ſand upon him, till he by degrees brings him down. All the endeavours of the ant to eſcape, when once it is within the verge of the pit, are in vain; for, as it attempts to climb, the ſand runs away from under its feet, and it ſinks the lower for every attempt. This motion of the ſand alſo informs the enemy where it is, and directs him to throw up more ſand in the right place; which it does, till the poor ant falls to the bottom between its horns. It then plunges the points deep into the ant's body; and, having ſucked all the juice out of the prey, it throws out the empty ſkin as far from the hole as it can. This done, it mounts up the edges of its pit, and, if it has ſuffered any injury, repairs it with great care, and immediately buries itſelf again in the centre, to wait for another meal. The horns of this creature are its only organs for receiving nouriſhment; it never brings any animal which it has ſeized near to its head, but always holds it at the tip of the horns. They therefore plainly ſerve as ſyringes, to draw into its ſtomach the juices of the bodies of the inſects it feeds upon: neither is there any mouth or trunk, or any other organ to be diſcovered about its head, which could anſwer the purpoſe of eating; the head ſeeming only intended for throwing away the ſand in forming the pit. The horns of this animal being ſo neceſſary to its life, nature has provided for the re-

ſtoring them in caſe of accidents; for, if cut off, they are found to grow again.

The food this creature procures by its pit can be but little; and as it has no power of catching its prey any other way, its motion being only backwards, and that ſlowly, and by ſmall ſpaces at a time, ſome people have believed its catching now and then an ant by this means was rather for diverſion than hunger. But though the formica-leo will live a long time without food, and even paſs through all its changes when ſhut up in a box, yet it is always ready to eat when food is offered it; it always appears ſtarved and ſmall when kept thus; and if a fly is given it in this hungry ſtate, it will ſo ſuck out all its juices, that the remaining ſhell may be rubbed to powder between the fingers, while the body of the creature that has ſucked it appears remarkably ſwelled and diſtended; ſo that it is plain that the juices of the prey are conveyed into the body of the creature; though it is not eaſy to ſee by what means, the horns not appearing to have any perforation.

When the formica-leo has lived a proper time in this ſtate, it leaves its pit, and is only ſeen drawing lines and traces on the ſurface of the ſand. After this it buries itſelf under the ſurface; and there incloſes itſelf in a fine web, in which it is to paſs its transformation into the winged ſtate. This caſe is made of a ſort of ſilk which the creature ſpins in the manner of the ſpider, and of a quantity of the grains of ſand cemented together by a glutinous humour which flows from its pores. This caſe, however, would be too harſh and coarſe for the body of the creature, and therefore it ſerves only for the outer covering to defend it from injuries; the creature ſpinning one of pure and incomparably fine ſilk, of a beautiful pearl colour, within it, which covers its whole body.

When the creature has lain ſome time in this caſe, it throws off its outer ſkin, with the eyes, the horns, and every other part neceſſary to its life before, and becomes an oblong nymph, in which a careful eye may trace the form of the fly into which it is to be transformed. There may be ſeen, through its tranſparent covering, new eyes, new horns, wings, and all the other parts of the animal in its perfect ſtate. This nymph makes its way about half out of the ſhell, and remains in this condition, but without farther life or motion, till the perfect fly makes its way out at a ſlit in the back. In this laſt ſtate it much reſembles the libellæ or dragon-flies common about our waters. The male couples with the female in this ſtate only; and M. Poupart, to whom the world is obliged for this curious deſcription, is of opinion that the females lay only one egg; but this is very different from the courſe of nature in the other animals of the ſame claſs.

When this inſect forms its pit in a bed of pure ſand, it is made and repaired with great eaſe; but where it meets with other ſubſtances among the ſand, the labour becomes greatly the more embarraſſing. If, for inſtance, when the creature has half formed its pit, and then comes to a ſtone of ſome moderate ſize, it does not deſert the work for this, but goes on, intending to remove that impediment at laſt. When the pit is finiſhed, the creature crawls backward up the ſide of the place where the ſtone is, and getting its backſide under it, takes great pains and time to get it on a true poiſe, and then begins to crawl backward with it up the edge to the top of the pit, to get it out of the way. It is a very common thing to ſee a formica-leo in this manner labouring at a ſtone four times as big as its own body; and as it can only move backward, and the poiſe is hard to keep, eſpecially up a ſlope of ſuch crumbly matter as ſand, which moulders away from under its feet, and neceſſarily alters the poſition of its body, the ſtone very frequently falls down when near the verge, and then it is ſure to roll to the bottom. In this caſe the animal attacks it again in the ſame way, and often is not diſcouraged by five or ſix miſcarriages of this kind; but, after all, attempts again, and at length gets it over the verge of the place. When it has done this, it does not leave it there, leſt it ſhould roll in again; but is always at the pains of puſhing it farther on, till it has removed it to a neceſſary diſtance from the edge of the pit.

The common formica-leo moves only backward; but Mr. Rouet has obſerved a ſpecies which moves forward in the common way of other animals, and makes no pit of this kind to entrap its prey, but ſeizes other inſects by force.

FORMING is uſed for the act of giving being or birth to any thing. The word is alſo ſimply uſed for giving the figure to any thing. The potter *forms* his veſſels as he pleaſes. Geometry teaches how to form all kinds of figures. It is likewiſe uſed for the producing of a thing: thus we ſay the lineaments of the face began to be formed.

Forming *a Siege*, is the making lines of circumvallation to fortify the camp, and diſpoſing things for the attack of a place in form. They alſo ſay, to form a ſquadron or battalion; meaning, to range the ſoldiers in form of a ſquadron, &c.

Forming *the Line*, is drawing up infantry, cavalry, and artillery, into line of battle. See Line.

Forming, is alſo uſed in grammar, in ſpeaking of certain tenſes of verbs, which are made from others by a change of certain letters. The preſent tenſe is formed from the infinitive. Compound and derivative words alſo, and even all that have any etymology, are ſaid to be formed.

FORMOSA, a large iſland in the Eaſtern Ocean, between 119° and 122° E. lon. and 22° and 25° N. lat. about 100 miles E. of Canton in China. It is ſubject to the Chineſe, who, notwithſtanding its proximity, did not know of its exiſtence till the year 1430. It is about 255 miles long and 75 broad. A long chain of mountains, running from N. to S. divides it into two parts, the E. and W. The Dutch built the fort of Zealand in the W. part in 1634. This ſecured to them the principal port of the iſland. They were driven thence in 1661 by a Chineſe pirate, who had made himſelf maſter of all the W. part. But in 1682 the whole iſland ſubmitted to the emperor of China. It contains extenſive and fertile plains, watered by a great number of rivulets that fall from the mountains. Its air is pure and wholeſome; and the earth produces abundance of corn, rice, &c. Moſt of the Indian fruits are found here, and many of thoſe of Europe. Tobacco, ſugar, pepper, camphire, and cinnamon are alſo common. Wholeſome water, fit for drinking, is the only thing wanting in Formoſa; and it is very extraordinary, that almoſt every kind of water in it is a poiſon to ſtrangers, for which no remedy has been hitherto found. On the 22d of May 1782, this fine iſland was overwhelmed, and almoſt totally deſtroyed, by a furious hurricane and dreadful inundation of the ſea.

FORMULA, or Formulary, a rule or model, or certain terms preſcribed or decreed by authority, for the form and manner of an act, inſtrument, proceeding, or the like.

Formula, in church-hiſtory and theology, ſignifies a profeſſion of faith.

Formula, in medicine, imports the conſtitution of medicines, either ſimple or compound, both with reſpect to their preſcription and conſiſtence.

FORMULARY, a writing, containing the form or formula of an oath, declaration, atteſtation, or abjuration, &c. to be made on certain occaſions. There are alſo formularies of devotion, of prayers, &c. Liturgies are formularies of the public ſervice in moſt churches.

FORNACALIA, or Fornicalia, in Roman antiquity, a feſtival inſtituted by Numa, in honour of Fornax, the goddeſs of ovens; wherein certain cakes were made, and offered in ſacrifice before the ovens.

FORNICATION (*Fornicatio*, from the *fornices* in Rome,

where the lewd women proſtituted themſelves for money), is whoredom, or the act of incontinency, between ſingle perſons; for, if either of the parties is married, it is *adultery*. Formerly court-leets had power to enquire of and puniſh fornication and adultery; in which courts the king had a fine aſſeſſed on the offenders, as appears by the book of Domeſday. In the year 1650, when the ruling powers found it for their intereſt to put on the ſemblance of a very extraordinary ſtrictneſs and purity of morals, not only inceſt and wilful adultery were made capital crimes, but alſo the repeated act of keeping a brothel, or committing fornication, were (upon a ſecond conviction) made felony without benefit of clergy. But, at the reſtoration, when men, from an abhorrence of the hypocriſy of the late times, fell into a contrary extreme, it was not thought proper to renew a law of ſuch extraordinary rigour; and theſe offences have been ever ſince left to the feeble coercion of the ſpiritual court. The temporal courts take no cognizance even of the crime of adultery otherwiſe than as a private injury. See ADULTERY.

FORNIX, in anatomy, is part of the corpus calloſum in the brain; ſo called, becauſe of a diſtant reſemblance it bears to the arches of ancient vaults when viewed in a particular manner.

FORRAGE, in the military art, denotes hay, oats, barley, wheat, graſs, clover, &c. brought into the camp by the troopers, for the ſuſtenance of their horſes. It is the buſineſs of the quarter-maſter-general to appoint the method of forraging, and poſt proper guards for the ſecurity of the forragers.

FORRES, a pleaſant little town of Murrayſhire in Scotland, ſituated on an eminence, cloſe to a ſmall river, two miles to the E. of the river Findhorn. It contains ſeveral handſome houſes, and manufactures ſome linen and ſewing thread. A little to the N. E. near the road is a remarkable column, called King Seven's or Sweno's Stone, above 20 feet high, and three broad, covered on both ſides by antique ſculpture; and ſaid to have been erected in memory of a victory obtained over the Danes, before their final retreat from Scotland in 1008.

FORSKOHLEA, in botany; a genus of the pentagynia order, belonging to the decandria claſs of plants. The calyx is pentaphyllous, and longer than the corolla. There are ten petals ſpatulated, *i. e.* roundiſh before, with a linear baſe.

FORSTERA, in botany; a genus of the triandria order, belonging to the gynandria claſs of plants. The perianthium is double; the exterior one beneath, three-leaved; the interior one above, and ſix-cleſt; the corolla, tubular.

FORT, in the military art, a ſmall fortified place, environed on all ſides with a moat, rampart, and parapet. Its uſe is to ſecure ſome high ground, or the paſſage of a river, to make good an advantageous poſt, to defend the lines and quarters of a ſiege, &c. Forts are made of different figures and extents, according as the ground requires. Some are fortified with baſtions, others with demi-baſtions. Some again are in form of a ſquare, others of a pentagon. A fort differs from a citadel, as this laſt is built to command ſome town.

Vitrified FORTS, a very ſingular kind of ſtructures found in the Highlands and northern parts of Scotland, in which the walls have the appearance of being melted into a ſolid maſs, ſo as to reſemble the lava of a volcano, for which indeed they have been taken by ſeveral perſons who have viſited them.

Theſe walls were taken notice of by Mr. Williams, an engineer, who wrote a treatiſe upon the ſubject, and was the firſt who ſuppoſed them to be the works of art; other naturaliſts having attributed them to a volcanic origin. Theſe works are commonly ſituated on the tops of ſmall hills, commanding an extenſive view of the adjacent valley or low country. The area on the ſummit, varying, as is ſuppoſed, according to the number of cattle the proprietor had to protect, or the dependents he was obliged to accommodate, is ſurrounded with a high and ſtrong wall, of which the ſtones are melted, moſt of them entirely; while others, in which the fuſion has not been ſo complete, are ſunk in the vitrified matter in ſuch a manner as to be quite incloſed with it; and in ſome places the fuſion has been ſo perfect, that the ruins appear like maſſes of coarſe glaſs. Mr. Williams has not only abſolutely determined the walls in queſtion to be the works of art, but has even hazarded a conjecture as to the manner in which they were conſtructed, and which, according to him, was as follows. Two parallel dikes of earth or ſod being raiſed, in the direction of the intended wall, with a ſpace between them ſufficient for its thickneſs, the fuel was put in, and ſet on fire. The ſtones beſt adapted for the purpoſe, called the *plum-pudding ſtone*, are every where to be found in the neighbourhood. Theſe were laid on the fuel, and, when melted, were kept by the frame of earth from running off; and by repeating the operation, the wall was raiſed to a ſufficient height. This opinion of the ſtones being thrown in without any order is thought to be confirmed by the circumſtance of there not being any where a large one to be ſeen, nor a ſtone laid in any particular direction, nor one piece which has not in ſome degree been affected by the fire. Mr. Williams mentions a fact tending to confirm his hypotheſis, viz. of a brick-kiln ſituated on the declivity of an eminence, ſo as to be expoſed to the wind, which, happening to riſe briſkly one time when the kiln was burning, ſo increaſed the heat, that the bricks were melted, and ran, like a lava, for a conſiderable way down the hill.

This opinion of Mr. Williams has been embraced by ſeveral other authors; particularly Mr. Freebairn and Dr. Anderſon, the latter having publiſhed two treatiſes upon theſe buildings in the Archæologia. In the ſame work, however, we meet with a paper by the Hon. Daines Barrington, in which the author expreſſes quite different ſentiments. He obſerves, that Mr. Williams and the other antiquaries, who ſuppoſe the walls in queſtion to be the works of art, imagine that the reaſon of their being conſtructed in this manner was the ignorance of cement, which in theſe remote ages prevailed in Scotland: but with reſpect to this circumſtance he ſays, that if one ſide of the wall only was heated, and that to any conſiderable height, the matter in fuſion would in all likelihood drop down to the bottom, without operating as any cement to the looſe ſtones thrown in amongſt it. This circumſtance of the walls being vitrified only on one ſide is indeed remarkable, and takes place in moſt of the forts of this kind to be met with at preſent: but with regard to it Mr. Barrington obſerves, that he himſelf has been twice in the Highlands of Scotland, and has found very few hills of any height which were clothed with wood; the trouble therefore of carrying it up to the top of ſuch a mountain would be very conſiderable. But to this it might eaſily be replied, that we cannot by any means argue from the preſent ſtate of the hills in the Highlands to their ſtate in a very remote period of antiquity. At that time, it is neither impoſſible nor in the leaſt improbable that moſt of the hills in Scotland were overgrown with wood; or, at any rate, there undoubtedly was plenty of peat, which is ſtill uſed as fuel in Scotland, and which affords ſuch a ſtrong heat as to be advantageouſly employed even in ſmelting iron, as we are informed by M. Magellan.

According to Mr. Cardonnel, the largeſt of theſe vitrified forts is ſituated on the hill of Knockſarril, to the ſouth of the valley of Strathpeffer, two miles weſt from Dingwall in Roſsſhire. The incloſure is 120 feet long and 40 broad within the walls; ſtrengthened on the outſide with works at each end. The fort next in conſequence to that of Knockfarril is ſituated on the hill of Craig-Phadrick near Inverneſs, "which (ſays Mr. Cardonnel) has this peculiar circumſtance, that there appears to have been two vitrified walls quite round the area. The inner one ſeems to have been very high and ſtrong; the outer wall but low: probably the ſpace between was intended for ſecuring

their cattle, as there are no remains of dry-ſtone buildings, ſuch as are found near the reſt. Several parts of this outer wall appear quite entire, ſticking to the firm bare rock, where it was firſt run. The area within the inner wall is near 80 paces long and 27 broad." Of this an account is given in the Edin. Phil. Tranſact. vol. II. claſs ii. art. 11. by Alexander Fraſer Tytler, Eſq. who viſited it in the year 1782. The other fortified hills mentioned by Mr. Cardonnel are thoſe of Dun-Evan in the ſhire of Nairn; Tordun Caſtle, near Fort Auguſtus; and another on the weſt ſide of Gleneves in Lochaber, three miles to the ſouth of Fort William. The Caſtle-hill of Finhaven, in the county of Angus, has likewiſe ſome conſiderable ruins of the ſame kind.

Beſides theſe fortifications, the hill of Noth affords a remarkable appearance of the ſame kind: of which Mr. Cordiner gives the following deſcription, not from his own obſervation, but thoſe of a gentleman of credit who viſited the place. "On the top of the hill there is an oblong hollow, as I could gueſs, of about an Engliſh acre, covered with a fine ſward of graſs: in the middle toward the eaſt end of this hollow is a large and deep well. The hollow is ſurrounded on all ſides with a thick rampart of ſtones. On three ſides of this rampart, from 8 to 12 feet thick, is one compact body of ſtones and minerals which have been in a ſtate of fuſion, reſembling a mixture of ſtone and iron-ore, all vitrified, calcined, and incorporated. On the north ſide, the rampart conſiſts of broken pieces of rock, which have the appearance of having been torn to pieces by ſome extraordinary violence. If the calcined compact wall exiſts under them, it is not at preſent viſible."

In the Phil. Tranſ. of the Royal Society of London for 1777, Part II. No. 20. is an account of *Creck Fatrick,* there termed *a Volcanic hill near Inverneſs,* in a letter from Tho. Weſt, Eſq. to Mr. Law, F. R. S. in which the writer does not heſitate to pronounce this hill an extinguiſhed volcano: and, having ſent ſpecimens of the burnt matter for the inſpection of the Royal Society, the ſecretary ſubjoins a note to the paper, intimating that theſe ſpecimens, having been examined by ſome of the members well acquainted with volcanic productions, were by them judged to be real lava. Such was likewiſe the opinion of the late Andrew Croſbie, Eſq. who, in an account which he gave to the Philoſophical Society of Edinburgh in 1780, offered ſome very curious conjectures with regard to that proceſs of nature, by which he ſuppoſed the whole of this hill to have been thrown up from the bottom of the ſea by the operation of inteſtine fire.

Mr. Tytler agrees with thoſe who think the vitrified ſtructures to be artificial works; but he differs from Mr. Williams and others, who think that they were vitrified on purpoſe for cementing the materials together. His reaſon for this is, that the number of forts that ſhow marks of vitrification is inconſiderable when compared with thoſe that do not. He therefore conſiders the vitrification as accidental, and deſcribes the manner in which he conceives it muſt have been accompliſhed. Among other obſervations in confirmation of his opinion, he urges, that, in the fortification on Craig Phadrick, a large portion of the outward rampart bears no marks of vitrification. Mr. Cordiner, on the other hand, is of opinion, that the vitrifications in queſtion cannot have been the works of art, and ridicules the contrary hypotheſis, though without adducing any argument againſt it.

Mr. Tytler concludes his diſſertation with a conjecture, which indeed ſeems well ſupported, that the forts in queſtion were conſtructed, not only before the Roman invaſion, but before the introduction of the rites of the Druids into Britain; as "there appears no probability that the inhabitants either lived under ſuch a government as we know to have prevailed under the influence of the Druids, or had any acquaintance with thoſe arts which it is certain they cultivated." On a view of the diſputes which have agitated the learned on this obſcure ſubject, we can only obſerve, that their arguments ſeem to have placed it in a ſtate of equiponderance, and that the fact remains open to the inveſtigation of future ſpeculators.

FORTESCUE (Sir John), lord chief juſtice of the king's bench, and lord high chancellor of England, in the reign of king Henry VI, was deſcended from the ancient family of Forteſcue, in the county of Devon. He ſtudied the municipal laws of England in Lincoln's Inn, of which he was made one of the governors in the fourth and ſeventh years of the reign of king Henry VI. In 1430 he was called to the degree of a ſerjeant at law, and in 1441 was conſtituted the king's ſerjeant. The following year he was made lord chief juſtice of the king's bench; in which honourable ſtation he continued till near the end of that king's reign, who ſhowed him many particular marks of his favour, and advanced him to the poſt of lord high chancellor of England. During the reign of King Edward IV. he followed the fortunes of the houſe of Lancaſter, and was many years in exile with queen Margaret and prince Edward her ſon. At length, they having a proſpect of retrieving their deſperate fortunes, the queen and prince returned to England; and Sir John Forteſcue, with many others, accompanied them: but ſoon after the deciſive battle of Tewkſbury, he was thrown into priſon and attainted, with other Lancaſtrians; but found means to procure his pardon from Edward IV. He wrote, 1. A learned commentary on the politic laws of England, for the uſe of prince Edward; to one edition of which Mr. Selden wrote notes. 2. The difference between an abſolute and limited monarchy, as it more particularly regards the Engliſh conſtitution (which was publiſhed, with ſome remarks, by John Forteſcue, afterwards lord Forteſcue, in 8vo, in 1714; and a ſecond edition was publiſhed, with amendments, in 1719): And ſeveral works, which ſtill remain in manuſcript. He died, near 90 years of age, and was buried in the pariſh church of Ebburton, where a monument was erected to his memory in 1677 by one of his deſcendants.

FORTH, one of the fineſt rivers in Scotland, which riſes near the bottom of Lomond Hills. Between Stirling and Alloa it winds in a beautiful and ſingular manner; ſo that, although it is but four miles by land, it is 24 by water between theſe two places. After a courſe of near 40 miles, it meets the ſea a little below Stirling, where it forms the noble eſtuary called the Frith of Forth. A communication between this river and the Clyde, by a canal, is now happily accompliſhed, and cannot but contribute greatly to the benefit of commerce in that quarter.

FORTIFICATION;

THE art of fortifying a city, town, or other place; or of putting them in ſuch a poſture of defence, that each individual part defends, and is defended by, ſome other parts, by means of ramparts, parapets, moats, and other bulwarks; to the end that a ſmall number of men within may be able to defend themſelves effectually againſt the aſſaults of a numerous army without.

The origin of fortification is undoubtedly to be attributed to

the difpofition in mankind to invade each other's rights and poffeffions. In the firft ages of the world, men were difperfed over the earth in feparate families, as we are told in the hiftories of the Jews and Scythians, who wandered from one place to another, for the fake of finding pafture for their cattle. Thefe families became in time fo numerous as to form large communities, which fettled all together in a place; from whence villages and towns had their origin and rife: but they found it was neceffary, for the common fecurity, to furround thofe towns with walls and ditches, to prevent all violences from their neighbours, and fudden furprifes. This was fufficient for fome time, till offenfive weapons were invented, and conquering became a fafhion. Then walls with loop-holes were made at proper diftances, in order to fcreen the defenders againft the arrows of the affailants: but finding that, as foon as the enemy got once clofe to the walls, they could from no part be difcovered or repulfed, for this reafon they added fquare towers at proper diftances from each other, fo that every part of the wall might be defended by the adjacent fides of the towers. However, this manner of inclofing of towns was found to be imperfect, becaufe there remained ftill one of the faces of the towers which fronted the field that could not be feen from any other part, and therefore could not be defended. To remedy this, they made the towers round inftead of fquare, imagining this figure to be the ftrongeft to refift the battering engines, as likewife to be better defended from the other parts of the wall.

Notwithftanding the fuperiority of this method over the former, there remained yet a part of thefe towers unfeen and incapable of being defended; which made them change the figure of the towers again; that is, they made them fquare as before; but, inftead of prefenting a face to the field as formerly, they prefented an angle. By this means they effectually found out fuch a difpofition of their works, that no part could be attacked without being feen or defended by fome other part.

This laft method was in ufe a long while, and would in all probability have continued to this day, if gunpowder had not been found out: but the violence of the guns and mortars foon convinced the world, that fuch towers and walls were but a weak defence againft thefe thundering engines; and befides, as the nature of the attack was entirely changed, it was alfo neceffary to change that of fortifying likewife. From that time ramparts were added to the walls, the towers enlarged into baftions, and all forts of out-works have been added, fuch as ravelins, counter-guards, horn and crown works, and others of the like nature, in order to render the defence in fome meafure equivalent to the attack.

Notwithftanding all the improvements which have been made in the art of fortifying fince the invention of gun-powder, that of attacking is ftill fuperior to it. Engineers have tried in vain to render the advantages of a fortification equal to thofe of the attack; the fuperiority of the befiegers' fire, together with the greater number of men, obliges generally, fooner or later, the befieged to fubmit. The greateft improvement made in the art of attacking happened in the year 1697, when M. Vauban firft made ufe of ricochet-firing at the fiege of Ath, whereby the befieged placed behind the parapets were as much expofed to the fire of the befiegers as if there had been none; whereas, before, they had been fecure as long as the parapet was not demolifhed: and the worft is, that there can be no remedy found to prevent this enfilading, without falling into inconveniencies almoft as bad as thofe which we endeavour to avoid.

Fortification is either regular or irregular. *Regular* fortification, is that built in a regular polygon, the fides and angles of which are all equal, being commonly about a mufket-fhot from each other. *Irregular* fortification, on the contrary, is that where the fides and angles are not uniform, equidiftant, or equal; which is owing to the irregularity of the ground, valleys, rivers, hills, and the like.

Sect. I. *Of* Regular Fortification.

Although authors agree as to the general form in the prefent manner of fortifying, yet they moftly differ in particular conftructions of the parts. As it would be both needlefs and fuperfluous to treat of all the different methods hitherto propofed, we fhall content ourfelves with explaining thofe only which are moft efteemed by the beft judges, and have been moftly put in practice.

Of M. Vauban's *Method.*

This method is divided into little, mean, and great; the *little* is chiefly ufed in the conftruction of citadels, the *mean* in that of all forts of towns, and the *great* in particular cafes only. We fhall give the conftruction of the mean, as being moft ufeful; and refer the reader to the table hereafter, for thofe dimenfions which are different in thefe feveral fortifications.

Infcribe in a circle a polygon of as many fides as the fortification is defigned to have fronts; let AB, fig. 1. plate 29. be one of the fides of half an hexagon, which bifect by the perpendicular CD; divide half of it AC into nine equal parts, and one of thefe into ten others; then thefe divifions will ferve as a fcale to conftruct all the parts of the fortification, and each of them is fuppofed to be a toife or fathom, that is, fix French feet; and therefore the whole fide AB is fuppofed to be 180 toifes. As the dividing a line into fo many equal parts is troublefome and tedious, it is more convenient to have a fcale of equal parts by which the works may be conftructed.

If therefore, in this cafe, the radius is taken equal to 180 toifes, and the circle defcribed with that radius being divided into fix equal parts, or the radius being carried fix times round, you will have an hexagon infcribed; AB being bifected by the perpendicular CD as before, fet off 30 toifes from C to D, and draw the indefinite lines ADG, BDF; in which take the parts AE, BH, each equal to 50 toifes; from the centre E defcribe an arc through the point H, meeting AD in G, and from the centre H defcribe an arc through the point E, meeting BD in F; or, which is the fame, make each of the lines EG, HF, equal to the diftance EH; then the lines joining the points A, E, F, G, H, B, will be the principal or outline of the front.

If the fame conftruction be performed on the other fides of the polygon, you will have the principal or outline of the whole fortification. If, with a radius of 20 toifes, there be defcribed circular arcs from the angular points B, A, M, T, and lines are drawn from the oppofite angles F, H, &c. fo as to touch thefe arcs, their parts *ab*, *bc*, &c. together with thefe arcs, will reprefent the outline of the ditch.

Definitions.

1. The part FEALN is called the baftion.
2. AE, AL, the faces of the baftion.
3. EF, LN, the flanks.
4. FG, the curtain.
5. FN, the gorge of the baftion.
6. AG, BF, the lines of defence.
7. AB, the exterior fide of the polygon.
8. CD, the perpendicular.
9. Any line which divides a work into two equal parts is called the capital of that work.
10. *a b c*, the counterfcarp of the ditch.
11. A, M, the flanked angles.
12. H, E, L, the angles of the fhoulder, or fhoulder only.
13. G, F, N, the angles of the flank.
14. Any angle whofe point turns from the place is called a

faliant angle, fuch as A, M: and any angle whofe point turns towards the place, *re-entering angle*, fuch as *b*, F, N.

15. If there be drawn two lines parallel to the principal or outline, the one at 3 toifes diftance, and the other at 8 from it, then the fpace *y x* included between the principal one and that fartheft diftant is called the *rampart*.

And the fpace *x x*, contained by the principal line, and that near to it, and which is generally ftained black, is called the *parapet*.

16. There is a fine line drawn within four feet of the parapet, which expreffes a ftep called *banquette*.

N. B. All works have a parapet of three toifes thick, and a rampart of 8 to 10, befides their flopes. The rampart is elevated more or lefs above the level of the place, from 10 to 20 feet, according to the nature of the ground and the particular conftructions of engineers.

The parapet is a part of the rampart elevated from 6 to $7\frac{1}{2}$ feet above the reft, in order to cover the troops which are drawn up there from the fire of the enemy in a fiege; and the banquette is two or three feet higher than the rampart, or about four feet lower than the parapet; fo that when the troops ftand upon it, they may juft be able to fire over the parapet.

17. The body of the place is all that which is contained within this firft rampart; for which reafon, it is often faid to conftruct the body of the place; which means, properly, the conftruction of the baftions and curtains.

18. All the works, which are conftructed beyond the ditch before the body of the place, are called *out-works*.

T A B L E.

	Forts.						Little Fortif.				Mean.		Great.	
Side of Polygon	80	90	100	110	120	130	140	150	160	170	180	190	200	260
Perpendicular	10	11	$12\frac{1}{2}$	14	15	16	20	21	23	25	30	31	25	22
Faces baftion	22	25	28	30	33	35	40	42	45	47	50	53	55	60
Capital of ravelin	25	28	30	35	38	40	45	50	50	52	55	55	60	50

In the firft vertical column are the numbers expreffing the lengths of the exterior fides, from 80 to 260. In the fecond, the perpendiculars anfwering to thefe fides. In the third, the lengths of the faces of baftions; and in the fourth, the lengths of the capitals of the ravelins.

The forts are moftly, if not always, fquares: for which reafon, the perpendiculars are made one-eighth of the exterior fides; becaufe, if they were more, the gorges of the baftions would become too narrow.

The little fortification is chiefly defigned for citadels, and are commonly pentagons; the perpendiculars are made one-feventh of the exterior fide: the mean is ufed in all kinds of fortifications, from an hexagon upwards to any number of fides: and the great is feldom ufed but in an irregular fortification, where there are fome fides that cannot be made lefs without much expence; or in a town which lies near a great river, where the fide next the river is made from 200 to 260 toifes; and, as that fide is lefs expofed to be attacked than any other, the perpendicular is made fhorter, which faves much expence.

The faces of the baftions are all $\frac{2}{7}$ths of the exterior fides, or nearly fo, becaufe the fractions are neglected.

It may be obferved in general, that in all fquares the perpendicular is $\frac{1}{8}$th of the exterior fide, and all pentagons $\frac{1}{7}$th, and in all the reft upward $\frac{1}{6}$th.

1. *Conftruction of Orillons and retired Flanks.*

Defcribe the front MPQRST as before, and divide the flank into three equal parts, of which fuppofe S *r* to be one: from the oppofite flanked angle M draw a line M *r*, in which take the part *m r* of 5 toifes; take likewife R *n* in the line of defence M R, produced equal to 5 toifes, and join *n m*, upon which as a bafe defcribe the equilateral triangle *n p m*, and from the angle *p*, oppofite to the bafe as centre, is defcribed the circular flank *n m*.

And if S *r* be bifected by the perpendicular 1, 2, and another be erected upon the face S T, at S, the interfection 2 of thefe two perpendiculars will be the centre of the arc which forms the orillon.

The orillons are very ufeful in covering the retired flanks, which cannot be feen but directly in the front; and, as thefe orillons are round, they cannot be fo eafily deftroyed as they would be if they were of any other figure.

2. *Conftruction of Ravelins or Half-Moons.*

Fig. 2. Set off 55 toifes, from the re-entering angle O of the counterfcarp, on the capital O L, or on the perpendicular produced; and from the point L draw lines to the fhoulders AB; whofe parts LM, LN, terminated by the counterfcarp, will be the faces, and MO, ON, the femi-gorges of the ravelin required.

This is Mr. Vauban's method of conftructing ravelins, according to fome authors: and others will have the faces of the ravelin to terminate on thofe of the baftions within 3 toifes of the fhoulders; which feems to be the beft way, for thefe ravelins cover the flanks much better than the others.

The ditch before the ravelin is 12 toifes, its counterfcarp parallel to the faces of the ravelins; and is made in a circular arc, before the faliant angle; as likewife all ditches are in general.

When the ravelins are made with flanks, as in fig. 3. the faces fhould terminate on thofe of the baftions, at leaft 5 toifes from the fhoulders. The flanks are made by fetting off 10 toifes from the extremities of the faces, from *f* to *b*, and from *m* to *l*; and from the points *b*, *l*, the flanks *b k*, *l p*, are drawn parallel to the capital L O of the ravelin. There are fometimes redoubts made in the ravelin, fuch as in fig. 2. which is done by fetting off 16 toifes from the extremities of the faces on the femi-gorges from N to *b*, and from M to *a*; and from the points *b*, *a*, the faces are drawn parallel to thofe of the ravelin: the ditch before the redoubt is 6 toifes, and its counterfcarp parallel to the faces.

3. *Conftruction of Tenailles.*

A tenaille is a work made in the ditch before the curtains, the parapet of which is only 2 or 3 feet higher than the level ground of the ravelin. There are three different forts: the firft are thofe, as in fig. 4. which are made in the direction of the lines of defence, leaving a paffage of 3 toifes between their extremities and the flanks of the baftions, as likewife another of 2 in the middle for a bridge of communication to the ravelin.

The fecond fort are thofe as in fig. 5. Their faces are in the lines of defence, and 16 toifes long, befides the paffage of 3 toifes between them and the flanks of the baftions; their flanks are found by defcribing arcs from one fhoulder of the tenaille as

centre through the other, on which are ſet off 10 toiſes for the flanks deſired.

And the third ſort are thoſe as in fig. 6. Their faces are 16 toiſes, as in the ſecond ſort, and the flanks are parallel to thoſe of the baſtions.

The uſe, in general, of tenailles is to defend the bottom of the ditch by a grazing fire, as likewiſe the level ground of the ravelin, and eſpecially the ditch before the redoubt within the ravelin, which can be defended from no where elſe ſo well as from them.

The firſt ſort do not defend the ditch ſo well as the others, as being too oblique a defence; but, as they are not ſubject to be enfiladed, M. Vauban has generally preferred them in the fortifying of places, as may be ſeen in the citadel of Liſle, at Landau, New Briſac, and in a great many other places.

The ſecond ſort defend the ditch much better than the firſt, and add a low flank to thoſe of the baſtions; but as theſe flanks are liable to be enfiladed, they have not been much put in practice. This defect might, however, be remedied, by making them ſo as to be covered by the extremities of the parapets of the oppoſite ravelins, or by ſome other work.

As to the third ſort, they have the ſame advantage as the ſecond, and are likewiſe liable to the ſame objections; for which reaſon, they may be uſed with the ſame precautions which have been mentioned in the ſecond.

Tenailles are eſteemed ſo neceſſary, that there is hardly any place fortified without them: and it is not without reaſon. For, when the ditch is dry, the part behind the tenailles ſerves as a place of arms, from which the troops may ſally, deſtroy the works of the enemy in the ditch, oppoſe their deſcent, and retire with ſafety; and the communication from the body of the place to the ravelin becomes eaſy and ſecure: which is a great advantage; for by that means the ravelin may be a much better defence, as it can be ſupplied with troops and neceſſaries at any time. And, if the ditch is wet, they ſerve as harbours for boats, which may carry out armed men to oppoſe the paſſage over the ditch whenever they pleaſe; and the communication from the tenailles to the ravelin becomes likewiſe much eaſier than it would be without them.

4. *Conſtruction of Lunettes.*

Fig. 7. Lunettes are placed on both ſides of the ravelin, ſuch as B, to increaſe the ſtrength of a place: they are conſtructed, by biſecting the faces of the ravelin with the perpendicular LN; on which is ſet off 30 toiſes from the counterſcarp of the ditch, for one of its faces; the other face, PN, is found by making the ſemi-gorge TP of 25 toiſes; the ditch before the lunettes is 12 toiſes, the parapet 3, and the rampart 8, as in the ravelin.

There is ſometimes another work made to cover the ſaliant angle of the ravelin, ſuch as A, called *bonnet*, whoſe faces are parallel to thoſe of the ravelin, and when produced biſect thoſe of the lunettes; the ditch before it is 10 toiſes.

There are likewiſe lunettes, ſuch as D in fig. 8. whoſe faces are drawn perpendicular to thoſe of the ravelin, within a third part from the ſaliant angle; and their ſemi-gorges are only 20 toiſes.

Theſe kind of works may make a good defence, and coſt no very great expence; for, as they are ſo near the ravelin, the communication with it is very eaſy, and one cannot well be maintained till they are all three taken.

5. *Conſtruction of Tenaillons.*

Fig. 9. Produce the faces of the ravelin beyond the counterſcarp of the ditch, at a diſtance MN of 30 toiſes, and take on the counterſcarp of the great ditch 15 toiſes from the re-entering angle p to q, and draw N q; then q N M p will be the tenailles required; its ditch is 12 toiſes, that is, the ſame as that of the ravelin. Sometimes there is made a retired battery in the front of the tenaillons, as in B; this battery is 10 toiſes from the front to which it is parallel, and 15 toiſes long.

There are commonly retrenchments made in the tenaillons, ſuch as O; their parapets are parallel to the fronts MN, and biſect the ſide q N; the ditch before this retrenchment is 3 toiſes: and there is a banquette before the parapet next to the ditch of about 8 feet, called *berm*; which ſerves to prevent the earth of the parapet (which ſeldom has any revetment) from falling into the ditch.

It is to be obſerved, that the ravelin, before which tenaillons are conſtructed, muſt have its ſaliant angle much greater than the former conſtruction makes them; otherwiſe the ſaliant angles of the tenaillons become too acute; for which reaſon we made the capital of this ravelin 45 toiſes, and the faces terminate within three toiſes of the ſhoulders.

6. *Conſtruction of Counterguards.*

Fig. 10, 11. When the counterguard is placed before the ravelin, ſet off 40 toiſes on the capital of the ravelin from the ſaliant angle A to the ſaliant angle B, of the counterguard; and 10 from C to D, on the counterſcarp of the ditch.

When the counterguard is before the baſtion, ſuch as in fig. 2. its ſaliant angle F is 50 toiſes from the ſaliant angle E of the baſtion, and the breadth near the ditch of the ravelin 10 toiſes as before.

The ditch before the counterguards is 12 toiſes, and its counterſcarp parallel to the faces.

Counterguards are made before the ravelin on ſome particular occaſions only; but are frequently conſtructed before the baſtions, as covering the flanks wonderfully well. Some authors, as Mr. Blondel and Mr. Coehorn, will have them much narrower than they are here.

7. *Conſtruction of Hornworks.*

Fig. 12. Produce the capital of the ravelin beyond the ſaliant angle A, at a diſtance AB of about 80 toiſes; draw DBE at right angles to AB; in which take BD, BE, each equal to 55 toiſes: and on the exterior ſide DE, trace a front of a polygon in the ſame manner as that of the body of the place, making the perpendicular BF 10 toiſes, and the faces 30.

The branches D a, E b, of the hornwork, when produced, terminate on the faces of the baſtions, within 5 toiſes of the ſhoulders. The ditch of the hornwork is 12 toiſes, and its counterſcarp parallel to the branches; and in the front terminates at the ſhoulders, in the ſame manner as the great ditch before the baſtions.

The capital of the ravelin before the front of the hornwork is 35 toiſes, and the faces terminate on the ſhoulders, or rather 2 or 3 toiſes beyond them: and the ditch before the ravelin is 8 toiſes.

There are ſometimes retrenchments made within the hornwork, ſuch as S, S; which are conſtructed by erecting perpendiculars to the faces of the ravelins, within 25 toiſes of their extremities. This retrenchment, like all others, has a parapet turfed only with a berm of 8 feet before it; as likewiſe a ditch from 3 to 5 toiſes broad.

Fig. 13. When a hornwork is made before the baſtion, the diſtance DL of the front from the ſaliant angle of the baſtion is 100 toiſes, and the branches terminate on the faces of the adjacent ravelins within 5 toiſes from their extremities; all the reſt is the ſame as before.

8. *Conſtruction of Crown-works.*

From the ſaliant angle, A (fig. 14.) of the ravelin, as a centre, deſcribe an arc of a circle with a radius of about 120 toiſes, cutting the capital of the ravelin produced at C; from the

point C, set off the cords CB, CF, each of them equal to 110 toises; and on each of which, as an exterior side, construct a front of a polygon of the same dimensions as in the hornwork; that is, the perpendicular should be 18 toises, the faces 30, and the branches terminate on the faces of the bastions within 25 toises of the shoulders.

The ditch is 12 toises, the capital of the ravelin 35, and its ditch 8; that is, the same as in the hornwork.

Sometimes the crownwork is made before the bastion, as in fig. 15. The arc is described from the saliant angle A of the bastion, with a radius of 120 toises, as before; and the branches terminate on the faces of the adjacent ravelins within 25 toises of their extremities: the rest of the dimensions and constructions are the same as before.

Hornworks, as well as crownworks, are never made but when a large spot of ground falls beyond the fortification, which might be advantageous to an enemy in a siege, or to cover some gate or entrance into a town.

9. *Construction of Covert-Ways and Glacis.*

Although we have not hitherto mentioned the covert-way, nevertheless all fortifications whatsoever have one; for they are esteemed to be one of the most essential parts of a modern fortification; and it is certain, the taking the covert-way, when it is in a good condition and well defended, is generally the most bloody action of the siege.

After having constructed the body of the place, and all the outworks which are thought necessary, lines are drawn parallel to the outmost counterscarp of the ditches, at 6 toises distant from it; and the space *m n*, *m n*, included between that line and the counterscarp, will be the covert-way required.

Fig. 1, pl. 30. There is in every re-entering angle of the counterscarp a place of arms, *m*; which is found by setting off 20 toises from the re-entering angle *a*, on both sides from *a* to *b*, and from *a* to *c*; and from the points *b*, *c*, as centres, arcs are described with a radius of 25 toises, so as to intersect each other in *d*; then the lines drawn from this intersection to the points *b*, *c*, will be the faces of the places of arms.

If lines are drawn, parallel to the lines which terminate the covert-way, and the places of arms, at 20 toises distant from them, the space *x*, *x*, *x*, between these lines and those which terminate the covert-way, will be the glacis.

At the extremities of the places of arms are traverses made, such as *v*, *v*, which serve to inclose them; these traverses are 3 toises thick, and as long as the covert-way is broad; and a passage is cut in the glacis round them, of about 6 or 8 feet, in order to have a free communication with the rest of the covert-way.

There are also traverses of the same dimensions before every saliant angle of the bastion and outworks, and are in the same direction as the faces of those works produced; and the thickness lies at the same side as the parapets. The passages round these last traverses are likewise from 6 to 8 feet wide. In each place of arms are two sally ports *z z*, which are 10 or 12 feet wide, for the troops to sally out; in time of a siege they are shut up with barriers or gates.

10. *Construction of Arrows and Detached Redoubts.*

An arrow is a work made before the saliant angles of the glacis, such as A, fig. 1. It is composed of a parapet of 3 toises thick, and 40 long; and the ditch before it 5 toises, terminating in a slope at both ends. The communication from the covert-way into these arrows is 4 or 5 toises wide; and there is a traverse, *r*, at the entrance, of 3 toises thick, with a passage of 6 or 8 feet round it.

A detached redoubt is a kind of work much like a ravelin, with flanks placed beyond the glacis, such as B: they are made in order to occupy some spot of ground which might be advantageous to the besiegers; likewise to oblige the enemy to open their trenches farther off than they would do otherwise.

Their distance from the covert-way ought not to exceed 120 toises, that it may be defended by musket-shot from thence.

The gorge *a b* is 40 toises; the flanks *a c*, *b f*, which are perpendicular to the gorge, 10; and the faces, *c d*, *f d*, 30: the ditch before it is 6 toises, ending in slopes at both ends; the covert-way, 4; the branches of the small covert-way are 42 toises long, or thereabouts; the faces of the places of arms *y*, *y*, which are perpendicular to the branches, 10; and the other, which is parallel to them, 14.

The communication from the covert-way into the redoubt is 5 or 6 toises wide; and there is a traverse made just at the entrance, and another in the middle when it is pretty long. The parapets of this communication terminate in a slope or glacis.

If these redoubts are above 50 toises distant from the covert-way, the besiegers carry their trenches round, and enter through the gorge; by which the troops that are in them are made prisoners of war, if they do not retire betimes; to prevent which, some other outworks should be made to support them.

11. *Construction of Second Ditches and Covert-Ways.*

Fig. 2. When the ground is low, and water to be found, there is often a ditch about 10 or 12 toises made round the glacis; and opposite to the places of arms are constructed lunettes, beyond the ditch: such as D, whose breadth on the counterscarp of the ditch is 10 toises, from *b* to *a*, and from *c* to *d*; and the faces *a* L, *d* L, are parallel to those of the places of arms; the ditch before them is from 8 to 10 toises wide.

The second covert-way is 4 toises; the semi-gorges of the places of arms, *m*, about 15; and the faces perpendicular to the counterscarp; the second glacis is from 15 to 18 toises broad. This second covert-way has traverses every where, in the same manner as the first.

12. *Construction of Profiles.*

A profile is the representation of a vertical section of a work; it serves to show those dimensions which cannot be represented in plans, and is necessary in the building of a fortification. Profiles are generally constructed upon a scale of 30 feet to an inch. It would be endless to describe all their particular dimensions; we shall therefore lay down the principal rules only, given by M. Vauban, on this subject.

1. Every work ought to be at least 6 feet higher than that before it, so that it may command those before it; that is, that the garrison may fire from all the works at the same time, with great and small arms, at the besiegers in their approaches. Notwithstanding this specious pretence, there are several authors who object against it. For, say they, if you can discover the enemy from all the works, they can discover, by the same reason, all the works from their batteries; so that they may destroy them without being obliged to change their situation, and thereby dismount all the guns of the place before they come near it.

But, if all the works were of the same height, those within cannot be destroyed, till such time as those before them are taken: guns might be placed in the covert-way and outworks to obstruct the enemy's approach; and when they come near the place, they might be transported into the inner-works: and as the body of the place would be much lower, the expence would be considerably diminished.

But when works are low, they are easily enfiladed by the ricochet batteries, which is a kind of firing with a small quantity of powder, by giving the gun an elevation of 10 or 12 degrees: this might, however, be partly prevented, by making the

parapets near the ſaliant angles, for the ſpace of 8 toiſes on each ſide, 5 or 6 feet higher than the reſt of the works.

2. The covert-way ſhould be lower than the level ground, otherwiſe the body of the place muſt be raiſed very high, eſpecially where there are ſeveral outworks: this is to be underſtood only when the works exceed each other in height, otherwiſe it need not be below the level.

3. The baſes of all inward ſlopes of earth ſhould be at leaſt equal to the height, if not more.

4. The baſes of all outward ſlopes of earth, two-thirds of their heights.

5. The ſlopes of all walls or revetments ſhould be one-fifth of their height; or one-ſixth might perhaps be ſufficient: the height of a wall is eſtimated from the bottom of the ditch, and not from the beginning of its foundation.

6. The ſlopes of all parapets and traverſes are one-ſixth of their breadth; that is, 3 feet towards the field; or the inſide, where the banquettes ſhould be 3 feet higher than the outſide.

7. When the revetment of a rampart goes quite up to the top, 4 feet of the upper part is a vertical wall of 3 feet thick, with a ſquare ſtone at the top of it projecting 6 inches; and a circular one below, or where the ſlope begins, of 8 or 10 inches diameter: they go quite round the rampart, and the circular projection is called the *cordon*.

Where the ſtraight part of the wall ends and the ſlope begins, the wall is always made 5 feet thick: and the counterforts or buttreſſes reach no higher than that place.

8. When the rampart is partly walled and partly turfed, then one-fifth of the height which is turfed muſt be added to 5 feet, to get the thickneſs of the wall above.

And having the thickneſs of any wall above, by adding one-fifth of its height from the bottom of the ditch, the ſum will be the thickneſs of the wall at the bottom; but if a ſixth part is only taken for the ſlope, then a ſixth part muſt be added.

For inſtance, ſuppoſe a rampart of 30 feet high from the bottom of the ditch, and that 10 of which are to be turfed; then the fifth part of 10, which is 2, added to 5, gives 7 for the wall above; and as this wall is 20 feet high, the fifth of which is 4, and 4 added to the thickneſs 7 above gives 11 for the thickneſs near the foundation.

Fig. 3. repreſents, in military perſpective, the profiles of the body of a place, the ravelin and covert-way; which gives a clear idea of what is meant by a profile, and from which thoſe of all other works may be eaſily conceived.

Sect. II. *Of* Irregular Fortification.

The moſt eſſential principle in fortification conſiſts in making all the fronts of a place equally ſtrong, ſo that the enemy may find no advantage in attacking either of the ſides. This can happen no otherwiſe in a regular fortification ſituated in a plain or even ground: but as there are but few places which are not irregular either in their works or ſituations, and the nature of the ground may be ſuch as makes it impracticable to build them regular without too great expence, it is ſo much the more neceſſary to ſhow in what conſiſts the ſtrength or weakneſs of a town irregularly fortified, ſo that the weakeſt part may be made ſtronger by additional outworks; as likewiſe, if ſuch a place is to be attacked, to know which is the ſtrongeſt or weakeſt part.

1. *Conſtruction of an irregular Place ſituated in an open Country.*

If the place to be fortified is an old town incloſed by a wall or rampart, as it moſt frequently happens, the engineer is to conſider well all the different circumſtances of the figure, ſituation, and nature of the ground; and to regulate his plan accordingly, ſo as to avoid the diſadvantages, and gain all the advantages poſſible: he ſhould examine whether, by cutting off ſome parts of the old wall or rampart, and taking in ſome ground, the place can be reduced into a regular figure, or nearly ſo; for, if that can be done without increaſing the expence conſiderably, it ſhould by no means be omitted. Old towns have often towers placed from diſtance to diſtance, as Douay, Tournay, and many other places, which are generally made uſe of, and mended when it may be done. If there is a rampart without baſtions or towers, it muſt be well conſidered whether baſtions may not be added, or if it is not better to make only ſome outworks: if the ditch about this rampart is not too wide and deep, it would be advantageous to make detached baſtions; otherwiſe ravelins and counterguards muſt be conſtructed. Special care muſt be taken to make all the ſides of the polygon as nearly equal as poſſible, and that the length of the lines of defence do not exceed the reach of muſket-ſhot; but, if that cannot be done, thoſe ſides which are on the narroweſt part ſhould be made the longeſt.

If it ſhould happen, that ſome of the ſides are inacceſſible or of very difficult approach, either on account of ſome precipice, marſhy ground, or inundation, they may be made much longer than the others which are of eaſy acceſs, and the flanks need not be ſo large as the reſt; by doing ſo, there will be ſome expences ſaved, which may be uſed in making the other ſides ſtronger by adding more outworks.

There are few ſituations but what are more advantageous in ſome parts than in others; it is therefore the buſineſs of an engineer to diſtinguiſh them, and to render thoſe ſides ſtrong by art which are not ſo by nature.

If the ſituation is low and watery, lunettes or tenaillons, and ſuch other ſmall outworks, ſhould be conſtructed; becauſe they are not of any great expence, and may make a very good defence. But if one ſide of the place only is low, and running water is to be had, a ſecond ditch and covert-way with lunettes may be made, by obſerving, that if the firſt glacis is made to ſlope, ſo as to become even with the level of the water in the ſecond ditch; or if the water can be ſwelled by means of dykes or ſluices, ſo as to overflow the beſt part of the firſt glacis, it ſhould be done: for by ſo doing theſe works will be able to make a very good defence, ſince the beſiegers will find it a difficult matter to lodge themſelves upon this glacis; which cannot be done but within a few toiſes of the firſt covert-way, where the beſieged are ready to receive them, and to deſtroy their works with great advantage; whereas the enemy cannot ſupport their workmen but from the ſecond covert-way, which is too far off to be of any great ſervice to them.

But if the ſituation is of a dry nature, without any water about it, caponiers ſhould be made in the great ditch, from the curtains to the ravelin, and batteries raiſed in the entrance of the ditch before the ravelin, whoſe parapet muſt ſlope off into a glacis ſo as to afford no cover for the enemy behind them. Arrows and detached redoubts are likewiſe very proper to be uſed in ſuch a caſe; and ſometimes horn or crown-works, if it ſhould be thought convenient: but theſe works ſhould never be conſtructed without an abſolute neceſſity, either to occupy a ſpot of ground which might be advantageous to the enemy, or to cover ſome gate or entrance into the town; for they are of great expence, and their defence ſeems not to be anſwerable to it.

Moſt of the places in Flanders are fortified with horn-works, ſuch as Ipres, Tournay, Liſle, and others.

If the place to be fortified is new, and the ſituation will not admit of a regular conſtruction, particular care muſt be taken in chooſing ſuch a ſpot of ground as is moſt advantageous, and leaſt liable to any diſadvantages either in the building or in the maintaining of it. All hills or riſing grounds ſhould be avoided, which might command any part of the works; marſhy grounds, becauſe ſuch ſituations are unwholeſome; or lakes and ſtanding

waters for the fame reafon, excepting a lake is or may be made navigable. Good water fhould be had either within the place or near it, for it is abfolutely neceffary for men and cattle; the air fhould be wholefome; otherwife the continual ficknefs that may reign in fuch a place might prevent people to come and live in it, and the garrifon would not be in a condition to defend themfelves as they ought to do. In fhort, all the different circumftances attending fuch an undertaking fhould be maturely confidered before a refolution is taken to fortify any place.

When a fituation is fixed upon, the next thing to be confidered is, the bignefs of the town and the number of its outworks; which muft abfolutely depend upon the confequence fuch a place is of to a nation. If it is only to guard a pafs or entrance into a country, it need not be fo large: but if it is to be a place either to promote or to protect trade, it fhould be large and commodious; the ftreets fhould be wide, and the buildings regular and convenient. As to what regards the fortification, its conftruction fhould depend on the nature of the fituation, and the number of works, on the funds or expence a prince or a nation will be at; which, however, ought to be according to the benefit arifing from fuch a place: for, as fuch undertakings are of very great expence, an engineer cannot be too fparing in his works; on the contrary, the greateft economy fhould be ufed both in regard to the number of works and to their conftruction. The body of the place may have * revetments quite up to the top, or only in part, and the reft turfed; but as to the outworks, they fhould have half revetments, or they may be made with turf only; as being not fo neceffary to prevent the place from being furprifed, which may neverthelefs make a good defence.

Fig. 4. is the plan of an octagon, one half of which is fimilar and equal to the other half; it being fuppofed, that the fituation would not admit of fortification quite regular. The exterior fides are each 180 toifes, and the works are conftructed according to our method: but becaufe the fides AB, EF, are weaker than the reft, as has been proved before, we have added tenailles, redoubts in the ravelins, and lunettes, to render them nearly equal in ftrength with the others; and, if counter-guards were made before the baftions A and B, it would effectually fecure that front. Inftead of lunettes, any other works may be made, as may be thought convenient and according to the nature of the ground. If it fhould be judged neceffary to add other outworks to the ravelins all round the place, care muft be taken to add likewife more to the fronts AB, EF, in order to render the advantages and difadvantages of attacking on either fide equal.

2. Conftruction of an irregular Place fituated on a Hill or Rock.

In the conftruction of fuch places, care muft be taken that no neighbouring hill commands any part of the works. The town fhould always be built on the higheft part; but if it fhould be thought more convenient to place it lower, then the upper part muft be fortified with a fort. The fituation fhould be made level as near as poffible, by removing the earth from fome places to fill up others; and, if it cannot well be levelled without extraordinary expence, works muft be made on the higheft part, fo as to command and protect the lower. The works ought to occupy all the upper part of the hill; but if it fhould be too extenfive to be all inclofed, or fo irregular as not to be fortified without great inconvenience, the parts which fall without fhould be fortified with fome detached works, and a communication with the place muft be made either above or under ground. There fhould be no cavity or hollow roads within cannon-fhot round about the place, where the enemy might be able to approach under cover. If there fhould happen to be a fpring near the top of the hill, it fhould be inclofed in the fortification; or, if that cannot be done, by fome work or other: for there is nothing more neceffary, and at the fame time fcarcer, in fuch fituations, than water; for which reafon there cannot be too much care in providing it: feveral cifterns are to be made to receive the rain-water, and to preferve it; wells fhould be dug likewife, though ever fo deep, the water of which will ferve for common ufe.

Places built on hills or rocks fhould never be large; for their ufe is generally to guard paffes or inlets into a country, and are feldom ufeful in traffic; and it is a difficult matter to provide for a large garrifon in fuch fituations, neither fhould any fuch place be built without fome very material reafons: but when it is abfolutely neceffary, great care and precaution fhould be taken to render the works as perfect as the fituation will admit of, and at the fame time to be as frugal in the expence as poffible.

3. Conftruction of irregular Fortifications fituated near Rivers, Lakes, or the Sea.

As the intent of building thefe kind of places is chiefly to facilitate and protect trade, they are of more importance than any other kind, efpecially in maritime countries, where the principal ftrength and power depend on them: for which reafon, we fhall treat of this conftruction more largely than of any other.

The firft thing to be confidered is their fituation, which ought to be fuch as to afford a good harbour for fhipping, or a fafe and eafy entrance in ftormy weather; but, as it is hardly poffible to find any where fhips may go in and lie fecure with all winds, care fhould be taken to make them fafe to enter with thofe winds which are moft dangerous: but it is not fufficient that harbours be fafe againft ftormy weather; they fhould likewife be fo againft an enemy both by land and water; for it often happens, that fhips are deftroyed where it was imagined they were fecure, which is of too great confequence not to be provided againft; for which reafon, forts or batteries muft be built in the moft convenient places, to prevent the enemy's fhips from coming too near, fo as to be able to cannonade thofe in the harbour, or fling fhells amongft them; and if there is any danger of an enemy's approach by land, high ramparts and edifices muft be built, fo as to cover them.

When a river is pretty large, and it is not convenient for making a harbour without great expence, the fhips may ride along the fhore; which, for that reafon, muft be made acceffible for fhips of burden: this may be done by advancing the quay into the river if the water is too fhallow, or by digging the river fufficiently deep for that purpofe.

And, to prevent an enemy from coming up the river, forts muft be built on both fides, efpecially when there are any turnings or windings. Antwerp is fuch a place: for the Scheld is fufficiently deep to carry fhips of great burden, which may come quite near the town-wall; and feveral forts are built below it on both fides, fo that it would not be an eafy matter for an enemy to come up the river.

When the river is but fmall, fo that no fhips of burden can come through it, it is fufficient to make it run through fome of the works, where proper landing-places are contrived, from whence the goods may be carried in to the place; as at Sarre-louis, where a hornwork is built beyond the Sarre, in the gorge of which the goods are landed.

If the breadth of the river does not exceed 200 yards, it com-

* Revetments are chiefly made to prevent a place from being furprifed: outworks do not want to be made fo; the taking them by furprife is of no great confequence, except in a fiege, when other cautions are ufed to prevent it.

monly paſſes through the middle of the town, and proper quays are made on each ſide; in ſuch a caſe, the fortification is ſo contrived, as that the river paſſes through the curtain, in order to have a baſtion on each ſide to defend the coming in and going out.

When M. Vauban fortified near rivers, he made always the exterior ſide near the water much longer than any of the others; ſuch as Hunninghen on the Rhine, and Sarrelouis on the Sarre; but for what reaſon he fortified theſe places in that manner, has not been explained by any author.

But it is plain that the ſides which terminate at the river are the weakeſt; becauſe the beſiegers' trenches being ſecured by the river, they may draw moſt of their troops off, and act therefore with more vigour and ſtrength on the other ſide: beſides, as the ſtrength of a ſide increaſes in proportion as the angle of the polygon is greater, by making the ſide next the river longer, the angles at its extremities become wider, and conſequently the adjacent ſides ſtronger.

There are other advantages, beſides thoſe mentioned already, which ariſe from the lengthening that ſide: for if the river is pretty deep ſo as not to be fordable, that ſide is not liable to be attacked; and by increaſing its length, the capacity of the place increaſes much more in proportion to the expence, than if more ſides were made; the centre of the place will be likewiſe nearer the river, which makes it more convenient for tranſporting the goods from the water-ſide to any part of the town.

To illuſtrate this method of M. Vauban's, we ſhall give the plan of Hunninghen: this place was built for the ſake of having a bridge over the Rhine, for which reaſon he made it only a pentagon; the ſide A B (fig. 5.) next to the river is 200 toiſes, and each of the others but 180.

About the ſpace *a b c*, which lies before the front AB, is a ſtone wall; and the paſſages *x x* are ſhut up with ſluices, to retain the water in the ditches in dry ſeaſons: and to prevent an enemy from deſtroying the ſluice near the point *c*, whereby the water would run out and leave the ditches dry, the redoubt *y* was built in the little iſland hard by, in order to cover that ſluice; without which precaution the place might be inſulted from the river ſide, where the water is ſhallow in dry ſeaſons.

The hornwork K beyond the Rhine was built to cover the bridge; but as this work cannot be well defended croſs the river, the hornwork H was made to ſupport the other.

Before finiſhing the deſcription of this plan, we ſhall ſhow how to find the long ſide AB. After having inſcribed the two ſides GE, GF, in a circle, draw the diameter CD, ſo as to be equally diſtant from the line joining the points E F that is parallel to it. On this diameter ſet off 100 toiſes on each ſide of the centre; from theſe points draw two indefinite perpendiculars to the diameter; then if from the points E F, as centres, two arcs are deſcribed with a radius of 180 toiſes, their interſections A and B, with the ſaid perpendiculars, will determine the long ſide AB, as likewiſe the other two FB and EA. In like manner may be found the long or ſhort ſide of any polygon whatſoever.

When a place near a river is to be fortified for the ſafety of commerce, particular care ſhould be taken in leaving a good ſpace between the houſes and the water-ſide, to have a key or landing place for goods brought by water; it ſhould alſo be contrived to have proper places for ſhips and boats to lie ſecure in ſtormy weather, and in time of a ſiege; and as water-carriage is very advantageous for tranſporting goods from one place to another, as likewiſe for bringing the neceſſary materials, not only for building the fortifications, but alſo the place itſelf, the expences will be leſſened conſiderably when this convenience can be had; for which reaſon, places ſhould never be built any where elſe but near rivers, lakes, or the ſea; excepting in extraordinary caſes, where it cannot be avoided.

FORTIN, Fortelet, or *Field-fort*, a ſconce or little fort, whoſe flanked angles are generally 120 fathoms diſtant from one another. The extent and figure of fortins are different, according to the ſituation and nature of the ground; ſome of them having whole baſtions, and others demi-baſtions. They are made uſe of only for a time, either to defend the lines of circumvallation, or to guard ſome paſſage or dangerous poſt.

FORTISSIMO, in muſic, ſometimes denoted by FFF, or *fff*, ſignifies, to ſing or play very loud or ſtrong.

FORTITUDE, a virtue or quality of the mind, generally conſidered as the ſame with Courage; though in a more accurate view they ſeem to be diſtinguiſhable. Courage may be a virtue or a vice, according to circumſtances; *fortitude* is always a virtue: we ſpeak of deſperate courage, but not of deſperate fortitude. A contempt or neglect of danger, without regard to conſequences, may be called *courage*; and this ſome brutes have as well as we: in them it is the effect of natural inſtinct chiefly; in man it depends partly on habit, partly on ſtrength of nerves, and partly on want of conſideration. But fortitude is the virtue of a rational and conſiderate mind, and is founded in a ſenſe of honour and a regard to duty. There may be courage in fighting a duel, though that folly is more frequently the effect of cowardice: there may be courage in an act of piracy or robbery; but there can be no fortitude in perpetrating a crime. Fortitude implies a love of equity and of public good; for, as Plato and Cicero obſerve, courage exerted for a ſelfiſh purpoſe, or without a regard to juſtice, ought to be called audacity rather than fortitude. This virtue takes different names, according as it acts in oppoſition to different ſorts of evil; but ſome of thoſe names are applied with conſiderable latitude. With reſpect to danger in general, fortitude may be termed *intrepidity*; with reſpect to the dangers of war, *valour*; with reſpect to pain of body or diſtreſs of mind, *patience*; with reſpect to labour, *activity*; with reſpect to injury, *forbearance*; with reſpect to our condition in general, *magnanimity*. The motives to fortitude are many and powerful. This virtue tends greatly to the happineſs of the individual, by giving compoſure and preſence of mind, and keeping the other paſſions in due ſubordination.

FORTUNA, a goddeſs worſhipped with great devotion by the ancient Greeks and Romans; who believed her to preſide over human affairs, and to diſtribute wealth and honour at her pleaſure. See Fortune.

FORTUNATE islands, in ancient geography, certain iſlands concerning the ſituation of which authors are not agreed. They were famous for the golden apples of the Hesperides. The common opinion is, that they are the Canary *Iſlands*.

FORTUNE, Τυχη, a name which among the ancients ſeems to have denoted a principle of fortuity, whereby things came to paſs, without being neceſſitated thereto: but what and whence that principle is, they do not ſeem to have ever preciſely decided. Hence their philoſophers are often intimating, that men only framed the phantom *Fortune* to hide their ignorance; and that they call *Fortune* whatever befalls a man without his knowing for what purpoſe. Fortune was not conſidered as a deity by the old Romans, but was made ſo by the devotion and

folly of the vulgar: and Mr. Spence ſays, that he has ſeen an ancient gem, in which Cybele, the mother of the gods, is repreſented as turning away her head from Fortune, in an attitude of diſowning and rejecting her.

According to the opinion of the heathens, therefore, fortune in reality was only the arrival of things in a ſudden and unexpected manner, without any apparent cauſe or reaſon: ſo that the philoſophical ſenſe of the word coincides with what is vulgarly called *chance*. But in religion it had a farther ſignification; altars and temples in great numbers were conſecrated to this Fortune, as a deity. This intimates, that the heathens had perſonified, and even deified, their Chance; and conceived her as a ſort of goddeſs, who diſpoſed of the fate of men at her pleaſure. Hence that invocation of Horace, *O diva, gratum quæ regis Antium*, in the 35th ode of the firſt book, where he recommends Auguſtus, then preparing for a viſit to Britain, to her protection. From theſe different ſentiments it may be inferred, that the ancients at one time took Fortune for a peremptory cauſe, bent upon doing good to ſome, and perſecuting others; and ſometimes for a blind inconſtant cauſe, without any view or determination at all.

If then the word *fortune* had no certain ſignification in the mouths of thoſe who erected altars to her, much leſs can it be aſcertained what it denotes in the minds of thoſe who now uſe the word in their writings. They who would ſubſtitute the name *Providence* in lieu of that of *Fortune* cannot give any tolerable ſenſe to half the phraſes wherein the word occurs.

Horace paints the goddeſs, preceded by Neceſſity, holding nails and wedges in her hands, with a cramp-iron, and melted lead to faſten it; rarely accompanied with Fidelity, unleſs when ſhe abandons a family; for in that caſe Fidelity never fails to depart with her, as well as friends. She is diſreſpectfully ſpoken of by moſt of the Roman writers, and repreſented as blind, inconſtant, unjuſt, and delighting in miſchief. However, they had a good as well as a bad Fortune, a conſtant and inconſtant Fortune; the latter of which was repreſented with wings, and a wheel by her. Juvenal alludes to a ſtatue of Fortune, which exhibited her under a very good character, as the patroneſs of the poor infants that were expoſed by their parents in the ſtreets. The painters repreſent her in a woman's habit, with a bandage before her eyes, to ſhow that ſhe acts without diſcernment; and ſtanding on a wheel, to expreſs her inſtability. The Romans, ſays Lactantius, repreſented her with a cornucopia and the helm of a ſhip, to ſhow that ſhe diſtributes riches, and directs the affairs of the world. In effect, it is with ſuch characters that we ſee her repreſented on ſo many medals, with the inſcriptions, FORTVNA AVG. FORTVNA REDVX. FORTVNÆ AVG. or REDVCIS, &c. Sometimes ſhe is ſeen pointing at a globe before her feet, with a ſceptre in one hand, and holding the cornucopia in the other.

The Romans had a virile as well as a muliebrian Fortune, for the objects of their adoration: the *Fortuna virilis* was honoured by the men, and the *Fortuna muliebris* by the women. They honoured Fortune alſo under a variety of other appellations. The Romans derived the worſhip of Fortune from the Greeks, under the reign of Servius Tullius, who dedicated the firſt temple to her in the public market. Nero alſo built a temple to Fortune. The Fortune worſhipped at Antium was probably of the moſt exalted character of any among the Romans; if we may judge by the account which Horace gives us of the great ſolemn proceſſions that were made to her: *Hor.* lib. i. od. 35. ver 22. But the moſt celebrated temple of Fortune was at Præneſte. Statius ſpeaks of ſeveral Fortunes there, and calls them the *Præneſtinæ ſorores*, lib. i. Sylv. iii. ver. 80.

FORTUNE-*Tellers*. Perſons pretending to tell fortunes are to be puniſhed with a year's impriſonment, and ſtanding four times on the pillory. Stat. 9 Geo. II. c. 5.

FORTY-DAYS *Court*, the court of *attachment* or *woodmote*, held before the verderers of the foreſt once every forty days, to inquire concerning all offenders againſt vert and veniſon. See ATTACHMENT.

FORUM, in Roman antiquity, a public ſtanding place within the city of Rome, where cauſes were judicially tried, and orations delivered to the people.

FORUM was alſo uſed for a place of traffic, anſwering to our market-place. Theſe were generally called *fora venalia*; in contradiſtinction to the former, which were called *fora civilia*. The *fora civilia* were public courts of juſtice, very magnificent in themſelves, and ſurrounded with porticos and ſtately edifices; of theſe there were ſix very remarkable: 1. *Forum Romanum*. 2. *Julianum*. 3. *Auguſtum*. 4. *Palladium*. 5. *Forum Trajani*. 6. *Forum Saluſtii*. The *Forum Romanum* was the moſt noted, and is often called ſimply *Forum*, by way of eminence. Here was the pleading place called *Roſtra*, the *Comitium*, the ſanctuary of *Saturn*, temple of *Caſtor*, &c. See ROSTRA, COMITIUM, &c. The *fora venalia*, or market-places, were very numerous. The chief of them were the *forum boarium*, for oxen or beef; *ſuarium*, for ſwine; *piſtorium*, for bread; *cupedinarium*, for dainties; *olitorium*, for garden ſtuff. The Grecian Αγοραι exactly correſpond with the Roman *fora*, being places where courts and markets were held. At Athens they had many *fora*, but the chief of them were the *old* and the *new*.

FORUM *Indicere*, was the act of the prætor appointing the place in Rome where cauſes were to be tried. *Agere forum* denoted the bringing on cauſes out of Rome, in a Roman province (Cicero, Suetonius); the ſame with *agere conventum* (Florus).

FORUM, added to a proper name, alſo denoted ſome market town or borough; as, FORUM *Allieni*, *Appii*, *Cornellii*, *Domitii*, *Fulvii*, &c.

FORUM is alſo uſed, among caſuiſts, &c. for juriſdiction; thus they ſay, *In foro legis*, &c.

FOSS, or FOSSE, in fortification, &c. a ditch or moat. The word is French, formed of the Latin participle *foſſum*, of the verb *fodio* "I dig."

FOSS, *Foſſa*, in anatomy, a kind of cavity in a bone, with a large aperture, but no exit or perforation. When the aperture is very narrow, it is called a *ſinus*. The term Foss is particularly uſed, however, for the cavity or denture in the back part of the neck.

FOSSA MAGNA, or NAVICULARIS, is an oblong cavity, forming the inſide of the *pudendum muliebre*, and which preſents itſelf upon opening the labia; and in the middle whereof are the *carunculæ myrtiformes*. See ANATOMY, p. 209.

FOSSA, in our ancient cuſtoms, was a ditch full of water, where women committing felony were drowned; as men were hanged: *Nam et ipſi in omnibus tenementis ſuis omnem ab antiquo legalem habuere juſtitiam, videlicet ferrum, foſſam, furcas, et ſimilia*. In another ſenſe it is taken for a grave, as appears by theſe old verſes:

Hic jacent in foſſa Bedæ venerabilis oſſa;
Hic eſt foſſatus, qui bis erat hic cathedratus.

FOSS-*Way* was anciently one of the four great Roman highways of England: ſo called, according to Cambden, becauſe it was ditched on both ſides, which was the Roman method of making highways.

FOSSARII, in antiquity, a kind of officers in the eaſtern church, whoſe buſineſs was to inter the dead. Ciaconius relates, that Conſtantine created 950 foſſaries, whom he took out of the divers colleges or companies of tradeſmen: he adds, that they were exempted from taxes, ſervices, burdenſome offices, &c. F. Goar, in his notes on the Greek Euchologion, inſinuates that the foſſarii were eſtabliſhed in the times of the apoſtles; and that

the young men who carried off the body of Ananias, and thofe perfons full of the fear of God who interred St. Stephen, were of the fame number. St. Jerom affures us, that the rank of foffarii held the firft place among the clerks; but he is to be underftood of thofe clerks only who had the direction and intendance of the interment of the devout.

FOSSE, the Roman military-way in South Britain, begins at Totnefs, and paffes through Exeter, Ivelchefter, Shepton-Mallet, Bath, Cirencefter, Leicefter, the Vale of Belvoir, Newark, Lincoln, to Barton upon the Humber, being ftill vifible in feveral parts, though of 1400 years ftanding. It had the name from the foffes or ditches made by the fides of it.

FOSSIL, in natural hiftory, denotes in general every thing dug out of the earth, whether they be natives thereof, as metals, ftones, falts, earths, and other minerals; or extraneous, repofited in the bowels of the earth by fome extraordinary means, as earthquakes, the deluge, &c. See METAL, STONE, &c.

Native foffils, according to Dr. Hill, are fubftances found either buried in the earth, or lying on its furface, of a plain fimple ftructure, and fhowing no figns of containing veffels or circulating juices. Thefe are fub-divided by the fame author, 1. Into foffils naturally and effentially fimple. Of thefe fome are neither inflammable nor foluble in water; as fimple earths, talcs, fibrariæ, gypfum, felenitæ, cryftal, and fpars: others, though uninflammable, are foluble in water; as all the fimple falts: and others, on the contrary, are inflammable, but not foluble in water; as fulphur, auripigmentum, zarnich, amber, ambergrife, gagates, afphaltum, ampelites, lithanthrax, naphtha, and piffafphalta. 2. The fecond general fub-divifion of foffils comprehends all fuch as are naturally compound, but unmetallic. Of thefe fome are neither inflammable nor foluble in water; as compound earths, ftones, feptariæ, fiderochita, femipellucid gems, &c.: others are foluble in water, but not inflammable; as all the metallic falts: and, laftly, fome are inflammable, but not foluble in water; as the marcafites, pyritæ, and phlogonia. 3. The third and laft general divifion of foffils comprehends all the metallic ores; which are bodies naturally hard, remarkably heavy, and fufible in fire. Of thefe fome are perfectly metallic, as being malleable when pure; fuch are gold, lead, filver, copper, iron, and tin: others are imperfectly metallic, as not being malleable even in their pureft ftate; fuch are antimony, bifmuth, cobalt, zinc, and quickfilver or mercury. Of all which fubftances the reader will find a particular defcription under their refpective heads.

Extraneous foffils are bodies of the vegetable or animal kingdoms accidentally buried in the earth. Of the vegetable kingdom there are principally three kinds, trees or parts of them, herbaceous plants, and corals; and of the animal kingdom there are four kinds, fea fhells, the teeth or boney palates and bones of fifhes, complete fifhes, and the bones of land-animals. See BONES, TREE, WOOD, PLANT, SHELL, &c. Thefe adventitious or *extraneous* foffils, thus found buried in great abundance in divers parts of the earth, have employed the curiofity of feveral of our lateft naturalifts, who have each a different fyftem to account for the furprifing appearances of petrified fea-fifhes, in places far remote from the fea, and on the tops of mountains; fhells in the middle of quarries of ftone; and of elephants' teeth, and bones of various animals, peculiar to the fouthern climates, and plants only growing in the eaft, found foffile in our northern and weftern parts.

Some will have thefe fhells, &c. to be real ftones, and ftone plants, formed after the ufual manner of other figured ftones; of which opinion is the learned Dr. Lifter. Another opinion is, that thefe foffil fhells, with all their foreign bodies found within the earth, as bones, trees, plants, &c. were buried therein at the time of the univerfal deluge; and that, having been penetrated either by the bituminous matter abounding chiefly in watery places, or by the falts of the earth, they have been preferved entire, and fometimes petrified. Others think, that thofe fhells, found at the tops of the higheft mountains, could never have been carried thither by the waters, even of the deluge; inafmuch as moft of thefe aquatic animals, on account of the weight of their fhells, always remain at the bottom of the water, and never move but clofe along the ground. They imagine, that a year's continuance of the waters of the deluge, intermixed with the falt waters of the fea, upon the furface of the earth, might well give occafion to the production of fhells of various kinds in different climates; and that the univerfal faltnefs of the water was the real caufe of their refemblance to the fea fhells, as the lakes formed daily by the retention of rain or fpring water produce different kinds. Others think, that the waters of the fea and the rivers, with thofe which fell from heaven, turned the whole furface of the earth upfide down; after the fame manner as the waters of the Loire, and other rivers, which roll in a fandy bottom, overturn all their fands, and even the earth itfelf, in their fwellings and inundations; and that in this general fubverfion, the fhells came to be interred here, fifhes there, trees in another place, &c. See DELUGE.

Dr. Woodward, in his Natural Hiftory of the Earth, purfuing and improving the hypothefis of Dr. Burnet, maintains the whole mafs of earth, with every thing belonging thereto, to have been fo broken and diffolved at the time of the deluge, that a new earth was then formed on the bofom of the water, confifting of different ftrata, or beds of terreftrial matter, ranged over each other ufually according to the order of their fpecific gravities. By this means plants, animals, and efpecially fifhes and fhells, not yet diffolved among the reft, remained mixed and blended among the mineral and foffil matters; which preferved them, or at leaft affumed and retained their figures and impreffions either indentedly, or in relievo. See more on this fubject under the article EARTH. See alfo PETRIFACTIONS and STRATA.

FOSSILE *Pitch*. See PETROLEUM.

FOSTER (Dr. James), a moft diftinguifhed and popular diffenting minifter, born at Exeter in the year 1697. He began to preach in 1718; and ftrong difputes arifing foon after among the diffenters, concerning the Trinity and fubfcription to tefts, his judgment determining him to the obnoxious opinions, the clamour grew loud againft him, and occafioned him more than one removal. His talents were hid among obfcure country congregations until 1724; when he was chofen to fucceed Dr. Gale in Barbican, where he laboured as paftor above 20 years. The Sunday evening lecture, begun in the Old Jewry meeting-houfe in 1728, and which he conducted with fuch uncommon applaufe for more than 20 years, indifputably fhowed his abilities as a preacher. Perfons of all perfuafions and ranks in life flocked to hear him, and Mr. Pope has honoured him with a commendatory couplet in his fatires; which, however, his commentator laboured to deftroy the intention of by a marginal note. In 1746 he attended the unhappy lord Kilmarnock at his execution on Tower-hill; an office which thofe who lived with him imagined made too deep an impreffion on his fympathizing fpirit, as his vivacity abated from that time. He died in 1753, after having publifhed feveral valuable compofitions and fermons, particularly, 1. A Defence of Chriftianity againft Tindal's Chriftianity as old as the Creation. 2. An Effay on Fundamentals. 3. Four volumes of Sermons. 4. Difcourfes on Natural Religion and Social Virtue, in 4to.

FOSTER (Samuel), an ingenious Englifh mathematician of the laft century, and aftronomical profeffor in Grefham college, was one of that learned affociation which met for cultivating the new philofophy during the political confufions, and which Charles II. eftablifhed into the Royal Society. Mr. Fofter,

however, died in 1652, before this incorporation took place; but wrote a number of mathematical and aſtronomical treatiſes, too many to particularize. There were two other mathematical ſtudents of this name; William Foſter, a diſciple of Mr. Oughtred, who taught in London; and Mark Foſter, author of a treatiſe on trigonometry, who lived later than the former two.

FOTHER, or FODDER, is a weight of lead, containing eight pigs, and every pig one-and-twenty ſtone and a half; ſo that it is about a ton or common cart-load. Among the plumbers in London, it is nineteen hundred and a half; and at the mines it is two-and-twenty hundred and a half. The word is of Teutonic origin, from *fuder*.

FOTHERGILL (Dr. George), was born in Weſtmoreland in 1705, where his family had been long ſeated on a competent eſtate that had deſcended regularly for ſeveral generations. After an academical education in Queen's college, Oxford, of which he became a fellow, he was in 1751 elected principal of St. Edmund's-hall, and preſented to the vicarage of Brumley in Hampſhire. Having been long afflicted with an aſthma, he died in 1760. He was the author of a collection of much eſteemed ſermons, in 2 vols 8vo. The firſt volume conſiſts of occaſional diſcourſes, publiſhed by himſelf; the ſecond printed from his MSS.

FOTHERGILL (Dr. John), a late eminent phyſician, ſon of John and Margaret, quakers, was born in 1712, at Carr End in Yorkſhire, where his father, who had been a brewer at Knareſborough (after having travelled from one end of America to the other), lived retired on a ſmall eſtate which he cultivated. The Doctor was the ſecond of five children (four ſons and a daughter), and received his education under the care of his grandfather Thomas Hough, a perſon of fortune in Cheſhire (which gave him a predilection for that county), and at Sedburg in Yorkſhire. He afterwards ſerved his time to one Mr. Bartlett, an apothecary at Bradford. From thence he removed to London, and became a pupil of Dr. (afterwards Sir Edward) Wilmot, at St. Thomas's Hoſpital. He then went to the univerſity of Edinburgh to ſtudy phyſic, and took his doctor's degree there. From Edinburgh he went to Leyden; whence, after a ſhort ſtay, he returned to London, and began to practiſe about the year 1740. After having accumulated a fortune, it is ſaid, of 80,000l. the largeſt ſum perhaps that has ever been obtained by any one in the medical profeſſion, he died at his houſe in Harpur-ſtreet, December 26, 1780; and his remains were interred, January 5, in the Quakers' burying-ground at Winchmore-hill, whither they were accompanied by more than 70 coaches and poſt-chaiſes, notwithſtanding the intention of the executors to have the funeral private. The Doctor by his will appointed, that his ſhells and other pieces of natural hiſtory ſhould be offered to the late Dr. Hunter, at 500l. under the valuation he ordered to be taken of them. Accordingly Dr. Hunter bought them for 1200l. The drawings and collections in natural hiſtory were alſo to be offered to Sir Joſeph Banks at a valuation. His Engliſh portraits and prints, which had been collected by Mr. John Nickolls of Ware, and purchaſed by him for 80 guineas, were bought for 200 guineas by Mr. Thane. His books were ſold by auction, April 30, 1781, and the eight following days. His houſe and garden at Upton, in which 15 men were conſtantly employed, were valued at 10,000l. He ſpared no expence to augment this as well as his other collections. He had an ingenious artiſt qualified to collect for him at the Cape of Good Hope, and another on the Alps, and employed for ſeveral years before his death a painter in natural hiſtory at Leeds. Dr. Fothergill's character was excellent. A tranſaction, indeed, with regard to one Dr. Leeds, gave occaſion to ſome of his enemies to blame him; but how far juſtly has been ſhown by his biographers. Beſides a valuable pamphlet on the ulcerated ſore throat, Dr. Fothergill wrote a conſiderable number of Tracts, which are now collected into one volume, 8vo, by Dr. Elliot. He ſometimes wrote in the newſpapers, and is ſaid to have been the author of more than 100 letters in the Gazetteer concerning the New Pavement.

FOTHERGILLA, in botany; a genus of the digynia order, belonging to the polyandria claſs of plants. The calyx is lobed, moſt entire; there is no corolla; the germen bifid; the capſule bilocular; and the cells two-valved; the ſeeds ſolitary and bony.

FOTHERING, a peculiar method of endeavouring to ſtop a leak in the bottom of a ſhip while ſhe is afloat, either under ſail or at anchor. It is uſually performed in the following manner: A baſket is filled with aſhes, cinders, and chopped rope-yarns, and looſely covered with a piece of canvas; to this is faſtened a long pole, by which it is plunged repeatedly in the water, as cloſe as poſſible to the place where the leak is conjectured to lie. The oakum or chopped rope-yarns being thus gradually ſhaken through the twigs, or over the top of the baſket, are frequently ſucked into the hole along with the water, ſo that the leak becomes immediately choaked; and the ready entrance of the water is thereby prevented.

FOTHERINGAY, a town of Northamptonſhire, nine miles S. of Stamford, near the river Nen. It is chiefly noted for the ruins of the caſtle, in which Mary, queen of Scotland, was beheaded.

FOU-TCHEOU, a city of China, in the province of FO-KEIN. It carries on a conſiderable trade; but is chiefly remarkable for the magnificence of its principal bridge, which has more than 100 arches, conſtructed of white ſtone, and ornamented with a double baluſtrade throughout. This city is the reſidence of a viceroy, and has under its juriſdiction nine cities of the third claſs.

FOUGADE, or FOUGASSE, in the art of war, a little mine, about 8 or 10 feet wide, and 10 or 12 deep, dug under ſome work or poſt, which is in danger of falling into the enemy's hands; and charged with ſacks of powder, covered with ſtones, earth, and whatever elſe can make great deſtruction. It is ſet on fire like other mines, with a fauciſſe. See MINE.

FOUL, or FOULE, in the ſea-language, is uſed when a ſhip has been long untrimmed, ſo that the graſs weeds, or barnacles, grow to her ſides under water. A rope is alſo foul when it has either entangled in itſelf, or is hindered by another, ſo that it cannot run or be over-hauled. The term *foul* imports alſo the running of one ſhip againſt another. This happens ſometimes by the violence of the wind, and ſometimes by the careleſſneſs of the people on board, to ſhips in the ſame convoy, and to ſhips in port by means of others coming in. The damages occaſioned by *running foul* are of the nature of thoſe in which both parties muſt bear a ſhare. They are uſually made half to fall upon the ſufferer, and half upon the veſſel which did the injury: but in caſes where it is evidently the fault of the maſter of the veſſel, he alone is to bear the damage.

FOUL-*Water*. A ſhip is ſaid to make ſoul-water when, being under ſail, ſhe comes into ſuch ſhoal-water, that though her keel may not touch the ground, yet it comes ſo near it, that the motion of the water under her raiſes the mud from the bottom.

FOUL is alſo a ſort of dropſical diſeaſe in cattle, in which a water falls down into the legs, and makes them ſwell.

FOUL or *Pimpled Face*. See GUTTA *Roſacea*.

FOULA, or FOUL *Iſland*, one of the Shetland iſles, lying between ſix and ſeven leagues weſt from the main land. It is about three miles long, narrow, and full of rough, ſteep, and bare rocks; one of which is ſo large, and runs up to ſuch an height, that it may be clearly ſeen from Orkney. This, therefore, may be reckoned with the greateſt probability to be the

Thule of Tacitus, whatever might be the Thule of the Phenicians and Greeks. It has fcarce any pafturage, and but very little arable land; but that, however fmall in extent, is very fertile, out of the produce of which, with fowl and fifh, the poor inhabitants fubfift. They have nothing that can be called a port; and the only commodities they poffefs are ftock-fifh, train-oil, and feathers.

FOUMART, in zoology, a fpecies of MUSTELA.

FOUNDATION, in architecture, is that part of a building which is under-ground. See ARCHITECTURE. Palladio allows a fixth part of the height of the whole building for the hollowing or under digging; unlefs there be cellars under ground, in which cafe he would have it fomewhat lower.

FOUNDATION denotes alfo a donation or legacy, either in money or lands, for the maintenance and fupport of fome community, hofpital, fchool, &c. The king only can found a college; but there may be a college in reputation founded by others. If it cannot appear by inquifition who it was that founded a church or college, it fhall be intended that it was the king, who has power to found a new church, &c. The king may found and erect an hofpital, and give a name to the houfe upon the inheritance of another, or licenfe another perfon to do it upon his own lands; and the words *fundo, creo*, &c. are not neceffary in every foundation, either of a college or hofpital made by the king; but it is fufficient if there be words equivalent: the incorporation of a college or hofpital is the very foundation; but he who endows it with lands is the founder; and to the erection of an hofpital nothing more is requifite but the incorporation and foundation. Perfons feifed of eftates in fee-fimple may erect and found hofpitals for the poor by deed enrolled in chancery, &c. which fhall be incorporated, and fubject to fuch vifitors as the founder fhall appoint, &c. ftat. 39 Eliz. c. 5.

FOUNDER, in a general fenfe, the perfon who lays a foundation, or endows a church, fchool, religious houfe, or other charitable inftitution. See FOUNDATION.

FOUNDER, alfo implies an artift who cafts metals in various forms for different ufes, as guns, bells, ftatues, printing-characters, candlefticks, buckles, &c. whence fuch are denominated gun-founders, bell-founders, figure-founders, letter-founders, founders of fmall works, &c. See FOUNDERY.

FOUNDER, in the fea-language: A fhip is faid to founder, when by an extraordinary leak, or by a great fea breaking in upon her, fhe is fo filled with water, that fhe cannot be freed of it; fo that fhe can neither veer nor fteer, but lies like a log; and, becoming lefs and lefs able to fwim, will at laft fink.

FOUNDER, in farriery. See FARRIERY, p. 445.

FOUNDERY, or FOUNDRY, the art of cafting all forts of metals into different forms. It likewife fignifies the work-houfe or fmelting-hut wherein thefe operations are performed.

FOUNDERY *of Small Works, or Cafting in Sand.* The fand ufed for cafting fmall-works is at firft of a pretty foft, yellowifh, and clammy nature: but, it being neceffary to ftrew charcoal-duft in the mould, it at length becomes of a quite black colour. This fand is worked over and over, on a board, with a roller and a fort of knife; being placed over a trough to receive it, after it is by thefe means fufficiently prepared. This done, they take a wooden board of a length and breadth proportional to the things to be caft, and, putting a ledge round it, they fill it with fand, a little moiftened, to make it duly cohere. Then they take either wood or metal models of what they intend to caft, and apply them fo to the mould, and prefs them into the fand, as to leave their impreffion there. Along the middle of the mould is laid half a fmall brafs cylinder, as the chief canal for the metal to run through, when melted, into the models or patterns; and from this chief canal are placed feveral others, which extend to each model or pattern placed in the frame. After this frame is finifhed, they take out the patterns, by firft loofening them all round, that the fand may not give way. Then they proceed to work the other half of the mould with the fame patterns in juft fuch another frame; only that it has pins, which, entering into holes that correfpond to it in the other, make the two cavities of the pattern fall exactly on each other. The frame, thus moulded, is carried to the melter; who, after extending the chief canal of the counter-part, and adding the crofs canals to the feveral models in both, and ftrewing mill-duft over them, dries them in a kind of oven for that purpofe. Both parts of the mould being dry, they are joined together by means of the pins; and to prevent their giving way, by reafon of the melted metal paffing through the chief cylindrical canal, they are fcrewed or wedged up like a kind of prefs. While the moulds are thus preparing, the metal is fufing in a crucible of a fize proportionate to the quantity of metal intended to be caft. When the moulds are cooled, the frames are unfcrewed or unwedged, and the caft-work taken out of the fand, which fand is worked over again for other caftings.

FOUNDERY *of Statues.* The cafting of ftatues depends on the due preparation of the pit, the core, the wax, the outer mould, the inferior furnace to melt off the wax, and the upper to fufe the metal. The pit is a hole dug in a dry place fomething deeper than the intended figure, and made according to the prominence of certain parts thereof. The infide of the pit is commonly lined with ftone or brick; or, when the figure is very large, they fometimes work on the ground, and raife a proper fence to refift the impulfion of the melted metal.

The inner mould, or core, is a rude mafs to which are given the intended attitude and contours. It is raifed on an iron grate, ftrong enough to fuftain it, and is ftrengthened within by feveral bars of iron. It is generally made either of potter's clay, mixed with hair and horfe-dung, or of plafter of Paris, mixed with brick-duft. The ufe of the core is to fupport the wax, the fhell, and leffen the weight of the metal. The iron bars and the core are taken out of the brafs figure through an aperture left in it for that purpofe, which is foldered up afterwards. It is neceffary to leave fome of the iron bars of the core, that contribute to the fteadinefs of the projecting part, within the brafs figure.

The wax is a reprefentation of the intended ftatue. If it be a piece of fculpture, the wax fhould be all of the fculptor's own hand, who ufually forms it on the core: though it may be wrought feparately in cavities, moulded on a model, and afterwards arranged on the ribs of iron over the grate, filling the vacant fpace in the middle with liquid plafter and brick duft, whereby the inner core is proportioned as the fculptor carries on the wax.

When the wax, which is the intended thicknefs of the metal, is finifhed, they fill fmall waxen tubes perpendicular to it from top to bottom, to ferve both as canals for the conveyance of the metal to all parts of the work; and as vent-holes, to give paffage to the air, which would otherwife occafion great diforder when the hot metal came to encompafs it.

The work, being brought thus far, muft be covered with its fhell, which is a kind of cruft laid over the wax, and which, being of a foft matter, eafily receives the impreffion of every part, which is afterwards communicated to the metal upon its taking the place of the wax, between the fhell and the mould. The matter of this outer mould is varied, according as different layers are applied. The firft is generally a compofition of clay, and old white crucibles well ground and fifted, and mixed up with water to the confiftence of a colour fit for painting: accordingly they apply it with a pencil, laying it feven or eight times over, and letting it dry between whiles. For the fecond impreffion, they add horfe-dung and common earth to the former compofition. The third impreffion is only horfe-dung and

earth. Laftly, the fhell is finifhed by laying on feveral more impreffions of this laft matter, made very thick with the hand.

The fhell, thus finifhed, is fecured by feveral iron girths, bound round it, at about half a foot diftance from each other, and faftened at the bottom to the grate under the ftatue, and at top to a circle of iron where they all terminate.

If the ftatue be fo big that it would not be eafy to move the moulds with fafety, they muft be wrought on the fpot where it is to be caft. This is performed two ways: in the firft, a fquare hole is dug under ground, much bigger than the mould to be made therein, and its infide lined with walls of free-ftone or brick. At the bottom is made a hole of the fame materials, with a kind of furnace, having its aperture outwards: in this is a fire made to dry the mould, and afterwards melt the wax. Over this furnace is placed the grate, and upon this the mould, &c. formed as above. Laftly, at one of the edges of the fquare pit is made another large furnace to melt the metal. In the other way, it is fufficient to work the mould above ground, but with the like precaution of a furnace and grate underneath. When finifhed, four walls are to be run round it, and by the fide thereof a maffive made for a melting-furnace. For the reft the method is the fame in both. The mould being finifhed, and inclofed as defcribed, whether under ground or above it, a moderate fire is lighted in the furnace under it, and the whole covered with planks, that the wax may melt gently down, and run out at pipes contrived for that purpofe, at the foot of the mould, which are afterwards exactly clofed with earth, fo foon as the wax is carried off. This done, the hole is filled up with bricks thrown in at random, and the fire in the furnace augmented, till fuch time as both the bricks and mould become red hot. After this, the fire being extinguifhed, and every thing cold again, they take out the bricks, and fill up their place with earth moiftened, and a little beaten to the top of the mould, in order to make it the more firm and fteady. Thefe preparatory meafures being duly taken, there remains nothing but to melt the metal, and run it into the mould. This is the office of the furnace above defcribed, which is commonly made in the form of an oven with three apertures, one to put in the wood, another for a vent, and a third to run the metal out at. From this laft aperture, which is kept very clofe while the metal is in fufion, a fmall tube is laid, whereby the melted metal is conveyed into a large earthen bafon, over the mould, into the bottom of which all the big branches of the jets or cafts, which are to convey the metal into all the parts of the mould, are inferted.

Thefe cafts or jets are all terminated with a kind of plugs, which are kept clofe, that, upon opening the furnace, the brafs, which gufhes out with violence, may not enter any of them, till the bafon be full enough of matter to run into them all at once. Upon which occafion they pull out the plugs, which are long iron rods with a head at one end, capable of filling the whole diameter of each tube. The whole of the furnace is opened with a long piece of iron fitted at the end of each pole, and the mould filled in an inftant. This completes the work in relation to the cafting part; the reft being the fculptor's or carver's bufinefs, who, taking the figure out of the mould and earth wherewith it is encompaffed, faws off the jets with which it appears covered over, and repairs it with chiffels, gravers, puncheons, &c.

Foundery *of Bells.* The metal, it is to be obferved, is different for bells from what it is for ftatues, there being no tin in the ftatue-metal: but there is a fifth, and fometimes more, in the bell-metal.

The dimenfions of the core and the wax for bells, if a ring of bells efpecially, are not left to chance, but muft be meafured on a fcale or diapafon, which gives the height, aperture, and thicknefs, neceffary for the feveral tones required.

It is on the wax that the feveral mouldings and other ornaments and infcriptions, to be reprefented in relievo on the outfide of the bell, are formed. The clapper or tongue is not properly a part of the bell, but is furnifhed from other hands. In Europe it is ufually of iron, with a large knob at the extremity; and is fufpended in the middle of the bell. In China, it is only a huge wooden mallet, ftruck by force of arm againft the bell; whence they can have but little of that confonancy fo much admired in fome of our rings of bells. The Chinefe have an extraordinary way of increafing the found of their bells; viz. by leaving a hole under the cannon; which our bell-founders rather reckon a defect.

The proportions of our bells differ very much from thofe of the Chinefe. In ours, the modern proportions are, to make the diameter 15 times the thicknefs of the brim, and the height 12 times. The parts of a bell are, 1. The founding bow, terminated by an inferior circle, which grows thinner and thinner. 2. The brim or that part of a bell whereon the clapper ftrikes, and which is thicker than the reft. 3. The outward finking of the middle of the bell, or the point under which it grows wider to the brim. 4. The waift or furniture, and the part that grows wider and thicker quite to the brim. 5. The upper vafe, or that part which is above the waift. 6. The pallet which fupports the ftaple of the clapper within. 7. The bent and hollowed branches of metal uniting with the cannons, to receive the iron keys, whereby the bell is hung up to the beam, which is its fupport and counterpoife, when rung out.

The bufinefs of bell-foundery is reducible to three particulars. 1. The proportion of a bell. 2. The forming of the mould. And, 3. The melting of the metal. There are two kinds of proportions, viz. the fimple and the relative; the former are thofe proportions only that are between the feveral parts of a bell to render it fonorous; the relative proportions eftablifh a requifite harmony between feveral bells.

The method of forming the profile of a bell, previous to its being caft, in which the proportion of the feveral parts may be feen, is as follows: The thicknefs of the brim, C1 in Plate 27. is the foundation of every other meafure, and is divided into three equal parts. Firft, draw the line HD, which reprefents the diameter of the bell; bifect it in F, and erect the perpendicular F f; let D F and H F be alfo bifected in E and G, and two other perpendiculars E e, G a, be erected at E and G: G E will be the diameter of the top or upper vafe, *i. e.* the diameter of the top will be half that of the bell; and it will therefore be the diameter of a bell which will found an octave to the other. Divide the diameter of the bell, or the line HD, into 15 equal parts, and one of thefe will give C1 the thicknefs of the brim; divide again each of thefe 15 equal parts into three other equal parts, and then form a fcale. From this fcale take 12 of the larger divifions or $\frac{12}{15}$ of the whole fcale in the compafs, and, fetting one leg in D, defcribe an arc to cut the line E e in N; draw N D, and divide this line into 12 equal parts; at the point 1 erect the perpendicular 1C = 10, and C1 will be the thicknefs of the brim = $\frac{1}{15}$ of the diameter: draw the line C D: bifect D N; and at the point of bifection 6 erect the perpendicular 6K = $1\frac{1}{2}$ of the larger divifions on the fcale. With an opening of the compafs equal to twice the length of the fcale or 30 brims, fetting one leg in N, defcribe an arc of a circle, and with the fame leg in K and the fame opening defcribe another arc to interfect the former: on this point of interfection as a centre, and with a radius equal to 30 brims, defcribe the arc N K; in 6K produced take C B = $\frac{1}{3}$ of the larger meafure of the fcale, or $\frac{1}{3}$ of the brim, and on the fame centre with the radius $30\frac{1}{3}$ brims defcribe an arc A B parallel to N K. For the arc B C, take 12 divifions of the fcale, or 12 brims in the compafs; find a centre, and from that centre, with this opening, defcribe the arc B C, in the fame manner as N K or A B were

defcribed. There are various ways of defcribing the arc K p; fome defcribe it on a centre at the diftance of nine brims from the points p and K; others, as it is done in the figure, on a centre at the diftance only of feven brims from thofe points. But it is neceffary firft to find the point p, and to determine the rounding of the bell p 1. For this purpofe, on the point C as a centre, and with the radius C 1, defcribe the arc 1 p n; bifect the part 1 2 of the line D n, and, erecting the perpendicular p m, this perpendicular will cut the arc 1 p n in m, which terminates the rounding 1 p. Some founders make the bendings K a third of a brim lower than the middle of the line D N; others make the part C 1 D more acute; and, inftead of making C 1 perpendicular to DN at 1, draw it $\frac{1}{6}$th of a brim higher, making it ftill equal to one brim; fo that the line 1 D is longer than the brim C 1. In order to trace out the top-part N *a*, take in the compafs eight divifions of the fcale or eight brims, and on the points N and D as centres, defcribe arcs to interfect each other in 8: on this point 8, with a radius of eight brims, defcribe the arc N b; this arc will be the exterior curve of the top or crown: on the fame point 8 as a centre, and with a radius equal to $7\frac{2}{7}$ brims, defcribe the arc A c, and this will be the interior curve of the crown, and its whole thicknefs will be one-third of the brim. As the point 8 does not fall in the axis of the bell, a centre M may be found in the axis by defcribing, with the interval of eight brims on the centres D and H, arcs which will interfect in M; and this point may be made the centre of the inner and outer curves of the crown as before. The thicknefs of the cap which ftrengthens the crown at Q is about one-third of the thicknefs of the brim; and the hollow branches or ears about one-fixth of the diameter of the bell. The height of the bell is in proportion to its diameter as 12 to 15, or in the proportion of the fundamental found to its third major: whence it follows, that the found of a bell is principally compofed of the found of its extremity or brim, as a fundamental of the found of the crown which is an octave to it, and of that of the height which is a third.

The particulars neceffary for making the mould of a bell are, 1. The earth: the moft cohefive is the beft; it muft be well ground and fifted, to prevent any chinks. 2. Brick-ftone, which muft be ufed for the mine, mould, or core, and for the furnace. 3. Horfe-dung, hair, and hemp, mixed with the earth, to render the cement more binding. 4. The wax for infcriptions, coats of arms, &c. 5. The tallow equally mixed with the wax, in order to put a flight lay of it upon the outer mould, before any letters are applied to it. 6. The coals to dry the mould.

For making the mould, they have a fcaffold confifting of four boards, ranged upon treffels. Upon this they carry the earth, grofsly diluted, to mix it with horfe-dung, beating the whole with a large fpatula.

The compaffes of conftruction is the chief inftrument for making the mould, which confift of two different legs joined by a third piece. And, laft of all, the founders' fhelves, on which are the engravings of the letters, cartridges, coats of arms, &c.

They firft dig a hole of a fufficient depth to contain the mould of the bell, together with the cafe or cannon, under ground; and about fix inches lower than the terreplain, where the work is performed. The hole muft be wide enough for a free paffage between the mould and walls of the hole, or between one mould and another, when feveral bells are to be caft. At the centre of the hole is a ftake erected, that is ftrongly faftened in the ground. This fupports an iron peg, on which the pivot of the fecond branch of the compaffes turns. The ftake is encompaffed with a folid brick-work, perfectly round, about half a foot high, and of the propofed bell's diameter. This they call a *mill-ftone*. The parts of the mould are, the core, the model of the bell, and the fhell. When the outer furface of the core is formed, they begin to raife the core, which is made of bricks that are laid in courfes of equal height upon a lay of plain earth. At the laying of each brick, they bring near it the branch of the compaffes, on which the curve of the core is fhaped, fo as that there may remain between it and the curve the diftance of a line, to be afterwards filled up with layers of cement. The work is continued to the top, only leaving an opening for the coals to bake the core. This work is covered with a layer of cement, made of earth and horfe-dung; on which they move the compaffes of conftruction, to make it of an even fmoothnefs every where.

The firft layer being finifhed, they put the fire to the core, by filling it half with coals, through an opening that is kept fhut during the baking, with a cake of earth that has been feparately baked. The firft fire confumes the ftake, and the fire is left in the core half or fometimes a whole day: the firft layer being thoroughly dry, they cover it with a fecond, third, and fourth; each being fmoothed by the board of the compaffes, and thoroughly dried before they proceed to another.

The core being completed, they take the compaffes to pieces, with intent to cut off the thicknefs of the model; and the compaffes are immediately put in their place to begin a fecond piece of the mould. It confifts of a mixture of earth and hair, applied with the hand on the core, in feveral cakes that clofe together. This work is finifhed by feveral layers of a thinner cement of the fame matter, fmoothed by the compaffes, and thoroughly dried before another is laid on. The firft layer of the model is a mixture of wax and greafe fpread over the whole. After which are applied the infcriptions, coats of arms, &c. befmeared with a pencil dipped in a veffel of wax in a chafing-difh: this is done for every letter. Before the fhell is begun, the compaffes are taken to pieces, to cut off all the wood that fills the place of the thicknefs to be given to the fhell.

The firft layer is the fame earth with the reft, fifted very fine; whilft it is tempering in water, it is mixed with cow's hair to make it cohere. The whole being a thin matter is gently poured on the model, that fills exactly all the finuofities of the figures, &c.; and this is repeated till the whole is two lines thick over the model. When this layer is thoroughly dried, they cover it with a fecond of the fame matter, but fomewhat thicker; when this fecond layer becomes of fome confiftence, they apply the compaffes again, and light a fire in the core, fo as to melt off the wax of the infcriptions, &c.

After this, they go on with other layers of the fhell, by means of the compaffes. Here they add to the cow's hair a quantity of hemp, fpread upon the layers, and afterwards fmoothed by the board of the compaffes. The thicknefs of the fhell comes to four or five inches lower than the mill-ftone before obferved, and furrounds it quite clofe, which prevents the extravafation of the metal. The wax fhould be taken out before the melting of the metal.

The ear of the bell requires a feparate work, which is done during the drying of the feveral incruftations of the cement. It has feven rings: the feventh is called the *bridge*, and unites the others, being a perpendicular fupport to ftrengthen the curves. It has an aperture at the top, to admit a large iron peg bent at the bottom; and this is introduced into two holes in the beam, faftened with two ftrong iron keys. There are models made of the rings, with maffes of beaten earth, that are dried in the fire, in order to have the hollow of them. Thefe rings are gently preffed upon a layer of earth and cow's hair, one half of its depth, and then taken out without breaking the mould. This operation is repeated 12 times for 12 half-moulds, that two and two united may make the hollows of the fix rings: the fame they do for the hollow of the bridge, and bake them all, to unite them together.

Upon the open place left for the coals to be put in, are placed the rings that constitute the car. They first put into this open place the iron ring to support the clapper of the bell; then they make a round cake of clay, to fill up the diameter of the thickness of the core. This cake, after baking, is clapped upon the opening, and soldered with a thin mortar spread over it, which binds the cover close to the core.

The hollow of the model is filled with an earth, sufficiently moist to fix on the place, which is strewed at several times upon the cover of the core; and they beat it gently with a pestle, to a proper height; and a workman smooths the earth at top with a wooden trowel dipped in water.

Upon this cover, to be taken off afterwards, they assemble the hollows of the rings. When every thing is in its proper place, they strengthen the outside of the hollows with mortar, in order to bind them with the bridge, and keep them steady at the bottom, by means of a cake of the same mortar, which fills up the whole aperture of the shell. This they let dry, that it may be removed without breaking. To make room for the metal, they pull off the hollows of the rings, through which the metal is to pass before it enters into the vacuity of the mould. The shell being unloaded of its ear, they range under the mill-stone five or six pieces of wood, about two feet long, and thick enough to reach almost the lower part of the shell: between these and the mould they drive in wooden wedges with a mallet, to shake the shell of the model whereon it rests, so as to be pulled up and got out of the pit.

When this and the wax are removed, they break the model and the layer of earth, through which the metal must run, from the hollow of the rings, between the shell and the core. They smoke the inside of the shell, by burning straw under it, that helps to smooth the surface of the bell. Then they put the shell in the place, so as to leave the same interval between that and the core; and before the hollows of the rings or the cap are put on again, they add two vents, that are united to the rings, and to each other, by a mass of baked cement. After which they put on this mass of the cap, the rings, and the vent, over the shell, and solder it with thin cement, which is dried gradually by covering it with burning coals. Then they fill up the pit with earth, beating it strongly all the time round the mould.

The furnace has a place for the fire, and another for the metal. The fire-place has a large chimney with a spacious ash-hole. The furnace which contains the metal is vaulted, and its bottom is made of earth, rammed down; the rest is built with brick. It has four apertures; the first, through which the flame revibrates; the second is closed with a stopple that is opened for the metal to run; the others are to separate the dross or scoriæ of the metal by wooden rakes: through these last apertures passes the thick smoke. The ground of the furnace is built sloping, for the metal to run down.

Foundery *of Great Guns and Mortar-Pieces.* The method of casting these pieces is little different from that of bells: they are run massy, without any core, being determined by the hollow of the shell; and they are afterwards bored with a steel trepan, that is worked either by horses or a water-mill. See farther the article Gunnery.

Letter-Foundery, or *Casting of Types for Printing.* In the business of cutting, casting, &c. letters for printing, the letter-cutter must be provided with a vice, hand-vice, hammers, and files of all sorts for watch-makers' use; as also gravers and sculpters of all sorts, and an oil-stone, &c. suitable and sizeable to the several letters to be cut: a flat gage made of box to hold a rod of steel, or the body of a mould, &c. exactly perpendicular to the flat of the using file: a sliding-gage, whose use is to measure and set off distances between the shoulder and the tooth, and to mark it off from the end, or from the edge of the work: a face-gage, which is a square notch cut with a file into the edge of a thin plate of steel, iron, or brass, of the thickness of a piece of common tin, whose use is to proportion the face of each sort of letter, *viz.* long letters, ascending letters, and short letters. So there must be three gages, and the gage for the long letters is the length of the whole body supposed to be divided into 42 equal parts. The gage for the ascending letters Roman and Italic are $\frac{5}{7}$, or 30 parts of 42, and 33 parts for the English face. The gage for the short letters is $\frac{3}{7}$, or 18 parts of 42 of the whole body for the Roman and Italic, and 22 parts for the English face.

The Italic and other standing gages are to measure the scope of the Italic stems, by applying the top and bottom of the gage to the top and bottom lines of the letters, and the other side of the gage to the stem; for when the letter complies with these three sides of that gage, it has its true shape.

The next care of the letter cutter is to prepare good steel punches, well tempered, and quite free from all veins of iron; on the face of which he draws or marks the exact shape of the letter with pen and ink, if the letter be large, or with a smooth blunted point of a needle if it be small; and then with sizeable, and proper shaped and pointed gravers and sculpters, digs or sculps out the steel between the strokes or marks so made on the face of the punch, and leaves the marks standing on the face. Having well shaped the inside strokes of his letter, he deepens the hollows with the same tools; for, if a letter be not deep in proportion to its width, it will, when used at press, print black, and be good for nothing. This work is generally regulated by the depth of the counter-punch. Then he works the outside with proper files till it be fit for the matrice.

But before we proceed to the sinking and justifying of the matrices, we must provide a mould to justify them by, of which you have draughts in plate 27. fig. 1. and 2. Every mould is composed of an upper and an under part. The under part is delineated in fig. 1. The upper part is marked fig. 2. and is in all respects made like the under part, excepting the stool behind, and the bow or spring also behind; and excepting a small roundish wire between the body and carriage, near the break, where the under part hath a small rounding groove made in the body. This wire, or rather half-wire, in the upper part makes the nick in the shank of the letter, when part of it is received into the groove in the under part. These two parts are so exactly fitted and gaged into one another (viz. the male-gage marked *c* in fig. 2. into the female marked *g* in fig. 1.) that when the upper part of the mould is properly placed on, and in the under part of the mould, both together make the entire mould, and may be slid backwards for use so far, till the edge of either of the bodies on the middle of either carriage comes just to the edge of the female gages cut in each carriage: and they may be slid forward so far, till the bodies on either carriage touch each other: and the sliding of these two parts of the mould backwards makes the shank of the letter thicker, because the bodies on each part stand wider asunder; and the sliding them forwards makes the shank of the letter thinner, because the bodies on each part of the mould stand closer together. The parts of the mould are as follow: viz. a, The carriage. b, The body. c, The male gage. d e, The mouth-piece. f, The register. g, The female gage. h h, The hag. *a a a a*, The bottom plate. *b b b*, The wood on which the bottom-plate lies. *c c c*, The mouth. *d d*, The throat. *e d d*, The pallat. *f*, The nick. *g g*, The stool. *h h*, The spring or bow.

Then the mould must be justified: and first the founder justifies the body, by casting about 20 proofs or samples of letters; which are set up in a composing stick, with all their nicks towards the right hand; and then, by comparing these with the pattern letters, set up in the same manner, he finds the exact measure of the body to be cast. He also tries if the two sides of

the body are parallel, or that the body be no bigger at the head than at the foot, by taking half the number of his proofs and turning them with their heads to the feet of the other half; and if then the heads and the feet be found exactly even upon each other, and neither to drive out nor get in, the two fides may be pronounced parallel. He farther tries whether the two fides of the thicknefs of the letter be parallel, by firft fetting his proofs in the compofing ftick with their nicks upwards, and then turning one half with their heads to the feet of the other half; and if the heads and feet lie exactly upon each other, and neither drive out nor get in, the two fides of the thicknefs are parallel.

The mould thus juftified, the next bufinefs is to prepare the matrices. A matrice is a piece of brafs or copper, of about an inch and a half long, and of a thicknefs in proportion to the fize of the letter it is to contain. In this metal is funk the face of the letter intended to be caft, by ftriking the letter-punch about the depth of an n. After this, the fides and face of the matrice muft be juftified and cleared with files of all bunchings made by finking the punch.

Every thing thus prepared, it is brought to the furnace; which is built of brick upright, with four fquare fides, and a ftone on the top, in which ftone is a wide round hole for the pan to ftand in. A foundery of any confequence has feveral of thefe furnaces in it.

As to the metal of which the types are to be caft, this, in extenfive founderies, is always prepared in large quantities; but caft into fmall bars of about 20 pounds weight, to be delivered out to the workmen as occafion requires. In the letter-foundery which has been long carried on with reputation under the direction of Dr. Alex. Wilfon and Sons at Glafgow, we are informed, that a ftock of metal is made up at two different times of the year, fufficient to ferve the cafters at the furnace for fix months each time. For this purpofe, a large furnace is built under a fhade, furnifhed with a wheel vent, in order the more equally to heat the fides of a ftrong pot of caft-iron, which holds when full 15 hundred weight of the metal. The fire being kindled below, the bars of lead are let foftly down into the pot, and their fufion promoted by throwing in fome pitch and tallow, which foon inflame. An outer chimney, which is built fo as to project about a foot over the fartheft lip of the pot, catches hold of the flame by a ftrong draught, and makes it act very powerfully in melting lead; whilft it ferves at the fame time to convey away all the fumes, &c. from the workmen to whom this laborious part of the bufinefs is committed. When the lead is thoroughly melted, a due proportion of the regulus of antimony and other ingredients is put in, and fome more tallow is inflamed to make the whole incorporate fooner. The workmen now having mixed the contents of the pot very thoroughly by ftirring long with a large iron ladle, next proceed to draw the metal off into the fmall troughs of caft-iron, which are ranged to the number of four-fcore upon a level platform faced with ftone, built towards the right hand. In the courfe of a day, 15 hundred weight of metal can be eafily prepared in this manner; and the operation is continued for as many days as are neceffary to prepare a ftock of metal of all the various degrees of hardnefs. After this, the whole is difpofed into preffes according to its quality, to be delivered out occafionally to the workmen.

The founder muft now be provided with a ladle, which differs nothing from other iron ladles but in its fize; and he is provided always with ladles of feveral fizes, which he ufes according to the fize of the letters he is to caft. Before the cafter begins to caft, he muft kindle his fire in the furnace to melt the metal in the pan. Therefore he takes the pan out of the hole in the ftone, and there lays in coals and kindles them; and, when they are well kindled, he fets the pan in again, and puts in metal into it to melt: if it be a fmall-bodied letter he cafts, or a thin letter of great bodies, his metal muft be very hot; nay fometimes red-hot, to make the letter come. Then having chofen a ladle that will hold about fo much as the letter and break is, he lays it at the ftoking-hole, where the flame burfts out, to heat. Then he ties a thin leather, cut with its narrow end againft the face to the leather groove of the matrice, by whipping a brown thread twice about the leather-groove, and faftening the thread with a knot. Then he puts both halves of the mould together, and puts the matrice into the matrice-cheek, and places the foot of the matrice on the ftool of the mould, and the broad end of the leather upon the wood of the upper half of the mould, but not tight up, left it might hinder the foot of the matrice from finking clofe down upon the ftool in a train of work. Then laying a little rofin on the upper wood of the mould, and having his cafting-ladle hot, he with the boiling fide of it melts the rofin: and, while it is yet melted, preffes the broad end of the leather hard down on the wood, and fo faftens it to the wood: all this is the preparation.

Now he comes to cafting; in the performance of which, placing the under half of the mould in his left hand, with the hook or hag forward, he clutches the ends of its wood between the lower part of the ball of his thumb and his three hind fingers; then he lays the upper half of the mould upon the under half, fo that the male gages may fall into the female gages, and at the fame time the foot of the matrice places itfelf upon the ftool; and, clafping his left-hand thumb ftrong over the upper half of the mould, he nimbly catches hold of the bow or fpring with his right-hand fingers at the top of it, and his thumb under it, and places the point of it againft the middle of the notch in the backfide of the matrice, preffing it as well forwards towards the mould, as downwards by the fhoulder of the notch clofe upon the ftool, while at the fame time with his hinder fingers, as aforefaid, he draws the under half of the mould towards the ball of his thumb, and thrufts by the ball of his thumb the upper part towards his fingers, that both the regifters of the mould may prefs againft both fides of the matrice, and his thumb and fingers prefs both halves of the mould clofe together.

Then he takes the handle of his ladle in his right hand, and with the ball of it gives a ftroke, two or three, outwards upon the furface of the melted metal, to fcum or clear it from the film or duft that may fwim upon it; then takes up the ladle full of metal, and having his mould, as aforefaid, in his left hand, he a little twifts the left fide of his body from the furnace, and brings the geat of his ladle (full of metal) to the mouth of the mould, and twifts the upper part of his right hand towards him to turn the metal into it, while at the fame moment of time he jilts the mould in his left hand forwards, to receive the metal with a ftrong fhake (as it is called), not only into the body of the mould, but while the metal is yet hot running, fwift and ftrongly, into the very face of the matrice, to receive its perfect form there, as well as in the fhank.

Then he takes the upper half of the mould off the under half, by placing his right-hand thumb on the end of the wood next his left hand thumb, and his two middle-fingers at the other end of the wood; and finding the letter and break lie in the under half of the mould (as moft commonly by reafon of its weight it does), he throws or toffes the letter, break and all, upon a fheet of wafte paper laid for that purpofe on the bench, juft a little beyond his left hand, and is then ready to caft another letter as before; and alfo, the whole number that is to be caft with that matrice. A workman will ordinarily caft about three thoufand of thefe letters in a day.

When the cafters at the furnace have got a fufficient number of types upon the tables, a fet of boys come and nimbly break

away the jets from them: the jets are thrown into the pots, and the types are carried away in parcels to other boys, who pafs them fwiftly under their fingers, defended by leather, upon fmooth flat ftones, in order to polifh their broad-fides. This is a very dexterous operation, and is a remarkable inftance of what may be effected by the power of habit and long practice; for thefe boys, in turning up the other fide of the type, do it fo quickly by a mere touch of the fingers of the left hand, as not to require the leaft perceptible intermiffion in the motion of the right hand upon the ftone. The types, thus finely fmoothed and flattened on the broad-fides, are next carried to another fet of boys, who fit at a fquare table, two on each fide, and there are ranged up on long rulers or fticks, fitted with a fmall projection, to hinder them from fliding off backwards. When the fticks are fo filled, they are placed, two and two, upon a fet of wooden pins fixed into the wall, near the dreffer, fometimes to the amount of an hundred, in order to undergo the finifhing operations. This workman, who is always the moft expert and fkilful in all the different branches carried on at the foundery, begins by taking one of thefe fticks, and, with a peculiar addrefs, flides the whole column of types off upon the dreffing-ftick: this is made of well-feafoned mahogany, and furnifhed with two end-pieces of fteel, a little lower than the body of the types, one of which is moveable, fo as to approach the other by means of a long fcrew-pin, inferted in the end of the ftick. The types are put into this ftick with their faces next to the back or projection; and after they are adjufted to one another fo as to ftand even, they are then bound up, by fcrewing home the moveable end-piece. It is here where the great and requifite accuracy of the moulds comes to be perceived; for in this cafe the whole column, fo bound up, lies flat and true upon the ftick, the two extreme types being quite parallel, and the whole has the appearance of one folid continuous plate of metal. The leaft inaccuracy in the exact parallelifm of the individual type, when multiplied fo many times, would render it impoffible to bind them up in this manner, by difpofing them to rife or fpring from the ftick by the fmalleft preffure from the fcrew. Now, when lying fo conveniently with the narrow edges uppermoft, which cannot poffibly be fmoothed in the manner before mentioned by the ftones, the workman does this more effectually by fcraping the furface of the column with a thick-edged but fharp razor, which at every ftroke brings on a very fine fmooth fkin, like to polifhed filver; and thus he proceeds till in about half a minute he comes to the farther end of the ftick. The other edges of the types are next turned upwards, and polifhed in the fame manner. It is whilft the types thus lie in the dreffing-ftick, that the operation of bearding or barbing is performed, which is effected by running a plane, faced with fteel, along the fhoulder of the body next to the face, which takes more or lefs off the corner, as occafion may require. Whilft in the dreffing-ftick they are alfo grooved, which is a very material operation. In order to underftand this, it muft be remembered, that when the types are firft broken off from the jets, fome fuperfluous metal always remains, which would make them bear very unequally againft the paper whilft under the printing-prefs, and effectually mar the impreffion. That all thefe inequalities may, therefore, be taken away, and that the bearings of every type may be regulated by the fhoulders imparted to them all alike from the mould, the workman or dreffer proceeds in the following manner: The types being fcrewed up in the ftick, as before mentioned, with the jet-end outermoft, and projecting beyond the wood about one-eighth of an inch, the ftick is put into an open prefs, fo as to prefent the jet-end uppermoft, and then every thing is made faft by driving a long wedge, which bears upon a flip of wood, which lies clofe to the types the whole length: then a plough or plane is applied, which is fo conftructed as to embrace the projecting part of the types betwixt its long fides, which are made of polifhed iron. When the plane is thus applied, the fteel cutter bearing upon that part between the fhoulders of the types, where the inequalities lie, the dreffer dexteroufly glides it along, and by this means ftrips off every irregular part that comes in the way, and fo makes an uniform groove the whole length, and leaves the two fhoulders ftanding; by which means every type becomes precifely like to another, as to the height againft paper. The types being now finifhed, the ftick is taken out of the prefs, and the whole column replaced upon the other ftick; and after the whole are fo dreffed, he proceeds to pick out the bad letters, previous to putting them up into pages and papers. In doing this he takes the ftick into his left hand, and turning the faces near to the light, he examines them carefully; and whenever an imperfect or damaged letter occurs, he nimbly plucks it out with a fharp bodkin, which he holds in the right hand for that purpofe. Thofe letters which, from their form, project over the body of the type, and which cannot on this account be rubbed on the ftones, are fcraped on the broad-fides with a knife or file, and fome of the metal next the face pared away with a pen-knife, in order to allow the type to come clofe to any other. This operation is called *kerning*.

The excellence of printing-types confifts not only in the due performance of all the operations above defcribed, but alfo in the hardnefs of the metal, form, and fine proportion of the character, and in the exact bearing and ranging of the letters in relation to one another.

FOUNT, or FONT, among printers, &c. a fet or quantity of characters or letters of each kind, caft by a letter-founder, and forted. We fay, a founder has caft a fount of *pica*, of *englifh*, of *pearl*, &c. meaning that he has caft a fet of characters of thefe kinds. A complete fount does not only include the running letters, but alfo large and fmall capitals, fingle letters, double letters, points, commas, lines, and numeral characters.

Founts are large or fmall, according to the demand of the printer, who orders them by the hundred weight, or by fheets. When the printer orders a fount of 500, he means that the fount fhould weigh 500 lb. When he demands a fount of 10 fheets, it is underftood that with that fount he fhall be able to compofe 10 fheets; or 20 forms, without being obliged to diftribute. The founder takes his meafures accordingly; he reckons 120 pounds for a fheet, including the quadrates, &c. or 60 pounds for a form, which is half a fheet: not that the fheet always weighs 120 pounds, or the form 60 pounds; on the contrary, it varies according to the fize of the form; befides, it is always fuppofed that there are letters left in the cafes.

The letter-founders have a kind of lift, or tariff, whereby they regulate their founts: the occafion thereof is, that fome letters being in much more ufe, and oftener repeated than others, their cells or cafes fhould be better filled and ftored than thofe of the letters which do not return fo frequently. Thus the *o* and *i*, for inftance, are always in greater quantity than the *k* or *z*. This difference will be beft perceived from a proportional comparifon of thofe letters with themfelves, or fome others. Suppofe a fount of 100,000 characters, which is a common fount; here the *a* fhould have 5000, the *c* 3000, the *e* 11,000, the *i* 6000, the *m* 3000, the *k* only 300, the *y* not many more, and the *x* and *z* rather lefs. But this is only to be underftood of the letters of the lower cafe; thofe of the upper having other proportions, which it would be, here, too long to defcribe.

FOUNTAIN, a fpring or fource of water rifing out of the earth. Among the ancients, fountains were generally efteemed as facred; but fome were held to be fo in a more particular manner. The good effects received from cold baths gave fprings and rivers this high reputation; for their falutary influence was fuppofed to proceed from fome prefiding deity. Particular rea-

ſons might occaſion ſome to be held in greater veneration than others. It was cuſtomary to throw little pieces of money into thoſe ſprings, lakes, or rivers, which were eſteemed ſacred, to render the preſiding divinities propitious; as the touch of a naked body was ſuppoſed to pollute their hallowed waters. For the phenomena, theory, and origin, of fountains or ſprings, ſee SPRING.

Artificial FOUNTAIN, called alſo a *jet d'eau*, is a contrivance by which water is violently ſpouted upwards. See HYDRAULICS.

Boiling FOUNTAIN. See ICELAND.

FOUNTAIN-*Tree*, a very extraordinary vegetable growing in one of the Canary Iſlands, which diſtils water from its leaves in ſuch plenty, as to anſwer all the purpoſes of the inhabitants who live near it. Of this tree we have an account in Glaſſe's Hiſtory of the Canary iſlands. "There are," ſays the author, "only three fountains of water in the whole iſland of Hierro, wherein the fountain-tree grows. One of theſe fountains is called *Acof*, which, in the language of the ancient inhabitants, ſignifies *river*; a name, however, which does not ſeem to have been given it on account of its yielding much water, for in that reſpect it hardly deſerves the name of a fountain. More to the northward is another called *Hapio*; and in the middle of the iſland is a ſpring, yielding a ſtream about the thickneſs of a man's finger. This laſt was diſcovered in the year 1565, and is called the *fountain of Anton. Hernandez*. On account of the ſcarcity of water, the ſheep, goats, and ſwine, here do not drink in the ſummer, but are taught to dig up the roots of fern, and chew them to quench their thirſt. The great cattle are watered at theſe fountains, and at a place where water diſtils from the leaves of a tree. Many writers have made mention of this famous tree, ſome in ſuch a manner as to make it appear miraculous; others again deny the exiſtence of any ſuch tree; among whom is Father Feyjoo, a modern Spaniſh author, in his Theatro Critico. But he, and thoſe who agree with him in this matter, are as much miſtaken as thoſe who would make it appear to be miraculous. This is the only iſland of all the Canaries which I have not been in; but I have ſailed with natives of Hierro, who, when queſtioned about the exiſtence of this tree, anſwered in the affirmative." From a work, called the *Hiſtory of the diſcovery and conqueſt*, this writer deſcribes this extraordinary production of nature.

Trees yielding water, however, are not peculiar to the iſland of Hierro; for travellers in form us of one of the ſame kind on the iſland of St. Thomas, in the bight or gulph of Guinea; and, in Cockburn's voyages, we find an account of a dropping tree, near the mountains of Fera Paz, in America.

FOUQUIERES (James), an eminent painter, was born at Antwerp in 1580, and received his chief inſtructions from Velvet Brughel. He applied himſelf to the ſtudy of landſcapes, and went to Italy to improve himſelf in colouring; and ſucceeded ſo happily, that his works are ſaid to be nearly equal to thoſe of Titian. He was engaged and much careſſed at the court of the elector Palatine, and afterwards ſpent ſeveral years of his life in France; where his works met with univerſal approbation, and he was proportionably well paid for his paintings. Yet by ſome miſconduct he ſunk into poverty, and died in the houſe of an inconſiderable painter in 1659. He had reſided for ſeveral years at Rome and Venice, where he acquired that excellent ſtyle of colouring and deſign for which he is ſo deſervedly diſtinguiſhed.

FOURCHEE, or FOURCHY, in heraldry, an appellation given to a croſs forked at the ends. See HERALDRY.

FOURMONT (Stephen), profeſſor of the Arabic and Chineſe languages, and one of the moſt learned men of his time, was born at Herbelai, a village four leagues from Paris, in 1683. He ſtudied in Mazarine college, and afterwards in the Seminary of Thirty-three. He became at length profeſſor of Arabic in the Royal College, and was made a member of the Academy of Inſcriptions. In 1738 he was choſen a member of the Royal Society in London, and of that of Berlin in 1741. He was often conſulted by the duke of Orleans, firſt prince of the blood; who had a particular eſteem for him, and made him one of his ſecretaries. He wrote a great number of books. The moſt conſiderable of thoſe which have been printed are, 1. The Roots of the Latin Tongue, in verſe. 2. Critical Reflections on the Hiſtories of ancient Nations, 2 vols. 4to. 3. *Meditationes Sinicæ*, folio. 4. A Chineſe Grammar, in Latin, folio. 5. Several Diſſertations printed in the Memoirs of the Academy of Inſcriptions, &c. He died at Paris in 1745. This perſon ought not to be confounded with *Michael Fourmont*, his youngeſt brother; who took orders, was profeſſor of the Syriac language in the Royal College, and a member of the Academy of Inſcriptions. Michael died in 1746.

FOURTH REDUNDANT, in muſic. See INTERVAL.

FOWEY, or FOY, a borough and ſea-port of Cornwall, with a market on Saturday. It is ſeated at the mouth of the river Fowey, and has a conſiderable ſhare in the pilchard fiſhery. It is 32 miles S. W. of Launceſton, and 240 W. by S. of London. Lon. 4. 35. W. Lat. 50. 19. N.

FOWEY, a river of Cornwall, which riſes in the N. E. part of the county, and taking a S. W. direction, paſſes by Leſtwithiel, and enters the Engliſh Channel at the town of the ſame name.

FOWL, among zoologiſts, denotes the larger ſorts of birds, whether domeſtic or wild: ſuch as geeſe, pheaſants, partridges, turkeys, ducks, &c. Tame fowl make a neceſſary part of the ſtock of a country farm. See the article POULTRY. Fowls are again diſtinguiſhed into two kinds, viz. *land* and *water* fowl, theſe laſt being ſo called from their living much in and about water: alſo into thoſe which are accounted *game*, and thoſe which are not. See the article GAME.

FOWLING, the art of catching birds by means of birdlime, decoys, and other devices, or the killing of them by the gun. See BIRD-*Catching*, BIRD-*Lime*, DECOY, SHOOTING, and the names of the different birds in the order of the alphabet.

FOWLING, is alſo uſed for the purſuing and taking birds with hawks, more properly called FALCONRY or HAWKING. See thoſe articles.

FOWLING-*Piece*, a light gun for ſhooting birds. That piece is always reckoned beſt which has the longeſt barrel, from $5\frac{1}{2}$ to 6 feet, with a moderate bore; though every fowler ſhould have them of different ſizes, ſuitable to the game he deſigns to kill. The barrel ſhould be well poliſhed and ſmooth within, and the bore of an equal bigneſs from one end to the other; which may be proved, by putting in a piece of paſte-board, cut of the exact roundneſs of the top: for if this goes down without ſtops or ſlipping, you may conclude the bore good. The bridge-pan muſt be ſomewhat above the touch-hole, and ought to have a notch to let down a little powder: this will prevent the piece from recoiling, which it would otherwiſe be apt to do. As to the locks, chooſe ſuch as are well filed with true work, whoſe ſprings muſt be neither too ſtrong nor too weak. The hammer ought to be well hardened, and pliable ſo as to go down to the pan with a quick motion.

FOX, in zoology. See CANIS. The fox is a great nuiſance to the huſbandman; taking away and deſtroying his lambs, geeſe, poultry, &c. The common way to catch him is by gins; which being baited, and a train made by drawing raw fleſh acroſs in his uſual paths or haunts to the gin, it proves an inducement to bring him to the place of deſtruction. The fox is alſo a beaſt of chace, and is taken with greyhounds, terriers, &c. See the article HUNTING.

Fox (John), the martyrologiſt, was born at Boſton in Lincolnſhire in the year 1517. At the age of 16 he was entered a ſtudent of Brazen-noſe college in Oxford; and in 1543 he became maſter of arts, and was choſen fellow of Magdalen college. He diſcovered an early genius for poetry, and wrote ſeveral Latin comedies, the ſubjects taken from ſcripture, which his ſon aſſures us were written in an elegant ſtyle. Forſaking the muſes, he now applied himſelf with uncommon aſſiduity to the ſtudy of divinity, particularly church-hiſtory; and, diſcovering a premature propenſity to the doctrine of reformation, he was expelled the college as an heretic. His diſtreſs on this occaſion was very great; but it was not long before he found an aſylum in the houſe of Sir Thomas Lucy of Warwickſhire, who employed him as a tutor to his children. Here he married the daughter of a citizen of Coventry. Sir Thomas's children being now grown up, after reſiding a ſhort time with his wife's father, he came to London; where, finding no immediate means of ſubſiſtence, he was reduced to the utmoſt degree of want; but was at length (as his ſon relates) miraculouſly relieved in the following manner: As he was one day ſitting in St. Paul's church, emaciated with hunger, a ſtranger accoſted him familiarly, and, bidding him be of good cheer, put a ſum of money into his hand; telling him at the ſame time, that in a few days new hopes were at hand. He was ſoon after taken into the family of the ducheſs of Richmond, as tutor to the earl of Surrey's children, who, when their father was ſent to the tower, were committed to her care. In this family he lived, at Ryegate in Surrey, during the latter part of the reign of Henry VIII. the entire reign of Edward VI. and part of that of queen Mary: but at length, perſecuted by his implacable enemy biſhop Gardiner, he was obliged to ſeek refuge abroad. Baſil in Switzerland was the place of his retreat, where he ſubſiſted by correcting the preſs. On the death of queen Mary he returned to England; where he was graciouſly received by his former pupil the duke of Norfolk, who retained him in his family as long as he lived, and bequeathed him a penſion at his death. Mr. ſecretary Cecil alſo obtained for him the rectory of Shipton near Saliſbury; and we are aſſured that he might have had conſiderable church-preferment, had it not been for his unwillingneſs to ſubſcribe to the canons. He died in the year 1587, in the 70th year of his age; and was buried in the chancel of St. Giles's, Cripplegate. He was a man of great induſtry, and conſiderable learning; a zealous, but not a violent reformer; a nonconformiſt, but not an enemy to the church of England. He left two ſons; one of whom was bred a divine, the other a phyſician. He wrote many pieces; but his principal work is, the Acts and Monuments of the Church, &c. commonly called *Fox's Book of Martyrs*. His facts are not always to be depended on, and he often loſes his temper; which, conſidering the ſubject, is not much to be wondered at.

Fox (George), the founder of the ſect of Engliſh Quakers, was a ſhoemaker of Nottingham. The accounts of thoſe times tell us, that, as he wrought at his trade, he uſed to meditate much on the ſcriptures; which, with his ſolitary courſe of life, increaſing his natural melancholy, he began at length to fancy himſelf inſpired; and in conſequence thereof ſet up for a preacher. He propoſed but few articles of faith; inſiſting chiefly on moral virtue, mutual charity, the love of God, and a deep attention to the inward motions and ſecret operations of the ſpirit: he required a plain ſimple worſhip, and a religion without ceremonies, making it a principal point to wait in profound ſilence the directions of the Holy Spirit. Fox met with much rough treatment for his zeal, was often impriſoned, and ſeveral times in danger of being knocked on the head. But, notwithſtanding all diſcouragements, his ſect prevailed much, and many conſiderable men were drawn over to them; among whom were Barclay and Penn. He died in 1681. His followers were called *Quakers*, in deriſion of ſome unuſual ſhakings and convulſions with which they were ſeized at their firſt meetings. See the article Quakers.

Fox-*Glove*, in botany. See Digitalis.

Fox-*Iſlands*, a group of iſlands in the N. Archipelago. They are 16 in number, and are ſituated between the E. coaſt of Kamtſchatka and the W. coaſt of America, between 52° and 55° N. lat. Each iſland has a peculiar name; but this general name is given to the whole group, on account of the great number of black, grey, and red foxes with which they abound. The dreſs of the inhabitants conſiſts of a cap, and a fur coat, which reaches down to the knee. Some of them wear common caps of a parti-coloured bird-ſkin, upon which they leave part of the wings and tail. On the fore part of their hunting and fiſhing caps they place a ſmall board, like a ſkreen, adorned with the jawbones of ſea-bears, and ornamented with glaſs beads, which they receive in barter from the Ruſſians. At their feſtivals and dancing parties, they uſe a much more ſhowy ſort of caps. They feed upon the fleſh of all ſorts of ſea animals, and generally eat it raw. But, when they dreſs their food, they make uſe of a hollow ſtone, in which they place the fiſh or fleſh: they then cover it with another, and cloſe the interſtices with lime or clay. They next lay it horizontally on two ſtones, and light a fire under it. The proviſion intended for keeping is dried without ſalt in the open air. Their weapons are bows, arrows, and darts; and, for defence, they uſe wooden ſhields. The moſt perfect equality reigns among them. They have neither chiefs nor ſuperiors, neither laws nor puniſhments. They live together in families, and ſocieties of ſeveral families united, which form what they call a race, who, in caſe of attack or defence, mutually aid each other. The inhabitants of the ſame iſland always pretend to be of the ſame race; and each one looks upon his iſland as a poſſeſſion, the property of which is common to all individuals of the ſame ſociety. Feaſts are very common among them, and more particularly, when the inhabitants of one iſland are viſited by thoſe of another. The men of the village meet their gueſts, beating drums, and preceded by the women, who ſing and dance. At the concluſion of the dance, the hoſts ſerve up their beſt proviſions, and invite their gueſts to partake of the feaſt. They feed their children, when very young, with the coarſeſt fleſh, and for the moſt part raw. If an infant cries, the mother immediately carries it to the ſeaſide, and, whether it be ſummer or winter, holds it naked in the water till it is quiet. This is ſo far from doing the children any harm, that it hardens them againſt the cold; and they accordingly go barefooted through the winter, without the leaſt inconvenience. They ſeldom heat their dwellings; but when they would warm themſelves, they light a bundle of hay, and ſtand over it; or they ſet fire to train oil, which they pour into a hollow ſtone. They have a good ſhare of plain natural ſenſe, but are rather ſlow of underſtanding. They ſeem cold and indifferent in moſt of their actions; but if an injury, or even a mere ſuſpicion, rouſe them from this phlegmatic ſtate, they become furious and inflexible, taking the moſt violent revenge, without any regard to the conſequences. The leaſt affliction prompts them to ſuicide; the apprehenſion of even an uncertain event often leads them to deſpair; and they put an end to their days with great apparent inſenſibility. The Ruſſians call theſe iſlands the Lyſſie Oſtrova.

FRACASTOR (Jerome), more uſually called Fracastorius, a moſt eminent Italian poet and phyſician, was born at Verona in the year 1482. Two ſingularities are related of him in his infancy: one is, that his lips adhered ſo cloſely to each other when he came into the world, that a ſurgeon was obliged to divide them with his inciſion knife; the other, that his mother was killed with lightning, while he, though in her arms at the very moment, eſcaped unhurt. Fracaſtor was of

parts ſo exquiſite, and made ſo wonderful a progreſs in every thing he undertook, that he became eminently ſkilled not only in the belles lettres, but in all arts and ſciences. He was a poet, a philoſopher, a phyſician, an aſtronomer, and a mathematician. He was a man of vaſt conſequence in his time; as appears from pope Paul III's making uſe of his authority to remove the council of Trent to Bonlogne, under the pretext of a contagious diſtemper, which, as Fracaſtor depoſed, made it no longer ſafe to continue at Trent. He was intimately acquainted with cardinal Bembus, Julius Scaliger, and all the great men of his time. He died of an apoplexy at Caſi near Verona, in 1553: and in 1559 the town of Verona erected a ſtatue in honour of him.

He was the author of many works, both as a poet and as a phyſician; yet, owing to an extraordinary diſintereſtedneſs and indifference as to what became of his performances, many were loſt. What we have now of his, are the three books of "Siphilis, or of the French diſeaſe;" a book of Miſcellaneous Poems; and two books of his poem intitled *Joſeph*, which he began at the latter end of his life, but did not live to finiſh. But, beſides many other admired productions of the ſame ſort, he compoſed a poem called *Alcon, ſive de cura canum venaticorum*. All his works are in Latin. His medical pieces are, *De Sympathia & Antipathia—De contagione & contagioſis morbis—De cauſis criticorum dierum—De vini temperatura*, &c. His works have been printed ſeparately and collectively. The beſt edition of them is that of Padua 1735, in 2 vols 4to.

FRACHES, in the glaſs trade, are the flat iron pans into which the glaſs veſſels already formed are put when in the tower over the working furnace, and by means of which they are drawn out through the leers, that they may be taken gradually from the fire, and cool by degrees.

FRACTION, in arithmetic and algebra, a part or diviſion of an unit or integer; or a number which ſtands to an unit in the relation of a part to its whole. The word literally imports a broken number. Fractions are uſually divided into decimal, ſexageſimal, and vulgar. See ALGEBRA and ARITHMETIC.

FRACTURE, in ſurgery, a rupture of a bone, or a ſolution of continuity in a bone when it is cruſhed or broken by ſome external cauſe. See SURGERY.

FRÆNUM, or FRENUM, *Bridle*, in anatomy, a name given to divers ligaments, from their office in retaining and curbing the motions of the parts they are fitted to.

FRÆNUM *Linguæ*, or *Bridle of the Tongue*; a membranous ligament, which connects the tongue with the muſcles about the fauces, and lower parts of the mouth. In ſome ſubjects the *frænum* runs the whole length of the tongue to the very tip; in which caſes, if it were not cut, it has been erroneouſly ſuppoſed, that there would be no poſſibility of ſpeech. See TONGUE-*Tied*.

FRÆNUM *Penis*, a ſlender ligament, whereby the prepuce is tied to the lower part of the glans of the penis. Nature varies in the make of this part; it being ſo ſhort in ſome, that unleſs divided it would not admit of perfect erection. There is alſo a kind of *frænum*, faſtened to the lower part of the clitoris in women.

FRAGA, a town of Spain, in Arragon, with a handſome caſtle. It is ſtrong by ſituation, among the mountains, having the river Cinca before it, whoſe high banks are difficult of acceſs, and at its back a hill, which cannot eaſily be approached with large cannon. The gardens produce herbs and ſaffron; but the parts about it are barren. Alphonſo VII. king of Arragon, and the firſt of that name of Caſtile, was killed here by the Moors, in 1134, when he beſieged this town. It is 46 miles E. of Saragoſſa. Lon. 0. 28. E. Lat. 41. 46. N.

FRAGARIA, the STRAWBERRY; a genus of the polygynia order, belonging to the icoſandria claſs of plants; and in the natural method ranking under the 35th order, *Senticoſæ*. The calyx is decemfid; the petals five; the receptacle of the ſeeds ovate, in the form of a berry, and deciduous. There is but one ſpecies, *viz.* the *veſca*, or cultivated ſtrawberry. The principal varieties are, 1. The *ſylveſtris*, or wood-ſtrawberry, with oval ſawed leaves, and ſmall round fruit. 2. The *Virginian ſcarlet*, or Virginia ſtrawberry, with oblong oval ſawed leaves, and a roundiſh ſcarlet-coloured fruit. 3. The *moſchatta*, or hautboy, or muſky ſtrawberry, having oval, lanceolate, rough leaves, and large pale-red fruit. 4. The *Chiloenſis*, or Chili ſtrawberry, with large, oval, thick, hairy leaves, large flowers, and very large firm fruit. 5. The *Alpina*, Alpine, or monthly ſtrawberry, having ſmall oval leaves, ſmall flowers, and moderate-ſized, oblong, pointed fruit. All theſe varieties are hardy, low, perennials, durable in root; but the leaves and fruit-ſtalks are renewed annually in ſpring. They flower in May and June, and their fruit comes to perfection in June, July, and Auguſt; the Alpine kind continuing till the beginning of winter. They all thrive in any common garden ſoil, producing abundant crops annually without much trouble. They increaſe exceedingly every ſummer, both by off-ſets or ſuckers from the ſides of the plants, and by the runners or ſtrings, all of theſe rooting and forming plants at every joint, each of which ſeparately planted bears a few fruit the following year, and bear in great perfection the ſucceeding ſummer. Thoſe of the Alpine kind will even bear fruit the ſame year that they are formed. All the ſorts are commonly cultivated in kitchen-gardens, in beds or borders of common earth, in rows lengthwiſe 15 or 18 inches diſtance; the plants the ſame diſtance from one another in each row. Patches of the differents ſorts, diſpoſed here and there in the fronts of the different compartments of the pleaſure-ground, will appear ornamental both in their flowers and fruit, and make an agreeable variety. Strawberries, eaten either alone, or with ſugar and cream, are univerſally eſteemed a moſt delicious fruit. They are grateful, cooling, ſubacid, and juicy. Though taken in large quantities, they ſeldom diſagree. They promote perſpiration, impart a violet ſmell to the urine, and diſſolve the tartareous incruſtations on the teeth. People afflicted with the gout or ſtone have found relief by uſing them very largely; and Hoffman ſays, he has known conſumptive people cured by them. The bark of the root is aſtringent.—Sheep and goats eat the plant: cows are not fond of it; horſes and ſwine refuſe it.

FRAGUIER (Claude Francis), a polite and learned French writer, born at Paris, of a noble family, in 1666. He was educated under the Jeſuits, and was even admitted into the order, though he afterwards quitted it; and, being thus at liberty to follow his inclinations, he ſoon after aſſiſted the Abbé Bignon in conducting the *Journal des Sçavans*, having all the qualifications for ſuch a work. His writings conſiſt of Latin poems, and a great number of very excellent diſſertations. He died in 1728.

FRAIL, a baſket made of ruſhes or the like, in which are packed up figs, raiſins, &c. It ſignifies alſo a certain quantity of raiſins, about 75 pounds.

FRAISE, in fortification, a kind of defence, conſiſting of pointed ſtakes, ſix or ſeven feet long, driven parallel to the horizon into the retrenchments of a camp, a half-moon, or the like, to prevent any approach or ſcalade. Fraiſes differ from paliſades chiefly in this, that the latter ſtand perpendicular to the horizon, and the former jet out parallel to the horizon, or nearly ſo, being uſually made a little ſloping, or with the points hanging down. Fraiſes are chiefly uſed in entrenchments and other works thrown up of earth; ſometimes they are found under the parapet of a rampart, ſerving inſtead of the cordon of ſtone uſed in ſtone-works.

To FRAISE *a Battalion*, is to line the muſqueteers round with

pikes, that in caſe they ſhould be charged with a body of horſe, the pikes being preſented may cover the ſoldiers from the ſhock, and ſerve as a barricade.

FRAME, in joinery, a kind of caſe, wherein a thing is ſet or incloſed, or even ſupported; as a window-frame, a picture-frame, &c.

FRAME is alſo a machine uſed in many arts; as,

FRAME, among printers, is the ſtand which ſupports the caſes. See CASE.

FRAME, among founders, a kind of ledge incloſing a board; which, being filled with wetted ſand, ſerves as a mould to caſt their works in. See FOUNDERY.

FRAME is more particularly uſed for a ſort of loom, whereon artificers ſtretch their linens, ſilks, ſtuff, &c. to be embroidered, quilted, or the like.

FRAME, among painters, a kind of ſquare, conſiſting of four long ſlips of wood joined together, whoſe intermediate ſpace is divided by threads into ſeveral little ſquares like a net; and hence ſometimes called *reticula*. It ſerves to reduce figures from great to ſmall; or, on the contrary, to augment their ſize from ſmall to great.

FRAMLINGHAM, a large town of Suffolk, with a market on Saturday. It is ſeated near the head of a ſmall rivulet, and has the remains of a caſtle, ſaid to have been built in the time of the Saxon heptarchy. To this caſtle the princeſs Mary, afterward Mary I. retired, when lady Jane Grey was proclaimed queen; and here ſhe found that powerful ſupport of the people of Suffolk, which ſo ſoon ſeated her on the throne. Here is alſo a ſtately church, in which are the monuments of ſome noble families. It is 30 miles E. of Bury, and 87 N. E. of London. Lon. 1. 26. E. Lat. 52. 25. N.

FRANC. See FRANK.

FRANCE, a country of Europe, bounded on the N. by the Engliſh Channel and the Auſtrian Netherlands; on the E. by Germany, and the Alps, which ſeparated it from Switzerland, Savoy, and Piedmont; on the S. by the Mediterranean Sea and Spain, from which kingdom it is divided by the Pyrenees; and the W. by the Atlantic Ocean; extending from 5° 5′ W. to 7° 47′ E. lon. and from 42° 30′ to 51° N. lat. From the Pyrenees in the S. to Dunkirk in the N. its extent is 625 miles, and ſomething more from the moſt eaſterly part of Alſace to the moſt weſtern point of Brittany; which province, it muſt be obſerved, extends above 100 miles farther into the ocean than any other part of the country. The climate is temperate; the air pure and wholeſome; and the ſoil, which is agreeably diverſified, produces all the neceſſaries of life, and, among its luxuries, ſome of the moſt excellent wines. The principal rivers are the Seine, Loire, Rhone, and Gironde, with many others, that give name to the new geographical diviſion of this country into departments. The moſt conſiderable mountains, beſide the Alps and Pyrenees, are thoſe of the Cevennes and Auvergne. France was lately an abſolute monarchy, and was divided into ſeveral military governments, or provinces. Theſe were Alſace, Angoumois, Anjou, Armagnac, Artois, Aunis, Auvergne, Barrois, Baſques, Bearn, Berry, Bigorre, Blaſois, Boulonnois, Bourbonnois, Breſſe, Brittany, Burgundy, Cambreſis, Champagne, Couſerans, Dauphiny, Forez, Foix, Franche Comté, French Flanders, Gaſcony, Gevaudan, Guienne, French Hainault, Iſle of France, Languedoc, Limoſin, Lorrain, Lyonois, Marche, Maine, Marſan, Navarre, Nivernois, Normandy, Orleanois, Perche, Perigord, Picardy, Poitou, Provence, Querci, Rouergue, Rouſillon, Saintonge, Soiſſonnois, Touraine, Velay, and Vermandois. Theſe varied much from each other in point of extent and importance, and there were others of ſtill inferior conſideration. The population of the whole is eſtimated by the French at 25,000,000. The eſtabliſhed religion was the Roman Catholic; and the eccleſiaſtical diviſion of the country was into 18 archbiſhoprics and 113 epiſcopal ſees, excluſive of Avignon, Carpentras, Caivaillon, and Vaiſon, which belonged to the pope. But in 1789 a very wonderful revolution took place. The deranged ſituation of the finances of the country, occaſioned in a conſiderable degree by the American war, had induced his moſt Chriſtian majeſty to convoke, firſt an aſſembly of the notables, or principal men in the kingdom, and next (on the ineffectual reſult of their deliberations) the ſtates-general, which had not been aſſembled ſince the reign of Lewis XIII. in 1614. Theſe conſiſted of three orders, the nobility, the clergy, and the third eſtate, or commons. The laſt were double the number of the other two orders united; and, when the ſtates-general were aſſembled at Verſailles, a conteſt aroſe, whether the three orders ſhould make three diſtinct houſes, or be blended in one aſſembly. The third eſtate inſiſted upon the latter; they were inflexible on this point; and, aſſuming the title of the National Aſſembly, they declared, that, as ſuch, they were competent to proceed to buſineſs, without the concurrence of the two other orders, if they ſtill refuſed to join them. In the ſequel, the nobility and clergy found it expedient to concede the point; and they all met in one hall. In the mean time, Paris was encircled by an army of 50,000 men, with the apparent view of coercing that city, if neceſſary. Notwithſtanding this, on the removal of the popular miniſter M. Neckar in July 1789, a dreadful inſurrection enſued in Paris; the military refuſed to fire upon the people; the formidable Baſtile was captured by the citizens; the governor and ſome other obnoxious perſons were beheaded, and their heads carried about, in horrid triumph, on poles: in a word, eight weeks after the opening of the ſtates-general, on the 5th of May, a revolution was effected, which then excited aſtoniſhment, and, ſince that period, even alarm and terror in all Europe. On the 17th of July, the king viſited the Hotel de Ville in Paris, and ſurrendered himſelf, as it were, to his people. From that moment, from being an abſolute monarch, he became one of the moſt limited in Europe. The national aſſembly, now triumphant, proceeded to the moſt extraordinary meaſures. They aboliſhed nobility and the whole feudal ſyſtem; and, confiſcating the poſſeſſions of the clergy, rendered them dependent for ſupport on a public allowance, like the ſervants of the ſtate; and all the monaſteries were ſuppreſſed. In October, in conſequence of another dreadful riot at Verſailles, the king, the royal family, and the national aſſembly, were removed to Paris. The king was now, in fact, a ſtate-priſoner, treated with the formalities appendant to royalty, but watched in all his motions with the utmoſt circumſpection. From this irkſome ſituation he attempted to eſcape, in June 1791, with the queen, his ſiſter, the dauphin, and the princeſs his daughter. He had almoſt reached the frontiers, when he was arreſted at Varennes, and conducted back to Paris. Such, however, was then the moderation of the popular party, that no diſaſtrous conſequences enſued. The national aſſembly completed a new conſtitution, which was accepted by the king in September of the ſame year, when a new national aſſembly was elected. Harmony did not long prevail between this aſſembly and the king. Some of their decrees he refuſed to ſanction; and, on their part, among other ſteps, which could not fail to give umbrage to a once powerful monarch, was the diſbanding of his guard. France was now involved in a war againſt the king of Hungary; and the executive power was ſuſpected, not only of not properly exerting the national force againſt the enemy, but of acting in concert with him, and with the emigrant princes, and others, who were in arms againſt their country. To loſe the reputation of ſincerity is the greateſt unhappineſs that can befall a prince. It was fatal to Lewis XVI. one of the moſt humane and well-meaning ſovereigns that ever ruled in France. In Auguſt 1792, the mayor of Paris, at the head of a deputation from that city, appeared at the bar of the national aſſembly,

and demanded the depofition of the king. Before they could deliberate on this demand, a dreadful infurrection enfued; the Tuilleries, the royal refidence, was attacked; the Swifs guards were defeated and maffacred; and the king and royal family took refuge in the national affembly. That body inftantly decreed the fufpenfion of the executive power in the hands of the king, and the convocation of a national convention. The king and his family were conveyed to a houfe in Paris called the Temple, and there kept in clofe confinement, with circumftances of the moft humiliating degradation. Between the prifon and the grave of a depofed fovereign, the diftance, it has been obferved, is not very remote. The convention met on the 21ft of September, and inftantly decreed the abolition of royalty, and the formation of a republic on the principles of "liberty and equality." In December following, they decreed, that the king fhould be tried before them. The trial accordingly took place; and this tribunal, exercifing at once the incompatible characters of accufers, profecutors, and judges, condemned the unfortunate monarch; who, in purfuance of their fentence, was publicly beheaded, in the Place de la Revolution, before called the Place de Louis XV. on the 21ft of January 1793. All Europe exclaimed againft the injuftice and cruelty, not to fay the impolicy, of this proceeding. Powers, hitherto neutral in the war, were eager to take an active part in it; and the new republic, in addition to the arms of Auftria, Pruffia, Sardinia, and the empire, had to encounter the powerful combination of Great Britain, the United Provinces, and Spain. This is not the place for political conjectures. Whether the French republic will be permanent, or the ancient order of things reftored, is a queftion foreign to this work, in which the prefent geographical ftate of the country muft be noticed, whether that ftate be permanent or not. France then, it muft be obferved, was divided by the firft legiflative affembly into 83 departments, inftead of the ancient military provinces; and thefe departments were fubdivided into diftricts, cantons, and municipalities. The names of the departments, are Ain, Aifne, Allier, Alps Upper, Alps Lower, Ardeche, Ardennes, Arriege, Aube, Aude, Aveiron, Calvados, Cantal, Charente, Charente Lower, Cher, Correze, Corfica, Côte d'Or, Côtes du Nord, Creufe, Dordogne, Doubs, Drome, Eure, Eure and Loire, Finifterre, Gard, Garonne Upper, Gers, Gironde, Herault, Indre, Indre and Loire, Ifere, Ille and Vilaine, Jura, Landes, Loir and Cher, Loire Upper, Loire Lower, Loiret, Lot, Lot and Garonne, Lozere, Maine, Maine and Loire, Manche, Marne, Marne Upper, Meurthe, Meufe, Morbihan, Mofelle, Nord, Nievre, Oife, Orne, Paris, Pas de Calais, Puy de Dome, Pyrenees Upper, Pyrenees Lower, Pyrenees Eaftern, Rhine Upper, Rhine Lower; Rhone, Bouches du; Rhone and Loire, Saone Upper, Saone and Loire, Sarte, Seine and Oife, Seine Lower, Seine and Marne; Sevres, les deux; Somme, Tarn, Var, Vendee, Vienne, Vienne Upper, Vofges, and Yonne. Each of thefe departments (which fee in the annexed map of France) has an archiepifcopal or epifcopal town; there being now only ten archbifhoprics, or metropolitan circles, and 73 bifhop's fees. Some of thefe fees are of new creation, as Colmar, Vefoul, Laval, Chateauroux, Gueret, and St. Maixent. Every town of France mentioned in this work, is placed in its refpective department; the late province, in which it is fituated, being preferved, as effentially neceffary to the elucidation of former hiftories, whatever may be the termination of a revolution, which has unfortunately been diftinguifhed hitherto by a feries of dreadful maffacres, confifcations, exiles, profcriptions, and all the calamities of foreign and domeftic war.

Ifle of FRANCE, a late province of France, fo called, becaufe it was formerly bounded by the rivers Seine, Marne, Oife, Aifne, and Ourque. It now includes the four departments of Oife, Seine and Oife, Seine and Marne, and Paris.

Ifle of FRANCE, or MAURITIUS, an ifland in the Indian Ocean, 200 leagues E. of Madagafcar. It was early difcovered by the Portuguefe. After them, the Dutch fettled on the S. E. fhore, and gave it the name of Mauritius, in honour of prince Maurice, their ftadtholder; but they abandoned it, on their acquifition of the Cape of Good Hope. It then remained uninhabited, till the French landed there in 1720. This ifland is about 45 leagues in circumference. Indigo is the general object of cultivation; of which four or five crops a-year are produced. In 1789 one perfon only fent to Europe 30,000lb. weight of it, of a very fuperior quality. Attempts have been made to rear cochineal, as the ifland abounds with the plant on which the infects lie; but a fmall bird deftroys the infect. The foil of this ifland is little fuperior to that at Port Jackfon. At the diftance of three leagues is a public garden, which, before the late French revolution, was kept with the utmoft care, and was called the King's Garden. Here a gardener lived at the king's expence; he reared the plants, and diftributed them gratis to the colonifts. The town and harbour are called Port Louis, and are ftrongly fortified; but no veffel ought to touch at this ifland in the hurricane months, October, November, and December; as the harbour cannot afford fhelter for more than fix or eight veffels. The town is large, and covers a great deal of ground; but the houfes, in general, are mean. Here are large ftore-houfes and every thing neceffary for the equipment of fleets. The number of inhabitants on the ifland, exclufive of the military, is 8000 whites and 12,000 blacks. Lon. 57. 9. E. Lat. 20. 10. S.

FRANCESCA (Peter), an eminent Florentine painter of night-pieces and battles, was employed to paint the Vatican. He alfo painted portraits, and wrote on arithmetic and geometry. He died in 1458.

FRANCFORT *on the* MAINE, an ancient, large, and free imperial town of Germany, in the circle of Franconia. The chief ftructure is the town-houfe, which is large and handfome, but built in the ancient tafte. In this the golden bull is preferved, which is the original of the fundamental laws of the empire; and here is the chamber in which the emperor is elected. All religions are tolerated at Frankfort, under certain reftrictions; but Lutheranifm is the eftablifhed faith, as the magiftrates are of that communion. The principal church is in the poffeffion of the Roman Catholics; but no public proceffion through the ftreets is permitted. In this church is a chapel, to which the emperor is conducted immediately after his election, in order to be crowned by the elector of Mentz. The Jews have a fynagogue in this city; but the Calvinifts have never been allowed any place of worfhip in the territory of Francfort. They attend divine fervice at Bockenheim, in the county of Hanau, where they have built a church. It is remarkable that, in all funeral proceffions here, the crucifix leads the way, whether the deceafed has died a Roman Catholic, a Lutheran, or a Calvinift. The Calvinifts are very numerous. They are thought to be the moft induftrious, and certainly are the richeft part of the inhabitants. The number of the Jews is very great, notwithftanding they are compelled to live together in a fingle narrow ftreet, built up at one end. There is a large gate at the other, which is regularly fhut at a certain hour of the night, after which no Jews dare appear in the ftreets. They are obliged to fetch water, when a fire happens in any part of the city; and the magiftrates, in return, permit them to choofe judges out of their own body for deciding difputes among themfelves; but an appeal is open to the magiftrates. Francfort is one of the moft trading places in Europe, and two great fairs are held here every year. It was taken by the French in October 1792, retaken by the Pruffians in December following, fince which the French have again taken it. It is feated on the river Maine, which divides it in two, 15 miles N. E. of Mentz, and 350 W. by N. of Vienna. Lon. 8. 40. E. Lat. 49. 55. N.

Francfort *on the Oder*, a rich and handſome town of Germany, in the middle marche of Brandenburg, formerly imperial, but now ſubject to the king of Pruſſia. It is remarkable for its three great fairs, and for its univerſity. It is 43 miles S. E. of Berlin, and 72 S. of Stetin. Lon. 14. 39. E. Lat. 52. 23. N.

FRANCHE-comte, a late province of France, bounded on the N. by Lorrain, on the E. by Alſace and Switzerland, on the W. by Burgundy, and on the S. by Breſſe. It is 125 miles in length, and 80 in breadth, and abounds in corn, wine, cattle, horſes, mines of iron, copper, and lead. It was conquered by France in 1674, and ceded to it by the treaty of Nimeguen in 1678. It is now included in the three departments of Doubs, Jura, and Upper Saone.

FRANCHISE, in law. *Franchiſe* and *liberty* ſome uſe as ſynonymous terms; and their definition is, " a royal privilege, or branch of the king's prerogative, ſubſiſting in the hands of a ſubject." Being therefore derived from the crown, they muſt ariſe from the king's grant; or, in ſome caſes, may be held by preſcription, which, as has been frequently ſaid, preſuppoſes a grant. The kinds of them are various, and almoſt infinite. We ſhall here briefly touch upon ſome of the principal; premiſing only, that they may be veſted in either natural perſons or bodies-politic; in one man, or in many: but the ſame identical franchiſe, that has before been granted to one, cannot be beſtowed on another; for that would prejudice the former grant. To be a county-palatine, is a franchiſe veſted in a number of perſons. It is likewiſe a franchiſe for a number of perſons to be incorporated and ſubſiſt as a body-politic; with a power to maintain perpetual ſucceſſion, and do other corporate acts: and each individual member of ſuch corporation is alſo ſaid to have a franchiſe or freedom. Other franchiſes are, to hold a court-leet: to have a manor or lordſhip; or, at leaſt, to have a lordſhip paramount: to have waifs, wrecks, eſtrays, treaſure-trove, royal fiſh, forfeitures, and deodands: to have a court of one's own, or liberty of holding pleas and trying cauſes: to have the cognizance of pleas; which is a ſtill greater liberty, being an excluſive right, ſo that no other court ſhall try cauſes ariſing within that juriſdiction: to have a bailiwick, or liberty exempt from the ſheriff of the county; wherein the grantee only, and his officers, are to execute all proceſs: to have a fair or market; with the right of taking toll, either there or at any other public places, as at bridges, wharfs, or the like; which tolls muſt have a reaſonable cauſe of commencement (as in conſideration of repairs, or the like), elſe the franchiſe is illegal and void: or laſtly, to have a foreſt, chaſe, park, warren, or fiſhery, endowed with privileges of royalty. See Chase, Forest, &c.

Franchise is alſo uſed for an aſylum or ſanctuary, where people are ſecure of their perſons, &c. Churches and monaſteries in Spain are franchiſes for criminals; ſo were they anciently in England, till they were abuſed to ſuch a degree that there was a neceſſity for aboliſhing the cuſtom. One of the moſt remarkable capitulars made by Charlemagne in his palace of Heriſtal, in 779, was that relating to the franchiſes of churches. The right of franchiſe was held ſo ſacred, that even the leſs religious kings obſerved it to a degree of ſcrupulouſneſs; but to ſuch exceſs in time was it carried, that Charlemagne reſolved to reduce it. Accordingly he forbad any proviſion being carried to criminals retired into churches for refuge.

Franchise *of Quarters*, is a certain ſpace or diſtrict at Rome, wherein are the houſes of the ambaſſadors of the princes of Europe; and where ſuch as retire cannot be arreſted or ſeized by the ſbirri or ſerjeants, nor proſecuted at law. The people of Rome look on this as an old uſurpation and a ſcandalous privilege, which ambaſſadors, out of a jealouſy of their power, carried to a great length in the 15th century, by enlarging inſenſibly the dependencies of their palaces or houſes, within which the right of franchiſe was anciently confined. Several of the popes, Julius III. Pius XIV. Gregory XIII. and Sixtus V. publiſhed bulls and ordinances againſt this abuſe; which had reſcued ſo conſiderable a part of the city from their authority, and rendered it a retreat for the moſt abandoned perſons. At length Innocent XI. expreſsly refuſed to receive any more ambaſſadors but ſuch as would make a formal renunciation of the franchiſe of quarters.

FRANCIA (Franceſco), a celebrated Bologneſe painter, born in 1450. He was firſt a goldſmith or jeweller, afterwards a graver of coins and medals; but, applying at laſt to painting, obtained great reputation by his works, particularly by a piece of St. Sebaſtian, whom he had drawn bound to a tree with his hands tied over his head. He pined himſelf into a conſumption, by deſpairing to equal Raphael, and died in 1518.

FRANCIS (Philip), a very ingenious writer, of Iriſh extraction, if not born in that kingdom. His father was a dignified clergyman in Ireland, being dean of ſome cathedral; and our author, his ſon, was alſo bred to the church, and had a doctor's degree conferred on him. He was more diſtinguiſhed as a tranſlator than as an original writer. His verſions of Horace and Demoſthenes have been juſtly valued: the former is accompanied with notes, and is perhaps as complete and uſeful a work of its kind as hath yet appeared. He was alſo a conſiderable political writer; and in the beginning of the preſent reign is ſuppoſed to have been employed by the government: for which ſervice, he was promoted to the rectory of Barrow in Suffolk, and to the chaplainſhip of Chelſea hoſpital. He was alſo the author of two tragedies, Eugenia, and Conſtantia; but, as a dramatic writer, not very ſucceſsful. He died at Bath in March 1773; leaving a ſon, who was then one of the ſupreme council at Bengal.

FRANCISCANS, in eccleſiaſtical hiſtory, are religious of the order of St. Francis, founded by him in the year 1209. Francis was the ſon of a merchant of Aſſiſi, in the province of Umbria, who, having led a diſſolute life, was reclaimed by a fit of ſickneſs, and afterwards fell into an extravagant kind of devotion, that looked leſs like religion than alienation of mind. Soon after this, viz. in the year 1208, hearing the paſſage repeated, Matt. x. 9, 10. in which Chriſt addreſſes his apoſtles, *Provide neither gold, nor ſilver*, &c. he was led to conſider a voluntary and abſolute poverty as the eſſence of the goſpel, and to preſcribe this poverty as a ſacred rule both to himſelf and to the few that followed him. This new ſociety, which appeared to Innocent III. extremely adapted to the preſent ſtate of the church, and proper to reſtore its declining credit, was ſolemnly approved and confirmed by Honorius III. in 1223, and had made a conſiderable progreſs before the death of its founder in 1226. Francis, through an exceſſive humility, would not ſuffer the monks of his order to be called *fratres*, i. e. brethren, or friars, but *fraterculi*, i. e. little brethren, or friars-minor, by which denomination they ſtill continue to be diſtinguiſhed. They are alſo called *grey friars*, on account of the colour of their clothing, and *cordeliers*, &c. The Franciſcans and Dominicans were zealous and active friends to the papal hierarchy, and, in return, were diſtinguiſhed by peculiar privileges and honourable employments. The Franciſcans, in particular, were inveſted with the treaſure of ample and extenſive indulgences; the diſtribution of which was committed to them by the popes, as a means of ſubſiſtence, and a rich indemnification for their voluntary poverty. In conſequence of this grant, the rule of the founder, which abſolutely prohibited both perſonal and collective property, ſo that neither the individual nor the community were to poſſeſs either fund, revenue, or any worldly goods, was conſidered as too ſtrict and ſevere, and diſpenſed with ſoon after his death. In 1231, Gregory IX. publiſhed an interpretation of this rule, mitigating its rigour; which was farther confirmed by Innocent

IV. in 1245, and by Alexander IV. in 1247. These milder alterations were zealously opposed by a branch of the Franciscans called the *spiritual*; and their complaints were regarded by Nicolas III. who in 1279 published a famous constitution, confirming the rule of St. Francis, and containing an elaborate explication of the maxims it recommended, and the duties it prescribed. In 1287 Matthew of Aqua Sparta, being elected general of the order, discouraged the ancient discipline of the Franciscans, and indulged his monks in abandoning even the appearance of poverty; and this conduct inflamed the indignation of the spiritual or austerer Franciscans; so that, from the year 1290, seditions and schisms arose in an order that had been so famous for its pretended disinterestedness and humility. Such was the enthusiastic phrensy of the Franciscans, that they impiously maintained, that the founder of their order was a second Christ, in all respects similar to the first: and that their institution and discipline were the true gospel of Jesus. Accordingly Albizi, a Franciscan of Pisa, published a book in 1383, with the applause of his order, intitled, The Book of the Conformities of St. Francis with Jesus Christ. In the beginning of this century, the whole Franciscan order was divided into two parties; the one, embracing the severe discipline and absolute poverty of St. Francis, were called *spirituals*; and the other, who insisted on mitigating the austere injunctions of their founder, were denominated *brethren of the community*. These wore long, loose, and good habits, with large hoods; the former were clad in a strait, coarse, and short dress, pretending that this dress was enjoined by St. Francis, and that no power on earth had a right to alter it. Neither the moderation of Clement V. nor the violence of John XXII. could appease the tumult occasioned by these two parties: however, their rage subsided from the year 1329. In 1368 these two parties were formed into two large bodies, comprehending the whole Franciscan order, which subsist to this day; viz. the *conventual brethren*, and the *brethren of the observance* or *observation*, from whom sprung the capuchins and recollects. The general opinion is, that the Franciscans came into England in the year 1224, and had their first house at Canterbury, and their second at London; but there is no certain account of their being here, till king Henry VII. built two or three houses for them. At the dissolution of the monasteries, the conventual Franciscans had about 55 houses, which were under seven custodies or wardenships; viz. those of London, York, Cambridge, Bristol, Oxford, Newcastle, and Worcester.

FRANCONIA, a circle of Germany, bounded on the N. by Thuringia, on the S. by Suabia, on the E. by the Upper Palatinate, and on the W. by the Lower Palatinate; being about 88 miles from N. to S. and 95 from E. to W. The middle is very fertile in corn, wine, and fruits; but the borders are full of woods and barren mountains. The Franks, who conquered France, came from this province, and gave their name to that kingdom.

FRANGULA, in botany. See RHAMNUS.

FRANK LANGUAGE, *Lingua Franca*, a kind of jargon spoken on the Mediterranean, and particularly throughout the coasts and ports of the Levant, composed of Italian, Spanish, French, vulgar Greek, and other languages.

FRANK, or *Franc*, an ancient coin, either of gold or silver, struck and current in France. The value of the gold franc was something more than that of the gold crown; the silver franc was a third of the gold one: this coin has been long out of use, though the term is still retained as the name of a money of account; in which sense it is equivalent to the livre, or 20 sols.

FRANK, or *Franc*, meaning literally *free* from charges and impositions, or exempt from public taxes, has various significations in the ancient English customs.

FRANK *Almoigne (libera eleemosyna)*, or "free alms;" a tenure of a spiritual nature, whereby a religious corporation, aggregate or sole, holdeth lands of the donor to them and their successors for ever. The service which they were bound to render for these lands was not certainly defined: but only in general to pray for the souls of the donor and his heirs, dead or alive; and therefore they did no fealty (which is incident to all other services but this), because this divine service was of a higher and more exalted nature. This is the tenure by which almost all the ancient monasteries and religious houses held their lands; and by which the parochial clergy, and very many ecclesiastical and eleemosynary foundations, hold them at this day; the nature of the service being upon the reformation altered, and made conformable to the purer doctrines of the church of England. It was an old Saxon tenure; and continued under the Norman revolution, through the great respect that was shown to religion and religious men in ancient times. This is also the reason that tenants in frankalmoigne were discharged of all other services except the *trinoda necessitas*, of repairing the highways, building castles, and repelling invasions; just as the Druids, among the ancient Britons, had *omnium rerum immunitatem*. And even at present, this is a tenure of a very different nature from all others; being not in the least feodal, but merely spiritual. For, if the service be neglected, the law gives no remedy by distress, or otherwise, to the lord of whom the lands are holden; but merely a complaint to the ordinary or visitor to correct it.

FRANK-*Chace* is defined to be a liberty of free chace in a circuit adjoining to a forest, whereby persons that have lands within the compass of the same are prohibited to cut down any wood, &c. out of the view of the forester.

FRANK-*Fee*, signifies the same thing as holding lands and tenements in fee-simple; that is, to any person and his heirs, and not by such service as is required by ancient demesne, but is pleaded at common law. See FEE.

FRANK-*Law*, a word applied to the free and common law of the land, or the benefit a person has by it. He that for any offence loseth this frank-law incurs these inconveniencies, viz. He may not be permitted to serve on juries, nor used as an evidence to the truth; and if he has any thing to do in the king's court, he must not approach it in person, but appoint his attorney; his lands, goods, and chattels, shall be seized into the king's hands; and his lands be estreated, his trees rooted up, and his body committed to custody.

FRANK-*Marriage*, in law, is where tenements are given by one man to another, together with a wife, who is the daughter or cousin to the donor, to hold in frank-marriage. By such gift, though nothing but the word *frank-marriage* is expressed, the donees shall have the tenements to them, and the heirs of their two bodies begotten; that is, they are tenants in special tail. For this one word, *frank-marriage*, denotes, *ex vi termini*, not only an inheritance, like the word *frank-almoigne*, but likewise limits that inheritance; supplying, not only words of descent, but of procreation also. Such donees in frank-marriage are liable to no service but fealty; for a rent reserved therein is void until the fourth degree of consanguinity be past between the issues of the donor and donee.

FRANK-*Pledge*, in law, signifies a pledge or surety for the behaviour of freemen. According to the ancient custom of England, for the preservation of the public peace, every freeborn man, at the age of fourteen, except religious persons, clerks, knights, and their eldest sons, was obliged to give security for his truth and behaviour towards the king and his subjects, or else be imprisoned. Accordingly, a certain number of neighbours became interchangeably bound for each other, to see each person of their pledge forthcoming at all times, or to answer for the offence of any one gone away: so that whenever any person offended, it was presently inquired in what pledge

he was, and there the perſons bound either produced the offender in 31 days, or made ſatisfaction for his offence.

Frank-*Tenement*. See Tenure.

FRANKED letters. The privilege of letters coming free of poſtage to and from members of parliament was claimed by the Houſe of Commons in 1660, when the firſt legal ſettlement of the preſent poſt-office was made; but afterwards dropped, upon a private aſſurance from the crown, that this privilege ſhould be allowed the members. Accordingly a warrant was conſtantly iſſued to the poſtmaſter-general, directing the allowance thereof to the extent of two ounces in weight: till at length it was expreſly confirmed by 4 Geo. III. c. 24. which added many new regulations, rendered neceſſary by the great abuſes in the practice of franking; whereby the annual amount of franked letters had increaſed from 23,600l. in the year 1715, to 170,700l. in the year 1763. Other regulations afterwards took place; in particular, franks were required to be dated (the month written at length), and put into the office the ſame day; notwithſtanding which, the revenue ſtill loſt by this privilege above 80,000l. *per annum*. The following are the regulations of franking required by 35 Geo. III. and now in force.

No letter directed by or to any member of parliament ſhall be exempted from poſtage if it exceeds one ounce in weight. No letter directed by any member ſhall be exempted unleſs he ſhall actually be in the poſt-town, or within the limits of its delivery of letters, or within twenty miles of ſuch poſt-town, on the day, or on the day before the day, on which the letter ſhall be put into the office. No member ſhall be entitled to ſend free from poſtage more than ten letters in one day, nor to receive more than fifteen.

Whenever the number of letters ſent or received by ſuch member in one day ſhall exceed the number exempted, and the poſtage upon any of them ſhall differ, the letters chargeable with a higher poſtage ſhall be included in the number exempted, in preference to any chargeable with a lower poſtage, and the remainder ſhall be chargeable with the poſtage to which common letters are now chargeable. Perſons who may now in right of their offices ſend and receive letters free may continue ſo to do. Printed votes or proceedings in parliament, and printed newſpapers, may alſo be ſent as uſual.

No ſingle letter *ſent by* the poſt from any non-commiſſioned officer, ſeaman, or private, in the navy, army, militia, fencible regiments, artillery, or marines, ſhall be charged with more poſtage than one penny, but the ſame muſt be paid at the time of putting the ſame into the poſt-office; and ſuch letter muſt have written thereon, in the hand-writing of and ſigned by the commanding officer, the name of ſuch commanding officer, and of the ſhip, veſſel, corps, regiment, or detachment. Alſo no ſingle letter *directed to* any ſuch non-commiſſioned officer, ſeaman, or private, ſhall be charged with more poſtage than one penny, to be paid on the delivery thereof; but ſuch letter muſt be directed to ſuch perſons, ſpecifying the ſhip, veſſel, regiment, troop, corps, company, or detachment to which they belong: And the poſtmaſter muſt deliver ſuch letter either to the party to whom it ſhall be directed, or to ſome perſon appointed to receive the ſame by the commanding officer, and to no other.

Every cover containing patterns or ſamples of goods, not exceeding one ounce, ſhall be charged only as a ſingle letter, if ſent open at the ſides, and without any letter or writing therewith, other than the name of the perſon ſending the ſame, the place of his abode, and the prices of the articles.

FRANKEN (Franciſcus), commonly called *Old Frank*, a famous Flemiſh painter, ſuppoſed to have been born about the year 1544; but though his works are well known, very few of the circumſtances of his life have been tranſmitted to poſterity. This maſter painted hiſtorical ſubjects from the Old and New Teſtaments; and was remarkable for introducing a great number of figures into his compoſitions, which he had the addreſs to group very diſtinctly. Vandyck often commended his works, and thought them worthy of a place in any collection.

Franken (Franciſcus), diſtinguiſhed by the name of *Young Frank*, was the ſon of the former, born in the year 1580. He was inſtructed by his father; whoſe ſtyle he adopted ſo cloſely, that their works are frequently miſtaken. When he found himſelf ſufficiently ſkilled at home, he travelled into Italy for improvement in colouring; and, on his return, his works were much coveted. The moſt capital performances of this painter are, a ſcriptural performance in the church of Notre-dame at Antwerp; and an excellent picture, in a ſmall ſize, of Solomon's idolatry. Young Frank died in 1642.

FRANKENDAL, a ſtrong town of Germany, in the dominions of the Elector Palatine. It was taken by the Spaniards in 1623, by the Swedes in 1632, and was burnt by the French in 1688. It is ſeated near the Rhine, ſeven miles S. of Worms. E. lon. 8. 29. N. lat. 49. 25.

FRANKENIA, in botany; a genus of the monogynia order, belonging to the hexandria claſs of plants; and in the natural method ranking under the 17th order, *Calycanthemæ*. The calyx is quinquefid, and funnel-ſhaped; the petals five; the ſtigma ſexpartite; the capſule unilocular and trivalvular.

FRANKINCENSE. See Incense.

FRANKLIN (Thomas), D. D. chaplain in ordinary to his majeſty, was the ſon of Richard Franklin, well known as the printer of an anti-miniſterial paper called *The Craftſman*; in the conduct of which he received great aſſiſtance from Lord Bolingbroke, Mr. Pulteney, and other excellent writers, who then oppoſed Sir Robert Walpole's meaſures. By the advice of the ſecond of theſe gentlemen, young Franklin was devoted to the church, with a promiſe of being provided for by the patriot; who afterwards forgot his undertaking, and then entirely neglected him. He was educated at Weſtminſter-ſchool; from whence he went to the univerſity of Cambridge, where he became fellow of Trinity-college, and was ſome time Greek profeſſor. In Dec. 1758 he was inſtituted vicar of Ware and Thundridge; which, with the lectureſhip of St. Paul, Covent-Garden, and a chapel in Queen-ſtreet, were all the preferments he held till he obtained the rectory of Braſted in Kent. This gentleman was poſſeſſed of no inconſiderable ſhare of learning and poetical abilities, and was long a favourite in the literary world. His tranſlations of Phalaris, Sophocles, and Lucian, equally evince his learning and his genius, as they are not more diſtinguiſhed for fidelity in the verſion, than congeniality with the ſpirit of the admirable originals. Dr. Franklin, like Mr. Foote, ſuffered a tranſlation from the French to be printed in his name; but the Oreſtes and Electra are ſuppoſed to be all that were really by him. It was a tranſlation of Voltaire's works, to which alſo Dr. Smollet's name appears. His own dramatic compoſitions, of which the principal are the tragedies of the Earl of Warwick and Matilda, are univerſally known, and deſervedly eſteemed by the public; ſo that his death, which happened March 15, 1784, may be conſidered as a real loſs to the republic of letters.

Franklin (Dr. Benjamin), one of the moſt celebrated philoſophers and politicians of the preſent age, was born at Boſton in North America in the year 1706. His father was a tallow-chandler; whoſe houſe he quitted before the age of 14, in order to go to Philadelphia, where he was introduced to the only printer eſtabliſhed in that city. This perſon, being ſtruck with his appearance and manner, took him into his houſe, and inſtructed him in his art; and Franklin, by his diſpoſition, genius, and diligence, ſoon deſerved and increaſed the favourable

opinion that had been entertained of him by his maſter. Nor was he leſs agreeable to thoſe who viſited the printing-houſe out of curioſity: for the typographical art being then almoſt unknown in thoſe parts, great numbers were attracted by the myſtery; and were ſo well pleaſed with the ſkill, activity, and communicative manner of our young operator, that they ſeldom went away without leaving him ſome marks of their liberality. Here he ſoon began to manifeſt that love of learning and thirſt after knowledge for which he was ſo remarkable: and, as it was difficult to procure books from England, young Franklin entered into a ſociety with ſome others of his own age; among whom it was agreed, that they ſhould bring ſuch books as they had into one place, in order to form a common library. This reſource, however, was found ſo defective, that the ſociety, at Franklin's perſuaſion, reſolved to contribute a ſmall ſum monthly towards the purchaſe of books for their uſe from London. Thus their ſtock began to increaſe rapidly; and the inhabitants of Philadelphia, being deſirous of having a ſhare in their literary knowledge, propoſed that the books ſhould be lent out on paying a ſmall ſum for the indulgence. Thus in a few years the ſociety became rich, and poſſeſſed more books than were perhaps to be found in all the other colonies; the collection was advanced into a public library; and the other colonies, ſenſible of the advantages reſulting from thence, began to form ſimilar plans; whence originated the libraries at Boſton, New York, Charleſtown, &c. that of Philadelphia being now inferior to none in Europe.

Mr. Franklin, notwithſtanding all the advantages he could derive from his ſituation in Philadelphia, was not yet ſatisfied. He came over to England, therefore, in the year 1724 or 1725, and worked as a journeyman printer with one Mr. Watts. By him he was greatly eſteemed; and treated with ſuch kindneſs, that it was always remembered with gratitude by our philoſopher. Mr. Watts often predicted, that this young American compoſitor would one day make a conſiderable figure in the world; and he lived to ſee his prediction fulfilled with regard to his philoſophical diſcoveries, as well as in the part he took in political matters.

Having ſtaid ſome time in London, Mr. Franklin returned to Philadelphia, where he perſuaded the printer with whom he formerly reſided to ſet up a newſpaper; which was attended with ſuch benefit, that his maſter admitted him as a partner in the buſineſs, and gave him his daughter in marriage. Having thus eſtabliſhed himſelf as a printer, and acquired ſome fortune, Mr. Franklin was left at liberty to follow the natural bent of his genius. Being much addicted to the ſtudy of natural philoſophy, and the diſcovery of the Leyden experiment in electricity having rendered that ſcience an object of general curioſity, Mr. Franklin applied himſelf to it, and ſoon began to diſtinguiſh himſelf eminently in that way. He is particularly remarkable for being the firſt who thought of ſecuring buildings from lightning; and he is generally thought to have been the inventor of the electrical kite, though ſome aſcribe this invention to another. His theory of poſitive and negative electricity has alſo received the ſanction of public approbation; though, when rigorouſly inveſtigated, it does not ſeem capable of ſupporting itſelf. See Electricity, p. 255. His theories were at firſt oppoſed by the members of the Royal Society in London; but in 1755, when he returned to that city, they voted him the gold medal which is annually given to the perſon who preſents a memoir on the moſt curious and intereſting ſubject. He was likewiſe admitted a member of the Society, and had the degree of doctor of laws conferred upon him by one of the univerſities: but at this time, by reaſon of the war which broke out between Britain and France, he returned to America, and began to take a ſhare in the public affairs of that country.

Having planned the different poſts through the continent of America, he was made poſtmaſter-general for that country; but, as in the ſubſequent diſputes he took always the popular ſide, he was afterwards removed from that employment. In the year 1767 he was examined before the houſe of commons concerning the ſtamp-act. In 1773, having been appointed agent for the province of Pennſylvania, he came over to England at the time when the diſputes between Great Britain and America were on the point of coming to extremities; when he attracted the public attention by a letter on the duel betwixt Mr. Whately and Mr. Temple concerning the publication of governor Hutchinſon's letters. On the 29th January next year, he was examined before the privy-council, on a petition he had preſented long before as agent for Maſſachuſets Bay againſt Mr. Hutchinſon: but this petition, being diſagreeable to miniſtry, was precipitately rejected, and Dr. Franklin was ſoon after removed from his office of poſtmaſter-general for America. He was now looked upon by government with ſuch a jealous eye, that ſome thoughts were entertained of having him arreſted as a fomenter of rebellion. The Doctor, however, being on his guard, departed for America in the beginning of the year 1775 with ſuch privacy, that he had left England before it was ſuſpected that he entertained any deſign of quitting it. Being named one of the delegates to the continental congreſs, he had a principal ſhare in bringing about the revolution and declaration of independency on the part of the colonies. In 1776 he was deputed by congreſs to Canada, to negotiate with the people in that country, and to perſuade them to throw off the Britiſh yoke; but the Canadians had been ſo much diſguſted with the hot-headed zeal of the New Englanders, who had burnt ſome of their chapels, that they refuſed to liſten to the propoſals, though enforced by all the arguments Dr. Franklin could make uſe of. On his return to Philadelphia, congreſs, ſenſible how much he was eſteemed in France, ſent him thither to put a finiſhing hand to the private negotiations of Mr. Silas Deane; and this important commiſſion was readily accepted by the Doctor, though then in the 71ſt year of his age. The event is well known; a treaty of alliance and commerce was ſigned between France and America; and M. Le Roi aſſerts, that the Doctor had a great ſhare in the tranſaction, by ſtrongly adviſing M. Maurepas not to loſe a ſingle moment, if he wiſhed to ſecure the friendſhip of America, and to detach it from the mother-country. He likewiſe informs us, that no man could be more rejoiced than Dr. Franklin was on the day that the Britiſh ambaſſador Lord Stormont quitted Paris on account of the rupture betwixt the two nations. In 1777 he was regularly appointed plenipotentiary from Congreſs to the French court, but obtained leave of diſmiſſion in 1780. Having at laſt ſeen the full accompliſhment of his wiſhes by the concluſion of the peace in 1783, which gave independency to America, he became deſirous of reviſiting his native country. He therefore requeſted to be recalled; and, after repeated ſolicitations, Mr. Jefferſon was appointed in his room. On the arrival of his ſucceſſor, he repaired to Havre de Grace, and, croſſing the Channel, landed at Newport in the Iſle of Wight; and, after a favourable paſſage, arrived ſafe at Philadelphia in the month of September 1785. He was received amidſt the acclamations of a vaſt multitude, who flocked from all parts to ſee him, and who conducted him in triumph to his own houſe. In a few days he was viſited by the members of the congreſs and the principal inhabitants of Philadelphia. He was afterwards twice choſen preſident of the aſſembly of Philadelphia; but his increaſing infirmities obliged him to aſk permiſſion to retire, and to ſpend the remainder of his life in tranquillity; which was granted.

During the greateſt part of his life-time, the Doctor had been very healthy. In the year 1735, indeed, he was attacked by a pleuriſy, which ended in a ſuppuration of the lungs, from which, as well as from another attack of the ſame kind af-

terwards, he neverthelefs recovered. As he advanced in years, however, he became fubject to fits of the gout, to which in the year 1782 a nephritic colic was fuperadded. From this time he became fubject to the ftone as well as the gout, and for the laft twelve months of his life thefe complaints almoft entirely confined him to his bed. Notwithftanding his diftreffed fituation, however, neither his mental abilities nor his natural cheerfulnefs ever forfook him. His memory was very tenacious to the very laft; and he feemed to be an exception to the general rule, that at a certain period of life the organs which are fubfervient to memory become callous; a remarkable inftance of which is, that he learned to fpeak French after he had attained the age of 70. About 16 days before his death, he was feized with a feverifh diforder; which, about the third or fourth, was attended with a pain in the left breaft. This became at laft very acute, and was accompanied with a cough and laborious breathing. Thus he continued for five days, when the painful fymptoms ceafed at once, and his family began to flatter themfelves with hopes of his recovery. But a new impofthume had now taken place in the lungs; which fuddenly breaking as the others had done, he was unable to expectorate the matter fully. Hence fatal fymptoms arofe, and he expired on the 17th of April 1790. He left one fon, governor William Franklin, a zealous loyalift, who afterwards refided at London; and a daughter, married to Mr. William Bache, merchant in Philadelphia. This lady was his greateft favourite, and waited upon him during his laft illnefs.

With regard to the character of Dr. Franklin, he was faid to be fententious but not fluent in fociety; rather inclined to liften than to talk; an informing rather than a pleafing companion; very impatient, however, of interruption; fo that he would frequently mention the cuftom of the Indians, who keep filence for fome time before they anfwer a queftion which they have heard with attention. With regard to religion, he was a firm believer in the Scriptures; and his fentiments on death may be gathered from a letter written about 35 years ago to Mifs Hubbard, on the death of her father-in-law Mr. John Franklin. The Doctor was author of many tracts on electricity, and other branches of natural philofophy, as well as on politics and mifcellaneous fubjects.

FRANKS, Francs, Frankis, or Franquis, a name which the Turks, Arabs, Greeks, &c. give to all the people of the weftern parts of Europe. The appellation is commonly fuppofed to have had its rife in Afia, at the time of the croifades; when the French made the moft confiderable figure among the croifées: from which time the Turks, Saracens, Greeks, Abyffinians, &c. ufed it as a common term for all the Chriftians of Europe; and called Europe itfelf *Frankiftan.* The Arabs and Mahometans, fays M. d'Herbelot, apply the term *Franks* not only to the French (to whom the name originally belonged), but alfo to the Latins and Europeans in general. But F. Goar, in his notes on Condinus, cap. 5. n. 43. furnifhes another origin of the appellation *Franks,* of greater antiquity than the former. He obferves, that the Greeks at firft confined the name to the *Franci, i. e.* the German nations who had fettled themfelves in France or Gaul; but afterwards they gave the fame name to the Apulians and Calabrians, after they had been conquered by the Normans; and at length the name was farther extended to all the Latins. In this fenfe is the word ufed by feveral Greek writers: as Comnenus, &c. who, to diftinguifh the French, call them the *weftern Franks.* Du Cange adds, that about the time of Charlemagne, they diftinguifhed eaftern France, weftern France, Latin or Roman France, and German France, which was the ancient France, afterwards called *Franconia.*

FRASCATI, or Frescati. See Frescati.

FRATERNITY, brotherhood, the relation or union of brothers, friends, partners, affociates, &c. In a civil fenfe it is ufed for a guild, affociation, or fociety of perfons, united into a body, for fome common intereft or advantage. See Company and Guild.

Fraternity, in the Roman Catholic countries, fignifies a fociety for the improvement of devotion. Of thefe there are feveral forts; as, 1. The fraternity of the rofary, founded by St. Dominic. It is divided into two branches, called the *common rofary*, and the *perpetual rofary*; the former of whom are obliged to confefs and communicate every firft Sunday in the month, and the latter to repeat the rofary continually. 2. The fraternity of the fcapulary, whom the bleffed Virgin, according to the fabbatine bull of pope John XXII. has promifed to deliver out of hell the firft Sunday after their death. 3. The fraternity of St. Francis's girdle are clothed with a fack of a grey colour, which they tie with a cord; and in proceffions walk barefooted, carrying in their hands a wooden crofs. 4. That of St. Auftin's leathern girdle, comprehends a great many devotees. Italy, Spain, and Portugal, are the countries where one fees the greateft number of thefe fraternities, fome of which affume the name of *arch-fraternities*. Pope Clement VII. inftituted the arch-fraternity of charity, which diftribute bread every Sunday among the poor, and give portions to 40 poor girls on the feaft of St. Jerom their patron. The fraternity of death bury fuch dead as are abandoned by their relations, and caufe maffes to be celebrated for them.

FRATRES arvales. See Arvales.

FRATRIAGE, the partition among brothers, or co-heirs, coming to the fame inheritance or fucceffion.

FRATRICELLI, in ecclefiaftical hiftory, an enthufiaftic fect of Francifcans, which rofe in Italy, and particularly in the marquifate of Ancona, about the year 1294. The word is an Italian diminutive, fignifying *fraterculi,* or "little brothers;" and was here ufed as a term of derifion, as they were moft of them apoftate monks, whom the Italians call *fratelli,* or *fratricelli.* For this reafon the term *fratricelli,* as a nickname, was given to many other fects, as the Catharifts, the Waldenfes, &c. however different in their opinions and in their conduct. But this denomination applied to the auftere part of the Francifcans was confidered as honourable. See Franciscans.

The founders were P. Maurato, and P. de Foffombroni, who having obtained of pope Celeftin V. a permiffion to live in folitude, after the manner of hermits, and to obferve the rule of St. Francis in all its rigour, feveral idle vagabond monks joined them, who, living after their own fancies, and making all perfection to confift in poverty, were foon condemned by pope Boniface VIII. and his fucceffor, and the inquifitors ordered to proceed againft them as heretics: which commiffion they executed with their ufual barbarity. Upon this, retiring into Sicily, Peter John Oliva de Serignan had no fooner publifhed his Comment on the Apocalypfe, than they adopted his errors. They held the Romifh church to be Babylon, and propofed to eftablifh another far more perfect one: they maintained, that the rule of St. Francis was the evangelical rule obferved by Jefus Chrift and his apoftles. They foretold the reformation of the church, and the reftoration of the true gofpel of Chrift, by the genuine followers of St. Francis, and declared their affent to almoft all the doctrines which were publifhed under the name of the abbot Joachim, in the "Introduction to the everlafting Gofpel," a book publifhed in 1250, and explained by one of the fpiritual friars, whofe name was Gerhard. Among other enormities inculcated in this book, it is pretended that St. Francis was the angel mentioned in Rev. xiv. 6. and had promulgated to the world the true and everlafting gofpel of God; that the gofpel of Chrift was to be abrogated in 1260, and to give place to this new and everlafting gofpel, which was to be fubftituted

in its room; and that the ministers of this great reformation were to be humble and bare-footed friars, destitute of all worldly employments. Some say they even elected a pope of their church; at least they appointed a general, with superiors, and built monasteries, &c. Beside the opinions of Oliva, they held that the sacraments of the church were invalid; because those who administered them had no longer any power or jurisdiction. They were condemned afresh by pope John XXII.; in consequence of whose cruelty they regarded him as the true antichrist: but several of them, returning into Germany, were sheltered by Lewis, duke of Bavaria, the emperor. There are authentic records, from which it appears, that no less than 2000 persons were burnt by the inquisition, from the year 1318 to the time of Innocent VI. for their inflexible attachment to the poverty of St. Francis. The severities against them were again revived towards the close of the 15th century by pope Nicolas V. and his successors. However, all the persecutions which this sect endured were not sufficient to extinguish it; for it subsisted until the times of the reformation in Germany, when its remaining votaries adopted the cause and embraced the doctrine and discipline of Luther. And this has led Popish writers to charge the Fratricelli with many enormities, some of which are recounted by M. Bayle, art. *Fratricelli*.

The Fratricelli had many other denominations: they were called *fratricelli*, according to some, because they lived in community, in imitation of the primitive Christians, or rather through the humility of the founder of the Franciscan order, to which the Fratricelli originally belonged; *dulcini*, from one of their doctors; *Bizochi*, *Beguins*, and *Begbardi*.

FRAUD, in law, signifies deceit in grants, or conveyances of lands, &c. or in bargains and sales of goods, &c. to the damage of another person. A fraudulent conveyance of lands or goods to deceive creditors, as to creditors, is void in law. And a fraudulent conveyance, in order to defraud purchasers, is also to such purchasers void; and the persons justifying or putting off such grants as good, shall forfeit a year's value of the lands, and the full value of the goods and chattels, and likewise shall be imprisoned. See CHEATING.

FRAUSTADT, a town of Silesia, remarkable for a battle the Swedes gained here over the Saxons in 1706. It is 20 miles N. W. of Glogaw. Lon. 16. 3. E. Lat. 51. 48. N.

FRAXINELLA, in botany. See DICTAMNUS. It is remarkable of this odorous plant, that, when in full blossom, the air which surrounds it in a still night may be inflamed by the approach of a lighted candle. Dr. Watson doubts whether this inflammability proceeds from an inflammable air which is exhaled by the plant, or from some of the finer parts of the essential oil of the plant being dissolved in the common atmospherical air. The latter is the most probable supposition; for were it the pure inflammable air, as Mr. Cavallo observes, it would, on account of its small specific gravity, leave the plant as soon as it was produced. Common air acquires the property of becoming inflammable, by being transmitted through several essential oils.

FRAXINUS, the ASH; a genus of the diœcia order, belonging to the polygamia class of plants; and in the natural method ranking under the 44th order, *Sepiariæ*. There is no hermaphrodite calyx, or it is quadripartite; and there is either no corolla, or it is tetrapetalous: there are two stamina; one pistil; one lanceolated seed; and the pistil of the female is lanceolated. There are six species; of which the most useful is the common ash, which is so well known, that it needs no description. If a wood of these trees is rightly managed, it will turn greatly to the advantage of the owner: for by the underwood, which will be fit to cut every eight or ten years, there will be a continual income, more than sufficient to pay the rent of the ground and all other charges; and still there will be a stock preserved for timber, which in a few years will be worth 40s. or 50s. per tree. This tree flourishes best in groves, but grows very well in rich soil in open fields. It bears transplanting and lopping. In the north of Lancashire they lop the tops of these trees to feed the cattle in autumn when the grass is on the decline; the cattle peeling off the bark as food. The wood hath the singular property of being nearly as good when young as when old. It is hard and tough, and is much used to make the tools employed in husbandry. The ashes of the wood afford very good potash. The bark is used in tanning calf-skin. A slight infusion of it appears of a pale yellowish colour, when viewed betwixt the eye and the light; but when looked down upon, or placed betwixt the eye and an opaque object, appears blue. This blueness is destroyed by the addition of an acid, but recovered by alkalis. The seeds are acrid and bitter. In the church-yard of Lochaber in Scotland, Dr. Walker measured the trunk of a dead ash tree, which at five feet from the surface of the ground was 58 feet in circumference. Horses, cows, sheep, and goats eat it; but it spoils the milk of cows, so that it should not be planted in dairy farms.

FRAY literally signifies to fret; as cloth or stuff does, by rubbing or over-much wearing. Among hunters a deer is said to fray his head, when he rubs it against a tree, to cause the skins of his new horns to come off.

FRAZERSBURG, a small but pleasant town of Scotland, in Aberdeenshire, built by Sir Alexander Frazer of Philorth in 1600. It is seated close by the promontory, called Kinnaird's Head, on which a lighthouse has been lately erected. This town has a tolerable harbour, and is 40 miles N. of Aberdeen.

FREA, or FRIGGA, the wife of Odin, was, next to him, the most revered divinity among the Heathen Saxons, Danes, and other northern nations. As Odin was believed to be the father, Frea was esteemed the mother of all the other gods. In the most ancient times, Frea was the same with the goddess Herthus, or Earth, who was so devoutly worshipped by the Angli and other German nations. But when Odin, the conqueror of the north, usurped the honours due only to the true Odin, his wife Frea usurped those which had been formerly paid to mother Earth. She was worshipped as the goddess of love and pleasure, who bestowed on her votaries a variety of delights, particularly happy marriages and easy child-births. To Frea the sixth day of the week was consecrated, which still bears her name.

FREAM, a name given by farmers to ploughed lands worn out of heart, and laid fallow.

FREATS, or FREITS, a term used in Scotland for *ill omens*, and sometimes denoting accidents supernaturally unlucky. King James VI. in his *Dæmonologie*, *MS. pen. Edit.* B. I. *chap.* IV. *p.* 13. "But I pray you forget not likeways to tell what are the Devill's rudiments? E. His rudiments I call first in generall all that quhilk is called vulgairelie the virtu of woode, herbe, and staine; quhilk is used by unlawful charmis without natural causis. As lykeways all kynd of prattiques, *freitis, or uther lyk extraordinair actions, quhilk cannot abyde the trew twiche of naturall raison.*" It occurs again in the same sense in *p.* 41. *marg. note*; and in *p.* 41. speaking of *Sorcerers*: "And in generall that naime was gevin thaime for using of sic chairmis and *freitis*, as that craft teachis thaime."

FRECKLES, LENTIGINES, spots of a yellowish colour, of the bigness of a lentile-seed, scattered over the face, neck, and hands. Freckles are either natural, or proceeding accidentally from the jaundice or the action of the sun upon the part. Heat, or a sudden change of the weather, will often cause the skin to appear of a darker colour than natural; and thereby produce what is called *tan*, *sunburn*, and *morphew*, which seem to differ only in degree; and usually disappear in winter. Persons of a

fine complexion, and ſuch whoſe hair is red, are the moſt ſubject to freckles, eſpecially in thoſe parts which they expoſe to the air. To remove freckles, put juice of lemons in a vial, and, mixing it with ſugar and borax finely powdered, let it digeſt eight days, and then uſe it. Homberg propoſes bullock's gall mixed with alum, and, after the alum has precipitated, expoſed three or four months to the ſun in a cloſe vial, as one of the beſt remedies known for the removing of freckles.

FREDBERG, a large, rich, and fine town of Germany, in Miſnia, remarkable for its mines, and for being the burying-place of the princes of the houſe of Saxony. It is a delightful place, ſeated on the river Multa, 15 miles S. W. of Dreſden. Lon. 13. 36. E. Lat. 51. 0. N.

FREDERICA, a town of N. America, in Georgia, on the river Alatamaha. The iſland on which it ſtands is called St. Simon's, and is about 13 miles in length, and four in breadth. Lon. 80. 20. W. Lat. 31. 6. N.

FREDERICK II. the Great, of Pruſſia, one of the greateſt warriors the preſent age has produced, was the ſon of Frederick-William, then hereditary prince of Brandenburg, and Maria Dorothea, a princeſs of the houſe of Brunſwick. He was born in 1712, the year before his father Frederick I. mounted the throne of Pruſſia. As he advanced towards manhood, he became famous by his diſagreement with his father; who was of a diſpoſition violent and arbitrary, of narrow views, and vehement paſſions, entirely engaged in little purſuits, or in ſchemes terminating in ſome ſpeedy conſequence, without any plan of laſting advantage to himſelf or his ſubjects, or any proſpect of diſtant events. He was therefore always buſy, though no effects of his activity ever appeared, and always eager though he had nothing to gain. His behaviour was to the laſt degree rough and ſavage. The leaſt provocation, whether deſigned or accidental, was returned by blows, which he did not always forbear even to the queen and princeſſes.

From ſuch a king, and ſuch a father, it was not any enormous violation of duty in the immediate heir of a kingdom ſometimes to differ in opinion, and to maintain that difference with decent pertinacity. A prince of a quick ſagacity, and comprehenſive knowledge, muſt find many practices in the conduct of affairs which he could not approve, and ſome which he could ſcarcely forbear to oppoſe.

The chief pride of the old king was to be maſter of the talleſt regiment in Europe. He therefore brought together from all parts, men above the common military ſtandard. To exceed the height of ſix feet was a certain recommendation to notice, and to approach that of ſeven a claim to diſtinction. Men will readily go where they are ſure to be careſſed, and he had therefore ſuch a collection of giants as perhaps was never ſeen in the world before. To review this towering regiment was his daily pleaſure, and to perpetuate it was ſo much his care, that when he met a tall woman he immediately commanded one of his Titanian retinue to marry her, that they might propagate procerity, and produce heirs to the father's habiliments. In all this there was apparent folly, but there was no crime. The tall regiment made a fine ſhow at an expence not much greater, when once it was collected, than would have been beſtowed upon common men. But the king's military paſtimes were ſometimes more pernicious. He maintained a numerous army, of which he made no other uſe than to review and talk of it; and when he, or perhaps his emiſſaries, ſaw a boy, whoſe form and ſprightlineſs promiſed a future ſoldier, he ordered a badge to be put about his neck, by which he was marked out for the ſervice, like the ſons of Chriſtian captives in Turkey, and his parents were forbidden to deſtine him to any other mode of life. This was ſufficiently oppreſſive; but this was not the utmoſt of his tyranny. He had learned, though otherwiſe perhaps no very great politician, that to be rich was to be powerful; but, that the riches of a king ought to be ſeen in the opulence of his ſubjects, he wanted either ability or benevolence to underſtand. He therefore raiſed exorbitant taxes from every kind of commodity and poſſeſſion, and piled up the money in his treaſury, from which it iſſued no more.

By which of theſe freaks of royalty the prince was offended, or whether, as perhaps more frequently happens, the offences of which he complained were of a domeſtic and perſonal kind, it is not eaſy to diſcover. But his reſentment, whatever was its cauſe, roſe ſo high, that he reſolved not only to leave his father's court, but his territories, and to ſeek a refuge among the neighbouring or kindred princes. It is generally believed that his intention was to come to England and live under the protection of his uncle, till his father's death, or change of conduct, ſhould give him liberty to return.

His deſign, whatever it was, he concerted with an officer of the army whoſe name was Kat, a man in whom he placed great confidence, and whom, having choſen him for the companion of his flight, he neceſſarily truſted with the preparatory meaſures. A prince cannot leave his country with the ſpeed of a meaner fugitive. Something was to be provided, and ſomething to be adjuſted. And, whether Kat found the agency of others neceſſary, and therefore was conſtrained to admit ſome partners of the ſecret; whether levity or vanity incited him to diſburden himſelf of a truſt that ſwelled in his boſom, or to ſhow to a friend or miſtreſs his own importance; or whether it be in itſelf difficult for princes to tranſact any thing in ſecret; ſo it was that the king was informed of his intended flight, and the prince and his favourite, a little before the time ſettled for their departure, were arreſted and confined in different places.

The lives of princes are ſeldom in danger; the hazard of their irregularities falls only on thoſe whom ambition or affection combines with them. The king, after an impriſonment of ſome time, ſet his ſon at liberty; but poor Kat was ordered to be tried for a capital crime. The court examined the cauſe, and acquitted him; the king remanded him to a ſecond trial, and obliged his judges to condemn him. In conſequence of the ſentence thus tyrannically extorted, he was publicly beheaded, leaving behind him ſome papers of reflections made in the priſon, which were afterwards printed, and among others an admonition to the prince for whoſe ſake he ſuffered, not to foſter in himſelf the opinion of deſtiny, for that a Providence is diſcoverable in every thing around us.

This cruel proſecution of a man who had committed no crime, but by compliance with influence not eaſily to be reſiſted, was not the only act by which the old king irritated his ſon. A lady with whom the prince was ſuſpected of intimacy, perhaps more than virtue allowed, was ſeized, it is not known upon what accuſation; and, by the king's order, notwithſtanding all the reaſons of decency and tenderneſs that operate in other countries and other judicatures, was publicly whipped in the ſtreets of Berlin.

At laſt, that the prince might feel the power of a king and a father in its utmoſt rigour, he was in 1733 married againſt his will to the princeſs Elizabetha Chriſtiana of Brunſwick Lunenburg Beveren. He married her indeed at his father's command, but without profeſſing for her either reſpect or affection; and, conſidering the claim of parental authority fully ſatisfied by the external ceremony, obſtinately and perpetually during the life of his father refrained from her bed. The poor princeſs lived about ſeven years in the court of Berlin, in a ſtate which the world has not often ſeen; a wife without a huſband, married ſo far as to engage her perſon to a man who did not deſire her affection, and of whom it was doubtful whether he thought himſelf reſtrained from the power of repudiation by an act performed under evident compulſion.

Thus he lived, fecluded from public bufinefs, in contention with his father, in alienation from his wife. This ftate of uneafinefs he found the only means of foftening. He diverted his mind from the fcenes about him by ftudies and liberal amufements.

He acquired fkill in the mathematical fciences, fuch as is faid to have put him on a level with thofe who have made them the bufinefs of their lives. His fkill in poetry and in the French language have been loudly praifed by Voltaire, a judge without exception, if his honefty were equal to his knowledge. Mufic he not only underftood, but practifed on the German-flute in the higheft perfection, fo that, according to the regal cenfure of Philip of Macedon, he might be afhamed to play fo well.

In 1740, the old king fell fick, and fpoke and acted in his illnefs with his ufual turbulence and roughnefs, reproaching his phyficians in the groffeft terms with their unfkilfulnefs and impotence, and imputing to their ignorance or wickednefs the pain which their prefcriptions failed to relieve. The king, finding his diftemper gaining upon his ftrength, grew at laft fenfible that his end was approaching, and, ordering the prince to be called to his bed, laid feveral injunctions upon him, of which one was to perpetuate the tall regiment by continual recruits, and another to receive his efpoufed wife. The prince gave him a refpectful anfwer, but wifely avoided to diminifh his own right or power by an abfolute promife; and the king died uncertain of the fate of the tall regiment.

The young king began his reign with great expectations, which he has even furpaffed. His father's faults produced many advantages to the firft year of his reign. He had an army of feventy thoufand men well difciplined, without any imputation of feverity to himfelf, and was mafter of a vaft treafure without the crime or reproach of raifing it. Being now no longer under influence or its appearance, he determined how to act towards the unhappy lady who had poffeffed for feven years the empty title of the princefs of Pruffia. It is certain that he received her as a queen, but whether he treated her as his wife is doubtful. In a few days his refolution was known with regard to the tall regiment: for, fome recruits being offered him, he rejected them; and this body of giants, by continued difregard, mouldered away. He treated his mother with great refpect, ordered that fhe fhould bear the title of Queen-Mother, and that, inftead of addreffing him as His Majefty, fhe fhould call him fon. As he was paffing foon after between Berlin and Potfdam, a thoufand boys who had been marked out for military fervice, furrounded his coach, and cried out, "Merciful King, deliver us from our flavery." He promifed them their liberty, and ordered the next day that the badge fhould be taken off.

He declared his refolution to grant a general toleration of religion, and among other liberalities of conceffion allowed the profeffion of free-mafonry.

There had fubfifted for fome time in Pruffia an order, called "The Order for Favour," which, according to its denomination, had been conferred with very little diftinction. The king inftituted "The Order for Merit," with which he honoured thofe whom he confidered as deferving. One of his firft cares was the advancement of learning. Immediately upon his acceffion, he wrote to Rollin and Voltaire that he defired the continuance of their friendfhip, and fent for M. Maupertuis, the principal of the French academicians, whom he requefted to come to Berlin to fettle an academy, in terms of great ardour and great condefcenfion.

To enter into a detail of all this king's exploits, his war and peace with the queen of Hungary, his treaty at Drefden, &c. would far exceed the limits of our work: fuffice it to fay, that the reign of this monarch was illuftrious, as well for the variety of characters he fuftained, as for the important viciffitudes he experienced. The pacification of Drefden in 1745 left him at liberty to appear in a character far more glorious than that of the conqueror of Silefia. He was now entitled to the nobleft eulogy, as the wife legiflator, and the father of his country. Exclufive of his general attention to agriculture, commerce, and manufactures, he peopled, in particular, the deferts of Pomerania, by encouraging, with royal bounties, a great number of induftrious emigrants to fettle in that province; the face of which, in a very few years, underwent the moft agreeable alteration. Above fixty new villages arofe amidft a barren wafte; and every part of the country exhibited marks of fuccefsful cultivation. Thofe defolate plains, where not a human footftep had been feen for ages, were now converted into fields of corn; and the happy peafants, under the protection of a patriot king, fowed their grounds in peace, and reaped their harveft in fecurity.

On the 16th of January 1756, he figned a treaty of alliance with the king of Great-Britain. This treaty, in its confequences, involved both the contracting powers in an expenfive continental war. A confederacy was formed againft him by the courts of Peterfburg, Verfailles, Drefden, and Vienna, in confequence of which, his Pruffian majefty entered Saxony on the 29th of Auguft 1756, at the head of a formidable army; preventing thus an attack upon his own territories, by carrying the war into the dominions of an enemy. On the firft of December following, he fought the battle of Lowofitz againft the Auftrians under marfhal Brown; and, although both parties claimed the victory, he foon after, in confequence of this battle, obliged the Saxon army, entrenched in the ftrong poft of Pirna, to furrender prifoners of war. He then took up his winter quarters in Saxony; treated that electorate as a conquered country; and, by feizing on the archives of Drefden, obtained ample and authentic proofs of the hoftile defigns againft him, and the confequent neceffity he was under of ftriking the firft blow. A long train of fieges, battles, and other interefting events enfued; in fhort, the wonderful viciffitudes in the affairs of this monarch exalted the admiration of his character in England to a degree of enthufiafm; and the parliament, in particular, feconding a new treaty concluded between the two courts, in the beginning of the year 1758, voted him a fubfidy of 670,000l.

In 1779, after a bufy life, he was at laft permitted to enjoy uninterrupted happinefs in his old age; yet in this feafon of repofe he was ftill active in rewarding military merit. For fome months before his death, he was afflicted with a dropfical complaint, which ended in his diffolution, on the 17th of Auguft 1786, in the 75th year of his age, after a reign of forty-fix years, two months, and feventeen days; during which time he difplayed the moft fplendid qualities of the ftatefman and the hero, the fovereign and the patriot.

FREDERICSBURG, a caftle and palace of the king of Denmark, in the ifle of Zealand, 15 miles N. W. of Copenhagen. Lon. 12. 25. E. Lat. 55. 52. N.

FREDERICSBURG, a town of Virginia in N. America, fituated on the S. fide of Rappahannoc river, 110 miles from its mouth. It contains about 200 houfes, principally in one ftreet, which runs nearly parallel with the river. It is 50 miles S. by W. of Alexandria. Lon. 77. 20. W. Lat. 38. 2. N.

FREDERICSBURG, a fort on the Gold Coaft of Guinea, in Africa, near Cape Threepoints, 62 miles from Cape Coaft Caftle. It is fubject to Denmark. Lon. 1. 5. W. Lat. 4. 30. N.

FREDERICSHALL, a town of Norway in the province of Aggerhuys, and on the frontiers of Sweden, fituated on the extremity of the Swinefund, at the mouth of the river Tifte. The harbour is fafe and commodious; but the large quantity of fawduft brought down the river, from the different faw-mills, occafions an annual expence to clear it way. On the fummit of

an almost perpendicular rock, which overhangs the town, stands the strong and hitherto impregnable fortress of Fredericstein, in the siege of which Charles XII. king of Sweden was killed by a musket-ball in 1718. The spot was once marked by a pillar erected by the king of Denmark, but demolished at the request of the king of Sweden. This town is 31 miles S. E. of Christiania. Lon. 10. 55. E. Lat. 59. 2. N.

FREDERICS-ODE, a town of Denmark, in Jutland, seated near the sea, 50 miles N. of Sleswick. Lon. 10. 0. E. Lat. 55. 30. N.

FREDERICSTADT, a town of Denmark, in S. Jutland, seated on the river Eyder, 17 miles S. W. of Sleswick. Lon. 9. 43. E. Lat. 54. 30. N.

Fredericstadt, a town of Norway, in the province of Aggerhuys. It stands on the river Glomme, and is the most regular fortress in this part of Norway, containing an arsenal amply supplied. A few years ago, the town was consumed by fire, and the houses are mostly new. Close to the town is the new fortress of Kongstein, on a rocky eminence, in which several convicts are condemned to hard labour. It is 26 miles W. of Fredericshall. Lon. 10. 50. E. Lat. 59. 12. N.

FREE, in a general sense, is used in opposition to whatever is constrained or necessitated. When applied to things endowed with understanding, it more peculiarly relates to the liberty of the will.

Free *Bench*, signifies that estate in copy-hold which the wife, being espoused a virgin, has after the decease of her husband for her dower, according to the custom of the manor. In regard to this free-bench, different manors have different customs: and in the manor of East and West Enbourne in the county of Berks, and in other parts of England, there is a custom, that when a copyhold tenant dies, the widow shall have her free-bench in all the deceased husband's lands, *dum sola & casta fuerit*, "whilst she lives single and chaste;" but if she is found to be guilty of incontinency, she shall forfeit her estate. Nevertheless, upon her coming into the court of the manor riding backwards on a black ram, with his tail in her hand, rehearsing a certain form of words, the steward is bound by custom to restore her to her free-bench. The words are,

Here I am,
Riding on a black Ram,
Like a whore as I am;
And for my crincum crancum
Have lost my bincum bancum,
And for my tail's game
Have done this worldly shame:
Therefore, pray, Mr. Steward, let me have my land again.

Free or *Imperial Cities* in Germany, are those not subject to any particular prince; but governed, like republics, by their own magistrates. There were free cities *(liberæ civitates)* even under the ancient Roman empire: such were those to whom the emperor, by the advice or consent of the senate, gave the privilege of appointing their own magistrates, and governing themselves by their own laws. See City.

Free *Fishery*. See *Free* Fishery.

Free *Warren*. See Warren.

Free-*Mason*. See Mason.

Free-*Stone*, a whitish stone, dug up in many parts of Britain, that works like alabaster, but is more hard and durable; being of excellent use in building, &c. It is a species of the grit stone, but finer fanded and smoother; and is called *free*, from its being of such a constitution as to allow of being cut freely in any direction.

The qualities of the several kinds of free-stones used in the different parts of Europe are very different. They all agree in this general property indeed, that they are softer while in the quarry, than when they have been some time exposed to the air: but even this general property differs greatly in degree. They have a sort of grey free-stone in use at Paris (of which we do not yet seem to have met with any in this country), which has the abovementioned quality in so great a degree, that the expence of working it is in a great measure saved.

This stone lies every-where on the south side of the river Seine, and is of a coarse and large grit. It is so soft when newly taken out of the strata, that they fashion it very conveniently with a sort of broad axe, and form as many stones for building in this manner in an hour, as an equal number of our people do in a day or two. Though this stone is as soft as dry clay when first taken up, it is found to harden so considerably in the air, that it becomes more than equal to our ordinary free-stone.

Our Portland stone of the finest kind, which is white, and of a close grit, is very fit for hewing and carving; but it will neither resist water nor fire, which is a very singular instance in so dense a stone; while the free-stone of Kent, which is less beautiful to the eye, and is of a greyish colour, and considerably close, though of a larger grain, resists the air and water very well. The free-stone of Derbyshire, on the other hand, is so brittle as to be unfit for any fine working; and so coarse and open in its texture, that it lets water through: yet it bears the fire extremely well, and is fit for ovens, hearths, &c.

FREEBOOTER, or Flibuster, a name given to the pirates who scour the American seas, particularly such as make war against the Spaniards. See Bucaneer.

FREEDOM, in general, the state or quality of being free. See Liberty.

Freedom *of a Corporation*, the right of enjoying all the privileges and immunities belonging to it. See Corporation. The freedom of cities, and other corporations, is regularly obtained by serving an apprenticeship; but it is also purchased with money, and sometimes conferred by way of compliment.

Freedom *of Conscience*. See Toleration.

Freedom *of the Will*, that power or faculty of the mind, whereby it is capable of acting or not acting, choosing or rejecting whatever it judges proper. See Metaphysics. Of this every man must be sensible, who finds in himself a power to begin or forbear, continue or end several actions, barely by a thought or preference of the mind.

FREEHOLD, Frank Tenement, *liberum tenementum*, is land or tenement which a man holds in *fee-simple*, *fee-tail*, or for term of life. See Fee and Tail. Freehold is of two kinds, in *deed* and in *law*. The first is the real possession of land or tenement in fee, fee-tail, or for life: the other is the right a man has to such land or tenement before his entry or seizure. A freehold, by the common law, cannot commence *in futuro*; but it must take effect presently, either in possession, reversion, or remainder. Whatever is part of the freehold goes to the heir; and things fixed thereto may not be taken in distress for rent, or in execution, &c. No man shall be disseised of his freehold by stat. Magna Charta, cap. 29. but by judgment of his peers, or according to the laws of the land: nor shall any distrain freeholders to answer for their freehold, in any thing concerning the same, without the king's writ. Freehold estates, of certain value, are required by statutes to qualify jurors, electors of the knights of the shire in parliament, &c.

Freehold is likewise extended to such offices as a man holds in fee, or for life.

Freehold is also sometimes taken in opposition to villenage. Lambard observes, that land, in the Saxon times, was distinguished into *bockland*, i. e. holden by book or writing; and *folklana*, held without writing. The former, he says, was held on far better conditions, and by the better sort of tenants, as noblemen and gentlemen; being such as we now call *freehold*:

the latter was moſtly in poſſeſſion of peaſants; being the ſame with what we now call *at the will of the lord.* In the ancient laws of Scotland, freeholders are called *milites*, "knights." In Reg. Judicial. it is expreſſed, that he who holds land upon an execution of a ſtatute merchant, until he hath ſatisfied the debt, *tenet ut liberum tenementum ſibi et aſſignatis ſuis;* and the ſame of a tenant *per elegit:* the meaning of which ſeems to be, not that ſuch tenants are freeholders, but as freeholders for the time, till they have received profits to the value of their debt.

FREETHINKER. See Deist.

FREEZE, Frieze, or *Frize*, in commerce. See Frize.

Freeze, in architecture, that part of the entablature of columns, between the architrave and corniche. The freeze is properly a large flat face, or member, ſeparating the architrave from the corniche. The ancients called it *zoophorus*, ζωοφορος, becauſe it was uſually enriched with figures of animals; and our denomination *freeze* has a like origin, being formed of the Latin *phrygio*, "an embroiderer," becauſe it is commonly adorned with ſculptures in baſſo-relievo, imitating embroidery.

FREEZING, in philoſophy, the ſame with congelation, or the fixing a fluid body into a firm or ſolid maſs by the action of cold. Having referred the conſideration of Cold and Congelation to this article, we ſhall take up the ſubject at its commencement.

We define cold to be the privation of heat, or that ſtate which is oppoſite to heat. As it is ſuppoſed that heat conſiſts in a particular motion of the parts of the hot body, hence the nature of cold, which is its oppoſite, is deduced; for it is found that cold extinguiſhes, or rather abates heat; hence it would ſeem to follow, that thoſe bodies are cold, which check and reſtrain the motion of the particles in which heat conſiſts.

In general, cold contracts moſt bodies, and heat expands them: though there are ſome inſtances to the contrary, eſpecially in the extreme caſes or ſtates of theſe qualities of bodies. Thus, though iron, in common with other bodies, expand with heat, yet, when melted, it is always found to expand in cooling again. So alſo, though water always is found to expand gradually as it is heated, and to contract as it cools, yet in the act of freezing it ſuddenly expands again, and that with a moſt enormous force, capable of rending rocks, or burſting the very thick ſhells of metal, &c. A computation of the force of freezing water has been made by the Florentine Academicians, from the burſting of a very ſtrong braſs globe or ſhell, by freezing water in it; when, from the known thickneſs and tenacity of the metal, it was found that the expanſive power of a ſpherule of water only one inch in diameter was ſufficient to overcome a reſiſtance of more than 27,000 pounds, or 13 tons and a half. See the experiments on burſting thick bomb-ſhells, by freezing water in them, by Major Edward Williams of the Royal Artillery, in the Edin. Philoſ. Tranſ. vol. 2.

Such a prodigious power of expanſion, almoſt double that of the moſt powerful ſteam-engines, and exerted in ſo ſmall a maſs, ſeemingly by the force of cold, was thought a very material argument in favour of thoſe who ſuppoſed that cold, like heat, is a poſitive ſubſtance. Dr. Black's diſcovery of latent heat, however, has now afforded a very eaſy and natural explication of this phenomenon. He has ſhewn, that, in the act of congelation, water is not cooled more than it was before, but rather grows warmer: that as much heat is diſcharged, and paſſes from a latent to a ſenſible ſtate, as, had it been applied to water in its fluid ſtate, would have heated it to 135°. In this proceſs, the expanſion is occaſioned by a great number of minute bubbles ſuddenly produced. Formerly theſe were ſuppoſed to be cold in the abſtract; and to be ſo ſubtle, that, inſinuating themſelves into the ſubſtances of the fluid, they augmented its bulk, at the ſame time that, by impeding the motion of its particles upon each other, they changed it from a fluid to a ſolid. But Dr. Black ſhews, that theſe are only air extricated during the congelation; and to the extrication of this air he aſcribes the prodigious expanſive force exerted by freezing water. The only queſtion, therefore, now remaining is, By what means this air comes to be extricated, and to take up more room than it naturally does in the fluid? To this it may be anſwered, that perhaps part of the heat, which is diſcharged from the freezing water, combines with the air in its unelaſtic ſtate, and, by reſtoring its elaſticity, gives it that extraordinary force, as is ſeen alſo in the caſe of air ſuddenly extricated in the exploſion of gun-powder.

Cold alſo uſually tends to make bodies electric, which are not ſo naturally, and to increaſe the electric properties of ſuch as are ſo. And it is farther found, that all ſubſtances do not tranſmit cold equally well; but that the beſt conductors of electricity, viz. metals, are likewiſe the beſt conductors of cold. It may farther be added, that when the cold has been carried to ſuch an extremity as to render any body an electric, it then ceaſes to conduct the cold ſo well as before. This is exemplified in the practice of the Laplanders and Siberians; where, to exclude the extreme cold of the winters from their habitations the more effectually, and yet to admit a little light, they cut pieces of ice, which in the winter time muſt always be electric in thoſe countries, and put them into their windows; which they find to be much more effectual in keeping out the cold than any other ſubſtance.

Cold is the deſtroyer of all vegetable life, when increaſed to an exceſſive degree. It is found that many garden plants and flowers, which ſeem to be very ſtout and hardy, go off at a little increaſe of cold beyond the ordinary ſtandard. And, in ſevere winters, nature has provided the beſt natural defence for the corn fields and gardens, namely, a covering of ſnow, which preſerves ſuch parts green and healthy as are under it, while ſuch as are uncovered by it are either killed or greatly injured.

Dr. Clarke is of opinion, that cold is owing to certain nitrous and other ſaline particles, endued with particular figures proper to produce ſuch effects. Hence ſal-ammoniac, ſaltpetre, or ſalt of urine, and many other volatile and alkalized ſalts, mixed with water, very much increaſe its degree of cold. In the Philoſ. Tranſ. No. 274, M. Geoffroy relates ſome remarkable experiments with regard to the production of cold. Four ounces of ſal-ammoniac, diſſolved in a pint of water, made his thermometer deſcend 2 inches and $\frac{3}{4}$ in leſs than 15 minutes. An ounce of the ſame ſalt, put into 4 or 5 ounces of diſtilled water, made the thermometer deſcend 2 inches and $\frac{1}{4}$. Half an ounce of ſal-ammoniac, mixed with 3 ounces of ſpirit of nitre, made the thermometer deſcend 2 inches and $\frac{5}{12}$; but, on uſing acid of vitriol inſtead of nitre, it ſunk 2 inches and $\frac{1}{2}$. In this laſt experiment it was remarked, that the vapours raiſed from the mixture had a conſiderable degree of heat, though the liquid itſelf was ſo extremely cold. Four ounces of ſaltpetre, mixed with a pint of water, ſunk the thermometer an inch and $\frac{1}{4}$; but a like quantity of ſea ſalt ſunk it only $\frac{1}{6}$ of an inch. Acids always produced heat, even common ſalt with its own ſpirit. Volatile alkaline ſalts produced cold in proportion to their purity, but fixed alkalis heat.

But the greateſt degree of cold produced by the mixture of ſalts and aqueous fluids was that ſhewn by Homberg; who gives the following receipt for making the experiment: Take a pound of corroſive ſublimate, and as much ſal ammoniac; powder them ſeparately, and mix the powders well; put the mixture into a vial, pouring upon it a pint and a half of diſtilled vinegar, ſhaking all well together. This compoſition grows ſo cold, that it can ſcarce be held in the hand in ſummer; and it happened, as M. Homberg was making the ex-

periment, that the matter froze. The ſame thing once happened to M. Geoffroy, in making an experiment with ſal-ammoniac and water; but it never was in his power to make it ſucceed a ſecond time.

If, inſtead of making theſe experiments with fluid water, it be taken in its congealed ſtate of ice, or rather ſnow, degrees of cold will be produced greatly ſuperior to any that have yet been mentioned. A mixture of ſnow and common ſalt ſunk Fahrenheit's thermometer to o; pot aſhes and pounded ice ſunk it 8 degrees farther; two affuſions of ſpirit of ſalt on pounded ice ſunk it $14\frac{1}{2}$ below o; and, by repeated affuſions of ſpirit of nitre, M. Fahrenheit ſunk it to 40° below o. This is the ultimate degree of cold which the mercurial thermometer will meaſure; for the mercury itſelf begins then to congeal; and therefore recourſe muſt afterwards be had to ſpirit of wine, naphtha, or ſome other fluid that will not congeal. The greateſt degree of cold hitherto produced by artificial means has been 80° below o; which was done at Hudſon's Bay by means of ſnow and vitriolic acid, the thermometer ſtanding naturally at 20° below o. Indeed greater degrees of cold than this have been ſuppoſed: Mr. Martin, in his Treatiſe on Heat, relates, that at Kirenga in Siberia, the mercurial thermometer ſunk to 118° below o; and profeſſor Brown at Peterſburg, when he made the firſt experiment of congealing quickſilver, fixed the point of congelation at 350° below o; but from later experiments it has been more accurately determined, that 40° below o is the freezing point of quickſilver.

The moſt remarkable experiment, however, was made by Mr. Walker of Oxford, with ſpirit of nitre poured on Glauber's ſalt, the effect of which was found to be ſimilar to that of the ſame ſpirit poured on ice or ſnow; and the addition of ſal-ammoniac rendered the cold ſtill more intenſe. The proportions of theſe ingredients recommended by Mr. Walker are, concentrated nitrous acid two parts by weight, water one part; of this mixture, cooled to the temperature of the atmoſphere, 18 ounces; of Glauber's ſalt, a pound and a half avoirdupois; and of ſal-ammoniac, 12 ounces. On adding the Glauber's ſalt to the nitrous acid, the thermometer fell 52°, viz. from 50 to −2; and on the addition of the ſal-ammoniac, it fell to −9°. Thus Mr. Walker was able to freeze quickſilver without either ice or ſnow, when the thermometer ſtood at 45°; viz. by putting the ingredients in 4 different pans, and incloſing theſe within each other.

Exceſſive degrees of cold occur naturally in many parts of the globe in the winter ſeaſon.

Although the thermometer in this country hardly ever deſcends ſo low as o, yet, in the winter of 1780, Mr. Wilſon of Glaſgow obſerved, that a thermometer laid on the ſnow ſunk to 25° below o; and Mr. Derham, in the year 1708, obſerved in England, that the mercury ſtood within one-tenth of an inch of its ſtation when plunged into a mixture of ſnow and ſalt. At Peterſburg, in 1732, the thermometer ſtood at 28° below o; and when the French academicians wintered near the polar circle, the thermometer ſunk to 33° below o; and in the Aſiatic and American continents, ſtill greater degrees of cold are often obſerved.

The effects of theſe extreme degrees of cold are very ſurpriſing. Trees are burſt, rocks rent, and rivers and lakes frozen ſeveral feet deep: metallic ſubſtances bliſter the ſkin like redhot iron: the air, when drawn in by breathing, hurts the lungs, and excites a cough: even the effects of fire in a great meaſure ſeem to ceaſe; and it is obſerved, that, though metals are kept for a conſiderable time before a ſtrong fire, they will ſtill freeze water when thrown upon them. When the French mathematicians wintered at Tornea in Lapland, the external air, when ſuddenly admitted into their rooms, converted the moiſture of the air into whirls of ſnow; their breaſts ſeemed to be rent when they breathed it, and the contact of it was intolerable to their bodies; and the ſpirit of wine, which had not been highly rectified, burſt ſome of their thermometers by the congelation of the aqueous part.

Extreme cold too, often proves fatal to animals in thoſe countries where the winters are very ſevere; thus 7000 Swedes periſhed at once in attempting to paſs the mountains which divide Norway from Sweden. But it is not neceſſary that the cold, in order to prove fatal to human life, ſhould be ſo very intenſe as has juſt been mentioned; it is only requiſite to be a little below 32° of Fahrenheit, or the freezing point, accompanied with ſnow or hail, from which ſhelter cannot be obtained. The ſnow which falls upon the clothes, or the uncovered parts of the body, then melts, and by a continual evaporation carries off the animal heat to ſuch a degree, that a ſufficient quantity is not left for the ſupport of life. In ſuch caſes, the perſon firſt feels himſelf extremely chill and uneaſy; he turns liſtleſs, unwilling to walk or uſe exerciſe to keep himſelf warm, and at laſt turns drowſy, ſits down to refreſh himſelf with ſleep, but wakes no more.

With regard to the term CONGELATION, it is applied to water when it freezes into ice; to metals, when they reſume their ſolid form after being melted by heat; or to glaſs, wax, pitch, tallow, &c. when they harden again after having been rendered fluid by heat. But it differs from cryſtallization, which is rather a ſeparation of the particles of a ſolid from a fluid in which it had been diſſolved more by the moiſture than the action of heat.

The proceſs of congelation is always attended with the emiſſion of heat, as is found by experiments on the freezing of water, wax, ſpermaceti, &c.; for in ſuch caſes it is always found, that a thermometer dipt into the fluid maſs keeps continually deſcending as this cools, till it arrives at a certain point, being the point of freezing, which is peculiar to each fluid, where it is rather ſtationary, and then riſes for a little, while the congelation goes on. But by what means it is that fluid bodies ſhould thus be rendered ſolid by cold, or fluid by heat, or what is introduced into the bodies by either of thoſe principles, are matters the learned have never yet been able to diſcover, or to ſatisfy themſelves upon. The following phenomena, however, are uſually taken notice of.

Water and ſome other fluids ſuddenly dilate and expand in the act of freezing, ſo as to occupy a greater ſpace in the form of ice than before, in conſequence of which it is that ice is ſpecifically lighter than the ſame fluid, and floats in it. And the degree of expanſion of water, in the ſtate of ice, is by ſome authors computed at about $\frac{1}{10}$ of its volume. Oil, however, is an exception to this property, and quickſilver too, which ſhrinks and contracts ſtill more after freezing. Mr. Boyle relates ſeveral experiments of veſſels made of metal, very thick and ſtrong; in which, when filled with water, cloſe ſtopped, and expoſed to the cold, the water being expanded in freezing, and not finding either room or vent, burſt the veſſels. A ſtrong barrel of a gun, with water in it cloſe ſtopped and frozen, was rent the whole length. Huygens, to try the force with which it expands, filled a cannon with it, whoſe ſides were an inch thick, and then cloſed up the mouth and vent, ſo that none could eſcape; the whole being expoſed to a ſtrong freezing air, the water froze in about 12 hours, and burſt the piece in two places. Mathematicians have computed the force of the ice upon this occaſion; and they ſay, that ſuch a force would raiſe a weight of 27720 pounds. We have ſaid, Major Edw. Williams, of the Royal Artillery, made many experiments on the force of it, at Quebec, in the years 1784 and 1785. He filled all ſizes of iron bomb-ſhells with water, then plugged the fuze hole cloſe up, and expoſed them to the ſtrong freezing air of the winter in that climate; ſometimes driving in the iron plugs as hard as

poffible with a fledge hammer; and yet they were always thrown out by the fudden expanfion of the water in the act of freezing, like a ball fhot by gunpowder, fometimes to the diftance of between 400 and 500 feet, though they weighed near 3 pounds; and when the plugs were fcrewed in, or furnifhed with hooks or barbs, to lay hold of the infide of the fhell by, fo that they could not poffibly be forced out, in this cafe the fhell was always fplit in two, though the thicknefs of the metal of the fhell was about an inch and three quarters. It is farther remarkable, that through the circular crack, round about the fhells, where they burft, there ftood out a thin film or fheet of ice, like a fin; and in the cafes when the plugs were projected by freezing water, there fuddenly iffued out from the fuze-hole a bolt of ice of the fame diameter, and ftood over it to the height fometimes of 8 inches and a half. And hence we need not be furprifed at the effects of ice in deftroying the fubftance of vegetables and trees, and even fplitting rocks, when the froft is carried to excefs.

It is alfo obferved that water lofes of its weight by freezing, being found lighter after thawing again, than before it was frozen. And indeed it evaporates almoft as faft when frozen, as when it is fluid.

It is faid too that water does not freeze in vacuo; requiring for that purpofe the prefence and contiguity of the air. But this circumftance is liable to fome doubt, and it may be fufpected that the degree of cold has not been carried far enough in thefe inftances; as it has been noticed that mercury in thermometers has even been frozen, though it requires a vaftly greater degree of cold to freeze mercury than water.

That water which has been boiled freezes more readily than that which has not been boiled; and that a flight difturbance of the fluid difpofes it to freeze more fpeedily; having fometimes been cooled feveral degrees below the freezing point, without congealing when kept quite ftill, but fuddenly freezing into ice on the leaft motion or difturbance.

That the water, being covered over with a furface of oil of olives, does not freeze fo readily as without it; and that nut oil abfolutely preferves it under a ftrong froft, when olive oil would not.

That rectified fpirit of wine, nut oil, and oil of turpentine, feldom freeze.

That the furface of the water, in freezing, appears all wrinkled; the wrinkles being fometimes in parallel lines, and fometimes like rays, proceeding from a centre to the circumference.

FREEZING *Mixture*, a preparation for the artificial congelation of water, and other fluids.

According to Mr. Boyle, all kinds of falts, whether alkaline or acid, and even all fpirits, as fpirit of wine, &c. as alfo fugar and faccharum faturni, mixed with fnow, are capable of freezing moft fluids; and the fame effect is produced, in a very high degree, by a mixture of the vitriolic or nitrous acids with fnow.

M. Homberg remarks the fame of equal quantities of corrofive fublimate, and fal ammoniac, with four times the quantity of diftilled vinegar.

Boerhaave gives a method of producing artificial froft without either fnow or ice: we muft have for this purpofe, at any feafon of the year, the coldeft water that can be procured; this is to be mixed with a proper quantity of any falt (fal-ammoniac will anfwer the intention beft), at the rate of about 3 ounces to a quart of water. Another quart of water muft be prepared in the fame manner with the firft; the falt, by being diffolved in each, will make the water much colder than it was before. The two quarts are then to be mixed together, and this will make them colder ftill. Two quarts more of water prepared and mixed in the fame manner are to be mixed with thefe, which will increafe the cold to a much higher degree in all. The whole of this operation is to be carried on in a cold cellar; and a glafs of common water is then to be placed in the veffel of the fluid thus artificially cooled, and it will be turned into ice in the fpace of 12 hours.

There is alfo a method of making artificial ice by means of fnow, without any kind of falt. For this purpofe fill a fmall pewter difh with water, and upon that fet a common pewter plate filled, but not heaped, with fnow. Bring this fimple apparatus near the fire, and ftir the fnow in the plate: the fnow will diffolve, and the ice will be formed on the back of the plate, which was fet in the difh of water.

M. Reaumur tried the effect of feveral falts, and examined the various degrees of cold by an ice thermometer, which being placed in the fluid to be frozen, fhowed very exactly the degree of cold by the defcent of the fpirit.

Nitre, or faltpetre, ufually paffes for a falt that may be very ferviceable in thefe artificial congelations; but the experiments of this gentleman prove that this opinion is erroneous. The moft perfectly refined faltpetre employed in the operation funk the fpirit in the thermometer only three degrees and a half below the fixed point. Lefs refined nitre funk the thermometer lower, and gave a greater degree of cold; owing to the common or fea-falt that it contains when lefs pure, which has a greater effect than the pure faltpetre itfelf.

Two parts of common falt being mixed with three parts of powdered ice in very hot weather, the fpirit in the thermometer immediately defcended 15 degrees, which is half a degree lower than it would have defcended in the fevereft cold of our winters. Mr. Reaumur then tried the falts all round, determining with great regularity and exactnefs, what was the degree of cold occafioned by each in a given dofe. Among the neutral falts, none produced a greater degree of cold than the common fea falt. Among the alkalis, fal ammoniac funk the thermometer only to 13 degrees. Pot-afhes funk it juft as low as well refined faltpetre.

For the common ufes of the table, the ice is not required to be very hard, or fuch as is produced by long continuance of violent cold: it is rather defired to be like fnow. Saltpetre, which is no very powerful freezer, is therefore more fit for the purpofe than a more potent falt. It is not neceffary that the congelation fhould be very fuddenly made; but that it may retain its form as long as may be, when made, is of great importance.

If it be defired to have ices very hard and firm, and very fuddenly prepared, then fea falt is of all others moft to be chofen for the operation. The ices thus made will be very hard, but they will foon run. Pot afhes afford an ice of about the hardnefs that is ufually required. This forms indeed very flowly, but then it will preferve a long time. And common wood-afhes will perform the bufinefs very nearly in the fame manner as the pot-afhes; but, for this purpofe, the wood which is burnt ought to be frefh.

The ftrong acid fpirits of the neutral falts act much more powerfully in thefe congelations than the falts themfelves, or indeed than any fimple falt can do. Thus fpirit of nitre, mixed with twice its quantity of powdered ice, immediately finks the fpirit in the thermometer to 19 degrees, or 4 degrees more than that obtained by means of fea-falt, the moft powerful of all the falts in making artificial cold. A much greater degree of cold may be given to this mixture, by piling it round with more ice mixed with fea-falt. This gives a redoubled cold, and finks the thermometer to 24 degrees. If this whole matter be covered with a frefh mixture of fpirit of nitre and ice, a ftill greater degree of cold is produced, and fo on; the cold being by this method of frefh additions to be increafed almoft without bounds;

but it is to be obferved, that every addition gives a fmaller increafe than the former.

It is very remarkable in the acid fpirits, that though fea-falt is fo much more powerful than nitre in fubftance in producing cold, yet the fpirit of nitre is much ftronger than that of fea-falt; and another not lefs wonderful phenomenon is, that fpirit of wine, which is little elfe than liquid fire, has as powerful an effect in congelations, or very nearly fo, as the fpirit of nitre itfelf.

The feveral liquid fubftances which produce cold, in the fame manner as the dry falts on being mixed with ice, are much more fpeedy in their action than the falts: becaufe they immediately and much more intimately come into contact with the particles of the ice, than the falts can. Of this nature are fpirit of nitre, fpirit of wine, &c. To produce the expected degree of cold, it is always neceffary that the ice and the added matter, whatever it be, fhould both run together, and, intimately uniting, form one clear fluid. It is hence that no new cold is produced with oil, which, though it melts the ice, yet cannot mix itfelf into a homogeneous liquid with it, but muft always remain floating on the furface of the water that is produced by the melting of the ice.

It has been difcovered, that fluids ftanding in a current of air grow by this means much colder than before. Fahrenheit had long fince obferved, that a pond, which ftands quite calm, often acquires a degree of cold much beyond what is fufficient for freezing, and yet no congelation enfued: but if a flight breath of air happens in fuch a cafe to brufh over the furface of the water, it ftiffens the whole in an inftant. It has alfo been difcovered, that all fubftances grow colder by the evaporation of the fluids which they contain, or with which they are mixed. If both thefe methods, therefore, be practifed upon the fame body at the fame time, they will increafe the cold to almoft any degree of intenfenefs we pleafe.

But the moft extraordinary inftances of artificial freezing have fince been made in Ruffia, at Hudfon's bay, and other parts, by which quickfilver was frozen into a folid mafs of metal. And the fame thing had before happened, from the natural cold of the atmofphere alone, in Siberia. In the winter of 1733, Profeffor Gmelin, with two other gentlemen of the Ruffian Academy, were fent by Anne Ivanouna, the new emprefs, to explore and defcribe the different parts of her Afiatic dominions, with the communication of Afia and America. In the winter of 1734-5, Mr. Gmelin being at Yenefeifk in 58° 30' north lat. and 92° long. eaft from Greenwich, firft obferved fuch a defcent of the mercury, as muft have been attended with congelation, being far below its freezing point, now fixed at —40 of Fahrenheit's thermometer. "Here," fays he, "we firft experienced the truth of what various travellers have related with refpect to the extreme cold of Siberia; for, about the middle of December, fuch fevere weather fet in, as we were fure had never been known in our time at Peterfburg. The air feemed as if it were frozen, with the appearance of a fog, which did not fuffer the fmoke to afcend as it iffued from the chimneys. Birds fell down out of the air as dead, and froze immediately, unlefs they were brought into a warm room. Whenever the door was opened, a fog fuddenly formed round it. During the day, fhort as it was, parhelia and haloes round the fun were frequently feen; and in the night mock moons, and haloes about the moon. Finally, our thermometer, not fubject to the fame deception as the fenfes, left us no doubt of the exceffive cold; for the quickfilver in it was reduced, on the 5th of January, old ftyle, to — 120° of Fahrenheit's fcale, lower than it had ever been obferved in nature."

The next inftance of congelation happened at Yakutfk, in 62° north lat. and 150° eaft longitude. The weather here was unufually mild for the climate, yet the thermometer fell to — 72°; and one perfon informed the profeffor by a note, that the mercury in his barometer was frozen. He haftened immediately to his houfe to behold fuch a furprifing phenomenon; but though he was witnefs to the fact, obferving that the mercury did not continue in one column, but was divided in different places as into little cylinders, which appeared frozen, yet the prejudice he had entertained againft the poffibility of the congelation would not allow him to believe it.

Another fet of obfervations, in the courfe of which the mercury muft frequently have been congealed, were made by Profeffor Gmelin at Kirenga fort, in $57\frac{1}{2}$ north lat, and 108 eaft long.; his thermometer, at different times, ftanding at —108, —86, —100, —113, and many other intermediate degrees; in the courfe of the winter of 1737-8. On the 27th of November, after the thermometer had been ftanding for two days at —46°, he found it funk at noon to —108. Sufpecting fome miftake, after he had noted down the obfervation, he inftantly ran back, and found at it —102; but afcending with fuch rapidity, that in the fpace of half an hour it had rifen to —19°. This phenomenon, which appeared fo furprifing, doubtlefs depended on the expanfion of the mercury frozen in the bulb of the thermometer, and which now melting, forced upwards the fmall-thread in the ftem. And fimilar appearances were obferved on other days afterwards, when the thread of quickfilver in the thermometer was feparated about 6 degrees.

A fecond inftance where a natural congelation of mercury has certainly been obferved, is recorded in the tranfactions of the Royal Academy of Sciences at Stockholm, as made by Mr. Andrew Hellant. The weather in January 1760 was remarkably cold in Lapland; fo that on the 5th of that month the thermometers fell to —76, —128, or lower; on the 23d and following days they fell to —58, —79, —92, and below —238 entirely into the ball. This was obferved at four different places in Lapland, fituated between the 65th and 78th degrees of north lat. and the 21ft and 28th degrees of eaft longitude.

But the congelation of quickfilver, by an artificial freezing mixture, was firft obferved, and put beyond doubt, by Mr. Jofeph Adam Braun, profeffor of philofophy at Peterfburg. This gentleman, wifhing to try how many degrees of cold he could produce, availed himfelf of a good opportunity which offered for that purpofe on the 14th of December 1759, when the mercury in the thermometer ftood in the natural cold at —34, which, it is now known, is only 5 or 6 degrees above its point of congelation. Affifting this natural cold, therefore, with a mixture prepared of aquafortis and pounded ice, his thermometer was funk to —69. Part of the quickfilver muft now have been really congealed, but unexpected by him, and he only thought of purfuing his object of producing ftill greater degrees of cold; and having expended all his pounded ice, he was obliged to ufe fnow inftead of it. With this frefh mixture, the mercury funk to —100, —240, and —350°. Taking the thermometer out, he found it whole, but the quickfilver fixed, and it continued fo for 12 minutes. On repeating the experiment, with another thermometer which had been graduated no lower than —220, all the mercury funk into the ball, and became folid as before, and did not re-afcend till after a ftill longer interval of time. Mr. Braun now fufpected that the quickfilver was really frozen, and prepared for making a decifive experiment. This was accomplifhed on the 25th of the fame month, and the bulb of the thermometer broken as foon as the metal was congealed: when it appeared that the mercury was changed into a folid and fhining metallic mafs, which flatted and extended under the ftrokes of a peftle, being rather lefs hard than lead, and yielding a dull found like that metal. Mr. Æpinus made fimilar experiments at the fame time, employing as well thermometers, as tubes of

a larger bore; in which last he remarked, that the quicksilver fell sensibly on being frozen, assuming a concave surface, and likewise that the congealed pieces sunk in fluid mercury: also, in their farther experiments, they invariably found, that the mercury sunk lower when the whole of it was congealed, than if any part of it remained fluid: all shewing that, contrary to water, mercury contracted in freezing. It was farther observed, that the mercury when congealed, looked like the most polished silver, and when beaten flat, was easily cut with a penknife, like thin sheet lead.

The fact being thus established, and fluidity no longer to be considered as an essential property of quicksilver, Mr. Braun communicated an account of his experiments to the Petersburgh academy, on the 6th of September 1760; of which a large extract was inserted in the Philos. Trans. vol. 52, page 156. He afterwards declared that he never suffered a winter to pass without repeating the experiment of freezing quicksilver, and never failed of success when the natural cold was of a sufficient strength for the purpose; and this degree of natural cold he supposes at —10 of Fahrenheit; though some commencement of the congelation might be perceived, when the temperature of the air was as high as + 2°.

The results of all his experiments were, that, with the above-mentioned frigorific mixtures, and once with rectified spirits and snow, when the natural cold was at —28°, he congealed the quicksilver, and discovered it, in fact, a real metal that melts with a very small degree of heat. However, not perceiving the necessary consequence of its great contraction in freezing, he always confounded its point of congelation with that of its greatest contraction in freezing, and thus marked the former a great deal too low.

In the process of his observations, Mr. Braun found, that double aquafortis was more effectual than spirit of nitre; but with this simple spirit, which seldom brings the mercury lower than —148, this metal may be frozen in the following manner: Six glasses being filled with snow as usual, and the thermometer put in one of them, the spirit of nitre was poured upon it; when the mercury would fall no lower in this, the thermometer was removed to the second, and so on to the third and fourth, in which fourth immersion the mercury was usually congealed.

Mr. Æpinus gives the following direction for using the fuming spirit of nitre: Take some of this spirit, cooled as much as possible, and put it into a wine glass till it be about half full, filling it up with snow, and stirring them till the mixture become of the consistence of pap; by which means you obtain, almost in an instant, the necessary degree of cold for the freezing of quicksilver.

It is remarked by Mr. Braun, that by the mixture of snow and spirit of nitre, which froze the mercury, he never was able to bring thermometers, filled with the most highly rectified spirit of wine, lower than —148: so that the cold which will freeze mercury, will not freeze spirit of wine; and therefore spirit thermometers are the most fit to determine the degree of coldness in frigorific mixtures, till we can construct solid metallic thermometers with sufficient accuracy. Mr. Braun tried the effects of different fluids in his frigorific mixtures: he always found that Glauber's spirit of nitre and double aquafortis were the most powerful; and, from a number of experiments made when the temperature of the air was between 21 and 28 of Fahrenheit, he concludes, that spirit of salt pounded upon snow increased the natural cold 36°; spirit of sal ammoniac, 12; oil of vitriol, 42; Glauber's spirit of nitre, 70; aquafortis, 48; simple spirit of nitre, 36: dulcified spirit of vitriol, 24; Hoffman's anodyne liquor, 38; spirit of hartshorn, 12; spirit of sulphur, 12; spirit of wine rectified, 24; camphorated spirit, 18; French brandy, 14; and several kinds of wine increased the natural cold to 7, 8, or 9 degrees.

The most remarkable congelation of mercury, by natural cold, that has ever been observed, was that related by Dr. Peter Simon Pallas, who had been sent by the empress of Russia, with some other gentlemen, on an expedition similar to that of Mr. Gmelin. Being at Krasnoyarsk in the year 1772, in north lat. 56° 30′, and east long. 93°, he had an opportunity of observing the phenomenon we speak of. On the 6th and 7th of December that year, says he, there happened the greatest cold I have ever experienced in Siberia: the air was calm at the time, and seemingly thickened; so that, though the sky was in other respects clear, the sun appeared as through a fog. I had only one thermometer left, in which the scale went no lower than —7°; and on the 6th in the morning, I remarked that the quicksilver in it sunk into the ball, except some short columns which stuck fast in the tube. When the ball of the thermometer, as it hung in the open air, was touched with the finger, the quicksilver rose; and it could plainly be seen that the solid columns stuck and resisted a good while, and were at length pushed upward with a sort of violence. He also placed upon the gallery, on the north side of his house, some quicksilver in an open bowl. Within an hour he found the edges and surface of it frozen solid; and some minutes afterward the whole was condensed by the natural cold into a soft mass very much like tin. While the inner part was still fluid, the frozen surface exhibited a great variety of branched wrinkles; but in general it remained pretty smooth in freezing. The congealed mercury was more flexible than lead: but, on being bent short, it was found more brittle than tin; and when hammered out thin, it seemed somewhat granulated. When the hammer was not perfectly cooled, the quicksilver melted away under it in drops; and the same thing happened when the metal was touched with the finger, by which also the finger was immediately benumbed. When the frozen mass was broken to pieces in the cold, the fragments adhered to each other and to the bowl in which they lay. In the warm room it thawed on its surface gradually, by drops, like wax on the fire, and did not melt all at once. Although the frost seemed to abate a little towards night, yet the congealed quicksilver remained unaltered, and the experiment with the thermometer could still be repeated. On the 7th of December he had an opportunity of making the same observations all day; but, some hours after sunset, a northwest wind sprung up, which raised the thermometer to —46°, when the mass of quicksilver began to melt.

The experiments of Mr. Braun were successfully repeated at Gottingen, in 1774, by Mr. John Frederick Blumenbach; being encouraged to this attempt by the excessive cold of the winter that year, especially the night of January the 11th, when he made the experiment, the thermometer standing at —10 in the open air. Mr. Blumenbach, at 5 in the evening, put 3 drams of quicksilver into a small sugar glass, and covered it with a mixture of snow and Egyptian sal ammoniac, setting the glass out in the air upon a mixture also of sal ammoniac. At one the next morning, the mercury was found frozen quite solid, and hard to the glass; and did not melt again till 7 or 8 the next morning. The colour of the frozen mercury was a dull pale white with a bluish cast, like zinc, very different from the natural appearance of quicksilver.

In the year 1775, by similar means, quicksilver was twice frozen by Mr. Hutchins, governor of Albany fort, in Hudson's bay, viz. in the months of January and February of that year. And the same was done on the 28th of January 1776, by Dr. Lambert Bicker, secretary of Rotterdam. The temperature of the atmosphere was then at + 2°; and the lowest it could reduce the thermometer by artificial cold was —94; when, on breaking the glass, the mercury was found frozen.

In the beginning of the year 1780 Mr. Von Elterlein of Vytegra, a town of Russia, in lat. 61° north, and long. 36° east,

froze quickſilver by natural cold. On the 4th of January 1780, the cold being increaſed to —34 that evening at Vytegra, he expoſed to the open air 3 ounces of very pure quickſilver in a china tea-cup, covered with paper pierced full of holes. Next day, at 8 in the morning, he found it ſolid, and looking like a piece of caſt lead, with a conſiderable depreſſion in the middle. On attempting to looſen it in the cup, his knife raiſed ſhavings from it as if it had been lead, which remained ſticking up; and at length the metal ſeparated from the bottom of the cup in one maſs. He then took it in his hand to try if it would bend: it was ſtiff like glue, and broke into two pieces; but his fingers immediately loſt all feeling, and could ſcarcely be reſtored in an hour and a half by rubbing with ſnow. At 8 o'clock the thermometer ſtood at —57; but by half after 9 it was riſen to —40; and then the two pieces of mercury which lay in the cup had loſt ſo much of their hardneſs, that they could no longer be broken, or cut into ſhavings, but reſembled a thick amalgam, which, though it became fluid when preſſed by the fingers, immediately afterwards reſumed the conſiſtence of pap. With the thermometer at —39, the quickſilver became fluid. The cold was never leſs on the 5th than —28, and by 9 in the evening it had increaſed again to —33. This experiment ſeems to fix the freezing point of mercury at —40 of Fahrenheit's thermometer, or 40 below 0; which is 72° below the freezing point of water.

In the winter of 1781 and 82, Mr. Hutchins reſumed the ſubject of freezing quickſilver by artificial cold, with ſuch ſucceſs, that from his experiments and thoſe of M. Von Elterlein, laſt mentioned, the freezing point of mercury is now almoſt as well ſettled, viz. at —40, as that of water is at +32. Other philoſophers, indeed, had not been altogether inattentive to this ſubject. Profeſſor Braun himſelf had taken great pains to inveſtigate it; but for want of a proper attention to the difference between the contraction of the fluid mercury by cold, and that of the congealing metal by freezing, he could not determine any thing certain concerning it.

An inſtance of the natural congelation of quickſilver alſo occurred in Jemptland, one of the provinces of Sweden, on the 1ſt of January 1782; and laſtly, on the 26th of the ſame month, Mr. Hutchins obſerved the ſame effect of the cold at Hudſon's bay; when he found that at the point of its freezing a mercurial thermometer ſtood at —40, and a ſpirit thermometer at —30. On this ſubject, a variety of curious facts may be traced in the Philoſ. Tranſ. vol. 51, pa. 672; vol. 52, pa. 156; vol. 66, pa. 174; vol. 73, pa. 303 and 325; vol. 76, pa. 241; vol. 77, pa. 285; vol. 78, pa. 43; and ſeveral others, particularly vol. 79, pa. 199, &c.; being experiments on the congelation of quickſilver in England, by Mr. Richard Walker, where he proves that mercury may be frozen not only in England in ſummer, but even in the hotteſt climate, at any ſeaſon of the year, and without the uſe of ice or ſnow.

Freezing *Point*, denotes the point or degree of cold, ſhewn by a mercurial thermometer, at which certain fluids begin to freeze, or, when frozen, at which they begin to thaw again. On Fahrenheit's thermometer, this point is at + 32 for water, and at —40 for quickſilver, theſe fluids freezing at thoſe two points reſpectively. It would alſo be well if the freezing points for other fluids were aſcertained, and the whole arranged in a table.

Freezing *Rain*, or *Raining Ice*, a very uncommon kind of ſhower, which fell in the weſt of England in December 1672; whereof we have various accounts in the Philoſophical Tranſactions. This rain, as ſoon as it touched any thing above ground, as a bough or the like, immediately ſettled into ice; and, by multiplying and enlarging the icicles, broke all down with its weight. The rain that fell on the ſnow immediately froze into ice, without ſinking in the ſnow at all. It made an incredible deſtruction of trees, beyond any thing in all hiſtory. "Had it concluded with ſome guſt of wind (ſays a gentleman on the ſpot), it might have been of terrible conſequence. I weighed the ſprig of an aſh tree, of juſt three-quarters of a pound, the ice on which weighed 16 pounds. Some were frighted with the noiſe in the air; till they diſcerned it was the clatter of icy boughs, daſhed againſt each other." Dr. Beale obſerves, that there was no conſiderable froſt obſerved on the ground during the whole; whence he concludes, that a froſt may be very intenſe and dangerous on the tops of ſome hills and plains; while in other places it keeps at two, three, or four feet diſtance above the ground, rivers, lakes, &c. and may wander about very furious in ſome places, and remiſs in others not far off. The froſt was followed by glowing heats, and a wonderful forwardneſs of flowers and fruits.

FREIGHT, in navigation and commerce, the hire of a ſhip, or a part thereof, for the conveyance and carriage of goods from one port or place to another; or the ſum agreed on between the owner and the merchant, for the hire and uſe of a veſſel. See *Maritime* Laws.

FREIND (John), a moſt learned Engliſh phyſician and writer in the 18th century, was born at Croton, Northamptonſhire, in 1675. In 1696 he publiſhed, in conjunction with Mr. P. Foulkes, an edition of two Greek orations, one of Æſchines againſt Cteſiphon, and the other of Demoſthenes *De Corona*, with a new Latin verſion. In 1699 he wrote a letter to Dr. Sloane concerning an *Hydrocephalus*, publiſhed in the Philoſophical Tranſactions; and another letter in Latin to the ſame gentleman, *De ſpaſmis rarior. hiſtoria*, printed in the ſame Tranſactions. In 1703 his *Emmenalogia* appeared, which gained him great reputation. In 1704 he was choſen profeſſor of chemiſtry in the univerſity of Oxford. In 1705 he attended the earl of Peterborough to Spain, as phyſician to the army there; and, upon his return in 1707, publiſhed an account of the earl's expedition and conduct. In 1709 he publiſhed his Chemical Lectures. In 1712 he attended the duke of Ormond in Flanders, as his phyſician. In 1716 he was admitted a fellow of the college of phyſicians in London. This year he publiſhed the firſt and third books of Hippocrates *De morbis popularibus*, with a Commentary on Fevers, written by himſelf. He ſat a member for the borough of Launceſton in Cornwall in 1722, where he diſtinguiſhed himſelf by his oppoſition to the adminiſtration. March 1722 he was committed to the tower on a charge of high-treaſon: and, while he was under confinement, he wrote a Latin epiſtle to Dr. Mead, *De quibuſdam variolarum generibus*; and began his Hiſtory of Phyſic, the firſt part of which was publiſhed in 1725, and the ſecond in 1726. Upon the acceſſion of George II. to the throne, he was appointed phyſician in ordinary to the queen, who ſhowed the utmoſt regard and eſteem for him. He died at London in 1728. His works were publiſhed together in Latin, at London 1733, in folio, and dedicated to the queen.

FREINSHEMIUS, a learned and elegant author, born at Ulm in 1608. He made Supplements to Livy, Tacitus, and Q. Curtius, in 60 books, printed at Straſburg in 1654. He wrote likewiſe Notes upon Q. Curtius, Florus, Tacitus, and ſome other Latin authors, and died in 1660.

FREITS. See Freats.

FRENCH, in general, ſomething belonging to France: thus we ſay, the French language, French cuſtoms, polity, &c. The French language, as it now ſtands, is no original or mother language, but a medley of ſeveral. Thoſe that prevail moſt, and which are, as it were, the baſis thereof, are, 1. The Celtic; whether that were a particular language itſelf, or whether it were only a dialect of the Gothic, as ſpoken in the weſt and north. 2. The Latin, which the Romans carried with them into Gaul, when they made the conqueſt thereof. And, 3. The Teutonic, or that dialect of the Teutonic uſed by the Franks, when they paſſed the Rhine, and eſtabliſhed themſelves in Gaul.

Of these three languages, in the ſpace of about thirteen hundred years, was the preſent French formed, ſuch as it is now found. Its progreſs was very ſlow; and both the Italian and Spaniſh were regular languages long before the French.

Paſquier obſerves, it was under Philip de Valois that the French tongue firſt began to be poliſhed: and that, in the regiſter of the chamber of accounts of that time, there is a purity ſeen almoſt equal to that of the preſent age. However, the French was ſtill a very imperfect language till the reign of Francis I. The cuſtom of ſpeaking Latin at the bar, and of writing the public acts and inſtruments of the courts of juſtice in that language, had made them overlook the French, their own language. Add, that the preceding ages had been remarkable for their ignorance, which was owing, in good meaſure, to the long and calamitous wars which France had been engaged in: whence the French nobleſſe deemed it a kind of merit not to know any thing; and the generals regarded little whether or no they wrote and talked politely, provided they could but fight valiantly.

But Francis I. who was the reſtorer of learning and the father of the learned, changed the face of things; and, after his time, Henry Stevens printed his book, *De la Precellence du Langage François*. The change was become very conſpicuous at the end of the 16th century; and under Henry IV. Amyot, Coeffeteau, and Malherbe, contributed towards bringing it to its perfection; which the Cardinal de Richelieu completed, by the eſtabliſhment of the French academy; an aſſembly, wherein the moſt diſtinguiſhed perſons of the church, the ſword, and the gown, have been members. Nor did the long reign of Louis XIV. contribute a little to the improvement of the language: the perſonal qualities of that prince, and his taſte for the fine arts, and that of the princes of the blood, rendered his court the politeſt in Europe. Wit and magnificence ſeemed to vie; and his generals might have diſputed with the Greeks, Romans, &c. the glory of writing well, if they could not that of fighting. From the court, the elegance and purity of the language ſoon ſpread itſelf into the provinces; and now there is ſcarce any perſon there who does not write and ſpeak good French.

One of the characters of the French language is, to be natural and eaſy. The words are ranged in it much in the ſame order as the ideas in our minds; in which it differs exceedingly from the Greek and Latin, where the inverſion of the natural order of words is reputed a beauty. Indeed the Hebrew ſurpaſſes even the French in this point; but then it comes ſhort of it in copiouſneſs and variety.

It muſt be added, however, that as to the analogy of grammar, and the ſimplicity wherewith the moods of verbs are formed, the Engliſh has the advantage not only over the French, but over all the known languages in the world; but then the turns, the expreſſions, and the idioms, of the Engliſh, are ſometimes ſo quaint and extraordinary, that it loſes a good deal of the advantage which its grammatical ſimplicity gives it over the reſt.

The French has but few compound words; wherein it differs widely from the Greek, High Dutch, and Engliſh. This the French authors own a great diſadvantage in their language; the Greek and Dutch deriving a great part of their force and energy from the compoſition of words, and frequently expreſſing that in one ſounding word, which the French cannot expreſs but by a periphraſis. The diminutives in the French are as few as the compounds, the greateſt part of thoſe remaining in uſe having loſt their diminutive ſignification; but what moſt diſtinguiſh the French language, are its juſtneſs, purity, accuracy, and flexibility.

French is the moſt univerſal and extenſive language in Europe. The policy of ſtates and courts has rendered it neceſſary for the miniſters of princes, and their officers, &c. and the taſte for arts and ſciences has had the ſame effect with regard to the learned. In Germany, and elſewhere, the princeſſes and perſons of diſtinction value themſelves on underſtanding French; and in ſeveral courts of Europe, it is almoſt as much known as the language of the country.

FRESCATI, a delightful village of Italy, on the declivity of a hill, 12 miles from Rome. It derives its name from the coolneſs of the air, and freſh verdure of the fields around. It is a biſhop's ſee, and always poſſeſſed by one of the ſix eldeſt cardinals. At preſent it belongs to the cardinal duke of York (as he is called) the ſole ſurviving deſcendant of James II. In the neighbourhood of Freſcati are ſituated ſome of the moſt magnificent villas in Italy. The ancient city of Tuſculum is ſuppoſed to have ſtood on the ſpot, or very near it, where Freſcati is now built; and, at the diſtance of a mile and a half, it is generally believed, was the Tuſculan villa of Cicero, at a place now called Grotta Ferrata. Some Greek monks of the order of St. Baſil, flying from the perſecution of the Saracens in the 11th century, were permitted to build a convent on the ruins of Cicero's famous houſe. They ſtill perform the ſervice in the Greek language. Freſcati, with Tivoli and Albano, is the favourite abode of the landſcape painters who travel into Italy for improvement. Nothing can ſurpaſs the admirable aſſemblage of hills, meadows, lakes, caſcades, gardens, ruins, groves, and terraces, which charm the eye as it wanders among the ſhades of theſe delightful villages. Lon. 11. 42. E. Lat. 41. 48. N.

FRESCO, a method of painting in relievo on walls, ſo as to endure the weather. It is performed with water-colours on freſh plaſter, or on a wall laid with mortar not yet dry. This ſort of painting has a great advantage by its incorporating with the mortar, and, drying along with it, becomes very durable. The Italians, from whom we borrow the term, call it *freſco*; becauſe it is frequently uſed for walls, alcoves, and other buildings in the *open air*. Vitruvius, lib. vii. cap. 4. calls it *udo tectorio.* Painting in freſco is very ancient, having been practiſed in the earlieſt ages of Greece and Rome. It is chiefly performed on walls and vaults, newly plaſtered with lime and ſand; but the plaſter is only to be laid, in proportion as the painting goes on; no more being to be done at once than the painter can diſpatch in a day, while it dries. Before he begins to paint, a cartoon or deſign is uſually made on paper, to be calked, and transferred to the wall, about half an hour after the plaſter is applied. The ancients painted on ſtucco; and we remark in Vitruvius what infinite care they took in making the incruſtation or plaſtering of their buildings, to render them beautiful and laſting; though the modern painters find a plaſter made of lime and ſand preferable to it; both as it does not dry ſo haſtily, and as, being a little browniſh, it is fitter to lay colours on than a ground ſo white as ſtucco.

In this kind of painting, all the compound and artificial colours, and almoſt all the minerals, are rejected, and ſcarce any thing is uſed but earths; which are capable of preſerving their colour, defending it from the burning of the lime, and reſiſting its ſalt, which Vitruvius calls its bitterneſs. For the work to come out in all its beauty, the colours muſt be laid on quick, while the plaſter is yet moiſt; nor ſhould they ever be retouched, dry, with colours mixed up with the white of an egg, or ſize, or gum, as ſome workmen do; becauſe ſuch colours grow blackiſh; nor do any preſerve themſelves, but only ſuch as were laid on haſtily at firſt. The colours uſed are, white, made of lime ſlaked long before, and white marble duſt; ochre, both red and yellow; verditer; lapis lazuli; ſmalt; black chalk, &c.: all which are only ground, and worked up with water; and moſt of them grow brighter and brighter as the freſco dries. The bruſhes and pencils for this work ought to be long and ſoft, otherwiſe they will rake and raiſe the painting. The colours

ſhould be full, and flowing from the bruſh; and the deſign perfect: for in this work you cannot alter or add upon any colour.

FRESHES, in ſea-language, denote the impetuoſity of an ebb tide, increaſed by heavy rains, and flowing out into the ſea, often diſcolouring it to a conſiderable diſtance, and forming a line that ſeparates the two colours, and which may be diſtinctly perceived for a great length along the coaſt.

FRESHES, a local term ſignifying annual inundations, from the rivers being ſwollen by the melted ſnows and other freſh waters from the uplands, as is the Nile, &c. from periodical or tropical rains. As a ſailor's term, it is oppoſed to marine or ſalt-water flooding, tides, &c. The word is of common uſe in America, where the inundations ſo called are of great ſervice. They bring down the ſoil to the intervals below, and form a fine mould, producing corn, grain, and herbage, in the moſt luxuriant plenty. They alſo afford another benefit, in regard to many rivers in America, viz. in equalizing the ſurface of the ſtream, where rapid falls or caſcades obſtruct the navigation; ſo that rafts of timber and other groſs produce are then floated down to the ſea-ports in great quantities.

FRESNOY (Charles Alphonſe du), an excellent poet and painter, was born at Paris in 1611. He was inſtructed there by Perrier and Simon Vouet in painting: but he did not long adhere to Vouet's manner of colouring; for, as ſoon as he fixed himſelf at Rome, he made the works of Titian the models for his imitation. He was, however, more celebrated as a poet than as a painter; and gave more attention to the theory than to the practice of the pencil. Accordingly, he is better known by his incomparable poem *De arte graphica*, than by his performances on the canvas: and on this poem he beſtowed ſo much pains, that he died, in 1665, before it was publiſhed. It was printed afterward with a French proſe tranſlation and notes by M. de Piles; and was tranſlated into Engliſh by Mr. Dryden, who prefixed to it an original preface containing a parallel between painting and poetry.

FRET, or FRETTE, in architecture, a kind of knot or ornament, conſiſting of two liſts or ſmall fillets variouſly interlaced or interwoven, and running at parallel diſtances equal to their breadth.

FRET, in heraldry, a bearing compoſed of ſix bars, croſſed and variouſly interlaced. Some call it the *true-lover's knot*. See HERALDRY.

FRET, in muſic, ſignifies a kind of ſtop on ſome inſtruments, particularly baſs-viols and guitars. Frets conſiſt of ſtrings tied round the neck of the inſtrument, at certain diſtances, within which ſuch and ſuch notes are to be found.

FRET-*Work*, that adorned with frets. It is ſometimes uſed to fill up and enrich flat empty ſpaces; but it is moſtly practiſed in roofs, which are fretted over with plaiſter work.

FRETTS, in mineralogy, a term uſed by our miners to expreſs the worn ſide of the banks of the rivers in mine-countries, where they ſearch for the ſhoad ſtones or grewts waſhed down from the hills, in order from thence to trace out the running of the ſhoad up to the mine.

FRIABLE, a quality of bodies by which they are rendered tender and brittle, eaſily crumbled or reduced to powder between the fingers; their force of coheſion being ſuch as eaſily expoſes them to ſuch ſolution. Such are pumice, and all calcined ſtones, burnt alum, &c. It is ſuppoſed that friability ariſes from hence, that the body conſiſts wholly of dry parts irregularly combined, and which are readily ſeparated, as having nothing unctuous or glutinous to bind them together.

FRIAR, or FRIER, by the Latins called *frater*, the Italians *fra*, and the French *frere*, that is, *brother*: a term common to the monks of all orders; founded on this, that there is a kind of fraternity or brotherhood preſumed between the ſeveral religious perſons of the ſame convent or monaſtery. Friars are generally diſtinguiſhed into theſe four principal branches, *viz.* 1. Minors, grey friars, or franciſcans. 2. Auguſtines. 3. Dominicans, or black friars. 4. White friars, or carmelites. From theſe four the reſt of the orders deſcend. See FRANCISCANS, AUGUSTINES, &c. In a more peculiar ſenſe, the term *Friar* is reſtrained to ſuch monks as are not prieſts; for thoſe in orders are uſually dignified with the appellation of *fathers*.

FRIARS *Obſervant*, *fratres obſervantes*, were a branch of the Franciſcans; thus called, becauſe not combined together in any cloyſter, convent, or corporation, as the conventuals are; but only agreed among themſelves to obſerve the rules of their order, and that more ſtrictly than the conventuals did, from whom they ſeparated themſelves out of a ſingularity of zeal, living in certain places of their own chooſing.

FRIBURG, a large town of Germany, capital of Briſgaw; remarkable for the ſteeple of the great church (which, except that of Straſburg, is the fineſt in Germany) and for its univerſity. The inhabitants are famous for poliſhing cryſtal and precious ſtones. It has been ſeveral times taken and retaken, particularly by the French in 1744, who demoliſhed the fortifications. It is ſeated on the river Triſer, 10 miles E. of Briſach, and 26 S. of Straſburg. Long. 7. 57. E. Lat. 48. 10. N.

FRIBURG, a town of Swiſſerland, capital of the canton of the ſame name. The public buildings, eſpecially the cathedral, are very handſome; and the inhabitants are papiſts. It is governed in ſpirituals by the biſhop of Lauſanne, who reſides here, and in temporals by a council, over which an avoyer preſides. Its ſituation is very extraordinary; for only the weſtern ſide is near plain ground, and all the reſt is built among rocks and hills. The ſtreets are clean and large, and it is divided into four parts, the town, the city, the iſland or meadow, and the hoſpital. Three miles from this town is the hermitage of a celebrated hermit. It is cut in a rock, and contains a church and ſteeple, a veſtry, a kitchen, a large hall, two rooms on each ſide, two pair of ſtairs, and a cellar. The church is 63 feet long, 36 broad, and 22 high. But the moſt wonderful thing of all is the ſteeple, which is 70 feet high above the rock. The chimney of the kitchen is alſo very ſurpriſing, for the paſſage up is 90 feet in height. It is almoſt inconceivable how one man, with his ſervant, could perform ſo difficult a work, though they were 25 years about it. Friburg is ſeated on the river San, 15 miles S. W. of Bern, and 75 S. W. of Zurich. Long. 6. 53. E. Lat. 46. 48. N.

FRIBURG, one of the cantons of Swiſſerland. It is ſurrounded on all ſides by the canton of Berne, and the land is fruitful in corn, fruits, and paſtures.

FRICENTI, an epiſcopal town of the kingdom of Naples, near the river Triapalto, 20 miles S. E. of Benevento. Long. 15. 9. E. Lat. 40. 59. N.

FRICTION, the act of rubbing or grating the ſurface of one body againſt that of another, called alſo *attrition*. The phenomena ariſing upon the friction of certain bodies, under different circumſtances, are very numerous and conſiderable. Mr. Hawkſbee gives us a number of experiments of this kind; particularly of the attrition or friction of glaſs, under various circumſtances, the reſult of which was, that it yielded light and became electrical. All bodies by friction are brought to produce heat; many of them to emit light; particularly a cat's back, ſugar, beaten ſulphur, mercury, ſea-water, gold, copper, &c. but, above all, diamonds, which, when briſkly rubbed againſt glaſs, gold, or the like, yield a light equal to that of a live coal when blowed by the bellows. See ELECTRICS and ELECTRICITY.

FRICTION, in mechanics, denotes the reſiſtance a moving body meets with from the ſurface on which it moves. Friction ariſes from the roughneſs or aſperity of the ſurface of the body

moved on, and that of the body moving: for ſuch ſurfaces conſiſting alternately of eminences and cavities, either the eminences of the one muſt be raiſed over thoſe of the other, or they muſt be both broken and worn off: but neither can happen without motion, nor can motion be produced without a force impreſſed. Hence the force applied to move the body is either wholly or partly ſpent on this effect; and conſequently there ariſes a reſiſtance or friction, which will be greater as the eminences are greater, and the ſubſtance the harder; and as the body, by continual friction, becomes more and more poliſhed, the friction diminiſhes.

As the friction is leſs in a body that rolls than when it ſlides, hence in machines, leſt the friction ſhould employ a great part of the power, care is to be taken that no part of the machine ſlide along another, if it can be avoided; but rather that they roll or turn upon each other. With this view it may be proper to lay the axis of cylinders, not in a groove or concave matrix as uſual, but between little wheels, called friction wheels, moveable on their reſpective axes: for, by this contrivance, the friction is transferred from the circumference of thoſe wheels to their pivots. And in like manner the friction may be ſtill farther diminiſhed, by making the axis of thoſe wheels reſt upon other friction-wheels that turn round with them. This was long ſince recommended by P. Caſabus; and experience confirms the truth of it. Hence alſo it is, that a pulley moveable on its axis reſiſts leſs than if it were fixed, and the cord ſliding over the circumference. And the ſame may be obſerved of the wheels of coaches and other carriages. Indeed, about 20 years ago, friction balls or rollers were placed within the naves of carriage-wheels by ſome perſons, particularly a Mr. Varlo; and lately Mr. Garnett had a patent for an improved manner of applying friction wheels to any axis, as of carriages, blocks or pulleys, ſcale beams, &c. in which the incloſed wheels or rollers are kept always at the ſame diſtance by connecting rods or bars.

From theſe principles, with the aſſiſtance of the higher geometry, Olaus Roemer determined the figure of the teeth of wheels that ſhould make the leaſt reſiſtance poſſible, which he found ſhould be epicycloids: and the ſame was afterwards demonſtrated by De la Hire and Camus.

M. Amontons, by experiment, attempted to ſettle a foundation for the preciſe calculation of the quantity of friction; which M. Parent endeavoured to confirm from reaſoning and geometry. M. Amontons' principle is, that the friction of two bodies depends only on the weight or force with which they preſs each other, being always more or leſs in proportion to that preſſure; eſteeming it a vulgar error, that the quantity of friction has any dependence on the extent of the ſurface that is rubbed, or that the friction increaſes with the ſurface: arguing that it will require the ſame weight to draw along a plane, a piece of wood on its narrow edge, as on its broad and flat ſide; becauſe, though on the broad ſide there be 4 times the number of touching particles, yet each particle is preſſed with but $\frac{1}{4}$ of the weight bearing on thoſe of the narrow ſide; and ſince 4 times the number multiplied by $\frac{1}{4}$ of the weight is equal to $\frac{1}{4}$ of the number multiplied by 4 times the weight, it is plain that the effect, that is, the reſiſtance, is equal in both caſes, and therefore requires the ſame force to overcome it.

On the firſt propoſal of this paradox, M. de la Hire very properly had recourſe to experiments, as the beſt teſt, had they been judiciouſly performed: ſuch as they were, however, they ſucceeded in favour of this ſyſtem. He laid ſeveral pieces of rough wood on a rough table; their ſizes were unequal; but he laid weights on them, ſo as to render them all equally heavy: and he found that the ſame preciſe force or weight, applied to them by a little pulley, was required to put each in motion, notwithſtanding all the inequality of the ſurfaces. The experiment ſucceeded in the ſame manner with pieces of marble, laid on a marble table: after this, by reaſoning, M. de la Hire gave a phyſical ſolution of the effect. And M. Amontons ſettled a calculus of the value of friction, with the loſs ſuſtained by it in machines, on the foundation of this new principle. In wood, iron, lead, and braſs, which are the chief materials uſed in machines, he makes the reſiſtance cauſed by friction to be nearly the ſame in all, when thoſe materials are anointed with oil or fat: and the quantity of this reſiſtance, independent of the magnitude of the ſurface, he makes nearly equal to a third part of the weight of the body moved, or of the force with which the two bodies are preſſed together. Others have obſerved, that, if the ſurfaces be hard and well poliſhed, the friction will be leſs than a third part of the weight; but, if the parts be ſoft or rugged, it will be much greater. It was farther obſerved, that in a cylinder moved on two ſmall gudgeons, or on a ſmall axis, the friction would be diminiſhed in the ſame proportion as the diameter of theſe gudgeons is leſs than the diameter of the cylinder; becauſe, in this caſe, the parts on which the cylinder moves and rubs will have leſs velocity than the power which moves it in the ſame proportion, which is in effect making the friction to be proportional to the velocity. So that, from the whole of their obſervations, this general propoſition is deduced, viz. That the reſiſtances ariſing from friction are to one another in a ratio compounded of the preſſures of the rubbing parts, and the velocities of their motions:—principles which, it is now known from better experiments, are both erroneous; notwithſtanding the hypotheſis of M. Amontons has been adopted, and attempted to be confirmed by Camus, Deſaguliers, and others.

M. Muſchenbroek and the abbé Nollet, however, on the other hand, have concluded from experiments, that the friction of bodies depends on the magnitude of their ſurface as well as on their weight. Though the former ſays, that in ſmall velocities the friction varies very nearly as the velocity, but that in great velocities the proportion increaſes faſter: he has alſo attempted to prove, that, by increaſing the weight of a body, the friction does not always increaſe exactly in the ſame ratio. Introd. ad Phil. Nat. vol. 1, c. 9, and Lect. Phyſ. Exp. tom. 1, p. 241. Helſham and Ferguſon, from the ſame kind of experiments, have endeavoured to prove, that the friction does not vary by changing the quantity of ſurface on which the body moves; and the latter of theſe aſſerts, that the friction increaſes very nearly as the velocity; and that, by increaſing the weight, the friction is increaſed in the ſame ratio. Indeed there is ſcarce any ſubject of experiment, with regard to which different perſons have formed ſuch various concluſions. Of thoſe who have written on the theory, no one has eſtabliſhed it altogether on true principles, till the experiments lately made by Mr. Vince of Cambridge. Euler, whoſe theory is extremely elegant, and would have been quite ſatisfactory, had his principles been founded on good experiments, ſuppoſes the friction to vary in proportion to the velocity of the body, and its preſſure upon the plane; neither of which is true: and others, though they have juſtly imagined that friction is a uniformly retarding force, have yet retained the other ſuppoſition, and ſo rendered their ſolutions not at all applicable to the caſes for which they were intended.

For theſe reaſons, a new and ingenious ſet of experiments was ſucceſsfully inſtituted by the Rev. Samuel Vince, A. M. of Cambridge, which are publiſhed in the 75th vol. of the Philoſ. Tranſ. p. 165. The object of theſe experiments was to determine:

1ſt, Whether friction be a uniformly retarding force.

2d, The quantity of friction.

3d, Whether friction varies in proportion to the preſſure or weight.

4th, Whether the friction be the fame on whichever of its furfaces a body moves.

Mr. Vince fays, "The experiments were made with the utmoft care and attention; and the feveral refults agreed fo very exactly with each other, that I do not fcruple to pronounce them to be conclufive."—"A plane was adjufted parallel to the horizon, at the extremity of which was placed a pulley, which could be elevated or depreffed, in order to render the ftring which connected the body and the moving force parallel to the plane or horizon. A fcale accurately divided was placed by the fide of the pulley perpendicular to the horizon, by the fide of which the moving force defcended; upon the fcale was placed a moveable ftage, which could be adjufted to the fpace through which the moving force defcended in any given time, which time was meafured by a well regulated pendulum clock vibrating feconds. Every thing being thus prepared, the following experiments were made to afcertain the law of friction. But let me firft obferve, that if friction be a uniform force, the difference between it and the given force of the moving power muft be alfo uniform, and therefore the moving body muft defcend with a uniformly accelerated velocity, and confequently the fpaces defcribed from the beginning of the motion muft be as the fquares of the times, juft as when there was no friction, only they will be diminifhed on account of the friction." Accordingly the experiments are then related, which are performed agreeably to thefe ingenious and philofophical ideas, and from them are deduced thefe general conclufions, which may be confidered as eftablifhed and certain facts or maxims: viz.

1ft, That friction is a uniformly retarding force in hard bodies, not fubject to alteration by the velocity: except when the body is covered with cloth, woollen, &c. and in this cafe the friction increafes a little with the velocity.

2dly, Friction increafes in a lefs ratio than the quantity of matter or weight of the body. This increafe, however, is different for the different bodies, more or lefs; nor is it yet fufficiently known, for any one body, what proportion the increafe of friction bears to the increafe of weight.

3dly, The fmalleft furface has the leaft friction; the weight being the fame. But the ratio of the friction to the furface is not yet accurately known.

Mr. Vince's experiments confifted in determining how far the fliding bodies would be drawn, in given times, by a weight hanging freely over a pulley. This method would both fhew him if the friction were a conftant retarding force, and the other conclufions above ftated. For as the fpaces defcribed by any conftant force, in given times, are as the fquares of the times, and as the weight drawing the body is a conftant force, if the friction, which acts in oppofition to the weight, fhould alfo be a conftant force, then their difference, or the force by which the body is urged, will alfo be conftant, in which cafe the fpaces defcribed ought to be as the fquares of the times; which happened accordingly in the experiments.

Mr. Vince adds fome remarks on the nature of the experiments which have been made by others. Thefe, he obferves, the authors "have inftituted to find what moving force would *juft* put a body at reft in motion: and they concluded from thence, that the accelerative force was then equal to the friction; but it is manifeft, that any force which will put a body in motion muft be greater than the force which oppofes its motion, otherwife it could not overcome it; and hence, if there were no other objections than this, it is evident, that the friction could not be very accurately obtained; but there is another objection, which totally deftroys the experiment, fo far as it tends to fhew the quantity of friction, which is the ftrong cohefion of the body to the plane when it lies at reft." This he confirms by feveral experiments, and then adds: "From thefe experiments, therefore, it appears, how very confiderable the cohefion was in proportion to the friction when the body was in motion: it being in one cafe almoft $\frac{1}{3}$, and in another it was found to be very nearly equal to the whole friction. All the conclufions, therefore, deduced from the experiments, which have been inftituted to determine the friction, from the force neceffary to *put* a body in motion (and I have never feen any defcribed but upon fuch a principle), have manifeftly been totally falfe; as fuch experiments only fhew the refiftance which arifes from the cohefion and friction conjointly." Philof. Tranf. vol. 75, pa. 165.

Mr. Emerfon, in his Principles of Mechanics, deduces from experiments the following remarks relating to the quantity of friction: When a cubic piece of foft wood of 8 pounds weight moves upon a fmooth plane of foft wood at the rate of 3 feet per fecond, its friction is about $\frac{1}{3}$ of the weight; but, if it be rough, the friction is little lefs than half the weight: on the fame fuppofition, when both the pieces of wood are very fmooth, the friction is about $\frac{1}{4}$ of the weight: the friction of foft wood on hard, or of hard wood upon foft, is $\frac{1}{5}$ or $\frac{1}{6}$ of the weight; of hard wood upon hard wood, $\frac{1}{7}$ or $\frac{1}{8}$; of polifhed fteel, moving on fteel or pewter, $\frac{1}{4}$; moving on copper or lead, $\frac{1}{5}$ of the weight. He obferves, in general, that metals of the fame fort have more friction than thofe of different forts; that lead makes much refiftance; that iron or fteel running on brafs makes the leaft friction of any; and that metals oiled make the friction lefs than when polifhed, and twice as little as when unpolifhed. Defaguliers obferves that, in M. Camus's experiments on fmall models of fledges in actual motion, there are more cafes in which the friction is lefs than where it is more than $\frac{1}{3}$ of the weight. See a table, exhibiting the friction between various fubftances, formed from his experiments in Defag. Exp. Philof. vol. 1, p. 193, &c. alfo p. 133 to 138, and p. 182 to 254, and p. 458 to 460. On the fubject of friction, feveral vols. of the Philof. Tranf. as vol. 1, p. 206; vol. 34, p. 77; vol. 37, p. 394; vol. 53, p. 139, &c. may be confulted.

Friction, in medicine and furgery, denotes the act of rubbing a difeafed part with oils, unguents, or other matters, in order to eafe, relieve, and cure it. Frictions with quickfilver ointment are much ufed in venereal cafes. Surgeons prefer the applying of mercury externally by way of friction, to that of giving it internally, to raife a falivation. There are alfo frictions with the flefh-brufh, a linen cloth, or the hand only, which are of confiderable fervice in all complaints where the circulation of the blood is impeded, or the power of the nerves deficient.

FRIDAY, the fixth day of the week; fo named of *Freya*, a Saxon deity. By the Romans it was called *dies Veneris*. See Frea.

Good-Friday. See Good-*Friday*.

FRIDBERG, a town of Germany, in Weteravia, and in the landgravate of Heffe. It was much more confiderable formerly than at prefent, though an imperial town. It is feated on a mountain, 15 miles N. E. of Francfort. Lon. 8. 46. E. Lat. 50. 10. N.

Fridberg, the name of two fmall towns in Silefia, the one in the duchy of Javer, and the other in the duchy of Schweidnitz. The laft is remarkable for a battle gained there by the king of Pruffia over the Auftrians in June 1745.

Fridberg, a town of Germany, in Bavaria, with a caftle, taken and plundered by the Swedes in 1632. It is 30 miles N. W. of Munich. Lon. 11. 10. E. Lat. 40. 23. N.

FRIDBURG, a town of Germany, in the circle of Upper Saxony, and province of Thuringia, feated on the river Unftrue, 30 miles W. of Leipfick. Lon. 11. 41. E. Lat. 51. 19. N.

FRIDSTOL, mentioned in our ancient writers, among the immunities granted to churches, fignifies a feat, chair, or place of peace and fecurity, where criminals might find fafety and

protection: of these there were many in England; but the most famous were that at Beverly, and that in St. Peter's church at York, granted by charter of king Henry I.

FRIENDLY ISLANDS, a cluster of islands in the S. Pacific Ocean, so named by Captain Cook in 1773, on account of the friendship that appeared to subsist among the inhabitants, and their courteous behaviour to strangers. Tasman, the celebrated Dutch navigator, first touched here in 1643, and gave the names of New Amsterdam, Rotterdam, and Middleburg, to three of the principal islands. Captain Cook explored the whole cluster, which he found to consist of more than 60. New Amsterdam is the largest, extending 21 miles from E. to W. and 13 from N. to S. It is intersected by straight and pleasant roads, with fruits-trees on each side, which provide shade from the scorching heat of the sun. Middleburg is called Eooa by the natives, who have given the names of Annamooka, Tangataboo, Hapaee, and Lefooga, to the other principal islands, which see respectively. The general appearance of these islands conveys an idea of the most exuberant fertility: the surface, at a distance, seems entirely clothed with trees of various sizes, some of which are very large, particularly the tall cocoa-palm, and a species of fig with narrow-pointed leaves. On closer examination, it is almost wholly laid out in plantations, in which are some of the richest productions of nature; such as bread-fruit, cocoa-nut trees, plantains, yams, sugar-canes, and a fruit like a nectarine. In short, here are most of the articles which the Society Islands produce, and some which they have not. Their stock of quadrupeds is as scanty as that of the Society Islands; but they received from Captain Cook the same valuable additions, both to the animal and vegetable kingdom. Their domestic fowls are as large as those of Europe. Among the birds are parrots and parroquets of various sorts, which furnish the red feathers so much esteemed in the Society Isles. The numerous reefs and shoals afford shelter for an endless variety of shellfish. Agriculture, architecture, boat-building, and fishing, are the employments of the men; to the women is confined the manufacture of the cloth. These islands lie between 170° and 180° W. lon. and 20° and 23° S. lat.

FRIESLAND, one of the united provinces of the Low Countries. It is bounded on the east by the river Lauvers, which parts it from the lordship of Groningen, on the south by Overyssel, on the west by the Zuider-Zee, and on the north by the German ocean. It is 30 miles from north to south, and 28 from east to west. The land is very fertile in corn and pasture; the horses are large, and the cows and sheep prolific. It is divided into three parts; Westergo to the west, Ostergo to the east, and Sevenwalden to the south. The islands of Sheling, Ameland, and other small ones, are dependent on this province. The principal towns are Leuwarden the capital, Franeker, Dockum, Harlingen, and Staveren.

FRIESLAND (East), a province of Germany, in the circle of Westphalia, lying near the German ocean. It is bounded on the south by the bishopric of Munster, on the east by the county of Oldenburg, on the west by the province of Groningen, and on the north by the sea, being about 50 miles in length, and 30 in breadth. It belongs to Prussia, and was formerly called the *county of Embden*. It is a very fertile country, and feeds a great number of cattle; but it was greatly damaged by an inundation in 1717, and the repair of the dykes cost an immense sum. The principal towns are Norden, Leer, Essens, Whitmunde, and Aurick. Embden was an imperial city, and the principal place in the country; but now belongs also to the king of Prussia, who bought it of the Dutch.

FRIESLAND (West), another name for that part of Holland called N. Holland. The states of Holland hence take the title of the states of Holland and W. Friesland.

FRIGATE, in sea affairs, a ship of war, usually of two decks, light built, designed for swift sailing. When it has but one deck, and consequently is of a smaller size, they call her a light frigate. Frigates mount from 20 to 44 guns, and are esteemed excellent cruisers. The name was formerly known only in the Mediterranean, and applied to a long kind of vessel navigated in that sea with sails and oars. The English were the first who appeared on the ocean with these ships, and equipped them for war as well as for commerce.

FRIGATE-*Built*, denotes the disposition of the decks of such merchant ships as have a descent of four or five steps from the quarter-deck and fore-castle into the waist, in contradistinction to those whose decks are on a continued line for the whole length of the ship, which are called *galley-built*.

FRIGATOON, a Venetian vessel, commonly used in the Adriatic, built with a square stern, and without any fore-mast, having only a main-mast, mizen-mast, and bow-sprit.

FRIGHT, or TERROR, a sudden and violent degree of fear. See FEAR. Sudden fear is frequently productive of very remarkable effects upon the human system. Of this many instances occur in medical writings. In general, the effects of terror are a contraction of the small vessels and a repulsion of the blood into the large and internal ones; hence proceed general oppression, trembling, and irregularity in the motions of the heart, whilst the lungs are also overcharged with blood.

Frights often occasion incurable diseases, as epilepsy, stupor, madness, &c. In this way they have evidently killed many, by the agitation into which they have thrown the spirits, already too much disordered. We have also accounts of persons absolutely killed by terrors when in perfect health at the time of receiving the shock. Out of many instances, the following is selected as one of the most singular: "George Grochantzy, a Polander, who had inlisted as a soldier in the service of the king of Prussia, deserted during the last war. A small party was sent in pursuit of him; and, when he least expected it, they surprised him singing and dancing among a company of peasants, who were got together in an inn and were making merry. This event, so sudden and unforeseen, and at the same time so dreadful in its consequences, struck him in such a manner, that, giving a great cry, he became at once altogether stupid and insensible, and was seized without the least resistance. They carried him away to Glocau, where he was brought before the council of war, and received sentence as a deserter. He suffered himself to be led and disposed of at the will of those about him, without uttering a word, or giving the least sign that he knew what had happened or would happen to him. He remained immoveable as a statue wherever he was placed, and was wholly passive with respect to all that was done to him or about him. During all the time that he was in custody, he neither ate, nor drank, nor slept, nor had any evacuation. After some time they knocked off his fetters, and left him at liberty to go whither he would. He received his liberty with the same insensibility that he had showed upon other occasions: he remained fixed and immoveable; his eyes turned wildly here and there without taking cognizance of any object, and the muscles of his face were fallen and fixed like those of a dead body. Being left to himself, he passed 20 days in this condition, without eating, drinking, or any evacuation, and died on the 20th day.

When a person is affected with terror, the principal endeavour should be to restore the circulation to its due order, to promote gentle perspiration, and to allay the agitation of the patient. For these purposes, he may drink warm diluting liquors; the feet and legs may be put into warm water, the legs rubbed, and, when the skin is warm, sleep may be promoted by opiates.

Yet frights have been known not only to cause, but also to cure, diseases. Mr. Boyle speaks of agues, gout, and sciatica, cured by this means. To turn from the serious to the ludicrous effects of fear, the following instance of the latter sort, quoted

from a French author by Mr. Andrews, in his volume of Anecdotes, ſhows upon what ſlight occaſions this paſſion may be ſometimes excited in a very high degree, even in perſons the moſt unlikely to entertain ſuch a gueſt. "Charles Guſtavus (the ſucceſſor of Chriſtina of Sweden) was beſieging Prague, when a boor of moſt extraordinary viſage deſired admittance to his tent; and, being allowed entrance, offered, by way of amuſing the king, to devour a whole hog of one hundred weight in his preſence. The old general Konigſmarc, who ſtood by the king's ſide, and who, ſoldier as he was, had not got rid of the prejudices of his childhood, hinted to his royal maſter that the peaſant ought to be burnt as a ſorcerer. "Sir," ſaid the fellow, irritated at the remark, "if your majeſty will but make that old gentleman take off his ſword and his ſpurs, I will eat him immediately before I begin the hog." General Konigſmarc (who had, at the head of a body of Swedes, performed wonders againſt the Auſtrians, and who was looked upon as one of the braveſt men of the age) could not ſtand this propoſal, eſpecially as it was accompanied by a moſt hideous and preternatural expanſion of the frightful peaſant's jaws. Without uttering a word, the veteran ſuddenly turned round, ran out of the court, and thought not himſelf ſafe until he had arrived at his quarters; where he remained above 24 hours locked up ſecurely, before he had got rid of the panic which had ſo ſeverely affected him."

Fear, obſerves Dr. Beattie in his Elements of Moral Science, ſhould not riſe higher than to make us attentive and cautious: when it gains an aſcendency in the mind, it becomes an inſupportable tyranny, and renders life a burden. The object of fear is evil; and to be exempt from fear, or at leaſt not enſlaved by it, gives dignity to our nature, and invigorates all our faculties. Yet there are evils which we ought to fear. Thoſe that ariſe from ourſelves, or which it is in our power to prevent, it would be madneſs to deſpiſe, and audacity not to guard againſt. External evils, which we cannot prevent, or could not avoid without a breach of duty, it is manly and honourable to bear with fortitude. Inſenſibility to danger is not fortitude, no more than the incapacity of feeling pain can be called patience; and to expoſe ourſelves unneceſſarily to evil is worſe than folly, and very blameable preſumption. It is commonly called fool-hardineſs; that is, ſuch a degree of hardineſs or boldneſs as none but fools are capable of. See the article FORTITUDE.

FRIGID, *frigidus*, in a general ſenſe, denotes the quality of being cold. It is frequently applied to a jejune ſtyle, that is unanimated by any ornaments, and conſequently without any force or vigour.

FRIGID-*Zone.* See ZONE.

FRIGIDITY, in medicine, the ſame with IMPOTENCE.

FRIGORIFIC, in phyſiology, ſmall particles of matter, which, according to Gaſſendus and others, being actually and eſſentially cold, and penetrating other bodies, produce in them that quality which we call *cold*. See COLD.

FRILAZIN, the name of a claſs or rank of people among the Anglo-Saxons, conſiſting of thoſe who had been ſlaves, but had either purchaſed, or by ſome other means obtained, their liberty. Though theſe were in reality free men, they were not conſidered as of the ſame rank and dignity with thoſe who had been born free, but were ſtill in a more ignoble condition, and dependent either on their former maſters or on ſome new patrons. This cuſtom the Anglo-Saxons ſeem to have derived from their anceſtors in Germany, among whom thoſe who had been made free did not differ much in point of dignity or importance in the ſtate from thoſe who continued in ſervitude. This diſtinction between thoſe who have been made free, and thoſe who enjoy freedom by deſcent from a long race of free men, ſtill prevails in many parts of Germany; and particularly in the original ſeats of the Anglo-Saxons. Many of the inhabitants of towns and cities in England, in this period, ſeem to have been of this claſs of men, who were in a kind of middle ſtate between ſlaves and freemen.

FRILL, in falconry. When a hawk trembles or ſhivers, they ſay ſhe *frills*.

FRINGILLA, in ornithology, a genus belonging to the order of paſſeres. See plate 34. The bill is conical, ſtraight, and ſharp-pointed. There are no leſs than 108 ſpecies comprehended under this genus, diſtinguiſhed principally by varieties in their colour. The following are the moſt noted.

1. The *carduelis*, or GOLDFINCH, with the quill-feathers red forwards, and the outermoſt without any ſpots; the two outermoſt are white in the middle, as the reſt are at the point. The young bird, before it moults, is grey on the head; and hence it is termed by the bird-catchers a *grey-pate*. There is a variety of goldfinches called by the London bird-catchers a *cheverel*, from the manner in which it concludes its jerk. It is diſtinguiſhed from the common ſort by a white ſtreak, or by two, ſometimes three, white ſpots under the throat. Their note is very ſweet; and they are much eſteemed on that account, as well as for their great docility. Towards winter, they aſſemble in flocks; and feed on ſeeds of different kinds, particularly thoſe of the thiſtle. It is fond of orchards, and frequently builds in an apple or pear-tree: its neſt is very elegantly formed of fine moſs, liverworts, and bents, on the outſide; lined firſt with wool and hair, and then with the goſlin or cotton of the ſallow. It lays five white eggs, marked with deep purple ſpots on the upper end; and has two broods in the year. When kept in cages, they are commonly fed much on hemp-ſeed, which they eat freely, but which is ſaid to make them grow black, and loſe both their red and yellow. The goldfinch is a long-lived bird, often attaining the age of 20 years. This ſpecies is plenty throughout Europe; it is alſo met with both in Aſia and Africa, but leſs common in thoſe countries.

2. The *cœlebs*, or CHAFFINCH, has black limbs, and the wings white on both ſides; the three firſt feathers of the tail are without ſpots, but two of the chief are obliquely ſpotted. It has its name from its delighting in chaff. This ſpecies entertains us agreeably with its ſong very early in the year, but towards the latter end of ſummer aſſumes a chirping note: both ſexes continue with us the whole year. What is very ſingular in Sweden, the females quit that country in September, migrating in flocks into Holland, leaving their mates behind: in the ſpring they return. In Hampſhire Mr. White has obſerved ſomething of this kind; vaſt flocks of females with ſcarcely any males among them. Their neſt is almoſt as elegantly conſtructed as that of the goldfinch, and of much the ſame materials, only the inſide has the addition of ſome large feathers. They lay four or five eggs of a dull white colour, tinged and ſpotted with deep purple. They are caught in plenty in flight-time; but their neſts are rarely found, though they build in hedges and trees of all ſorts. They make their neſts of moſs and wool, or any thing they can gather up; and have young ones thrice a-year. They are ſeldom bred from the neſt, as being a bird not apt to learn another's ſong, nor to whiſtle; ſo that it is beſt to leave the old ones to bring them up. The Eſſex finches are generally allowed to be the beſt ſort, both for length of ſong and variety, ending with ſeveral notes that are very pretty. It is an hardy bird, and will live almoſt upon any ſeeds, none coming amiſs to him. He is ſeldom ſubject to diſeaſe, but will be very louſy if not ſprinkled with wine two or three times a-month.

3. The *montifringilla*, or BRAMBLING, has a yellow bill tipt with black; the head, hind part of the neck, and back, are black; the throat, fore part of the neck, and breaſt, pale rufous orange; lower part of the breaſt and belly, white; the quill feathers, brown, with yellowiſh edges; the tail a little forked: the legs grey. This ſpecies migrates into England at certain ſea-

ſons, but does not build here. It is frequently found among chaffinches, and ſometimes comes in vaſt flocks. They are alſo ſeen at certain times in vaſt clouds in France, inſomuch that the ground has been quite covered with their dung, and more than 600 dozen were killed each night. They are ſaid to be particularly fond of beech maſt, but will alſo eat ſeeds of various other kinds. Their fleſh is eaten by many, but is apt to prove bitter. They are ſaid to breed about Luxemburg, making their neſts on the tall fir-trees, compoſed of long moſs without, and lined with wool and feathers within: the eggs are four or five in number, yellowiſh, and ſpotted; and the young are fledged at the end of May. This ſpecies is found more or leſs throughout Europe; and is common in the pine foreſts of Ruſſia and Siberia, but thoſe of the laſt are darker in colour and leſs in ſize.

4. The *domeſtica*, or SPARROW, has the prime feathers of the wings and tail brown, the body variegated with grey and black, and a ſingle white ſtreak on the wings. Theſe well-known birds are proverbially ſalacious, and have three broods in a year. They are every where common about our houſes, where they build in every place they can find admittance to; under the roof, corner of the brick-work, or in holes of the wall. They make a ſlovenly neſt; generally a little hay ill put together, but lined well with feathers; where they lay five or ſix eggs of a reddiſh white colour ſpotted with brown. They will ſometimes build in the neighbouring trees, in which caſe they take more pains with the neſt: and not unfrequently they expel the martins from theirs, to ſave the trouble of conſtructing one of their own. The ſparrow, from frequenting only habitations and parts adjacent, may be ſaid to be chiefly fed from human induſtry; for, in ſpite of every precaution, it will partake with the pigeons, poultry, &c. in the food thrown out to them, grain of all kinds being moſt agreeable to its taſte; though it will eat refuſe from the kitchen of moſt kinds. It is a familiar but crafty bird, and will not ſo eaſily come into a ſnare as many others. In autumn they often collect into flocks, and rooſt in numbers on the neighbouring trees, when they may be ſhot by dozens, or at night caught in great numbers by a bat fowling-net. The fleſh is accounted tolerable by many. The ſparrow has no ſong, only a chirp or two frequently repeated, and far from agreeable. This ſpecies is ſpread every where throughout Europe, and is alſo met with in Egypt, Senegal, Syria, and other parts of Africa and Aſia.

5. The *ſpinus*, or SISKIN, hath the prime feathers of the wings yellow in the middle, and the four firſt chief tail-feathers without ſpots; but they are yellow at the baſe, and black at the points. Mr. Willughby tells us, that this is a ſong-bird: that in Suſſex it is called the *barley-bird*, becauſe it comes to them in barley-ſeed time. We are informed that it viſits theſe iſlands at very uncertain times, like the groſs beak, &c. It is to be met with in the bird-ſhops in London; and, being rather a ſcarce bird, ſells at a higher price than the merit of its ſong deſerves: it is known there by the name of the *aberdavine*. It is a very tame and docile ſpecies; and is often kept and paired with the Canary-bird, with which it breeds freely. The bird-catchers have a notion of its coming out of Ruſſia. Dr. Kramer informs us, that this bird conceals its neſt with great art; and though there are infinite numbers of young birds in the woods on the banks of the Danube, which ſeem juſt to have taken flight, yet no one could diſcover it.

6. The *linota*, or LINNET, has the bottom of the breaſt of a fine blood-red, which heightens as the ſpring advances. Theſe birds are much eſteemed for their ſong. They feed on ſeeds of different kinds, which they peel before they eat; the ſeed of the linum or flax is their favourite food; from whence the name of the linnet tribe. They breed among furze and white thorn: the outſide of their neſt is made with moſs and bents, and lined with wool and hair. They lay five whitiſh eggs, ſpotted like thoſe of the goldfinch.

7. The *cannabina*, or GREATER RED-POLE, is rather leſs than the common linnet, and has a blood-coloured ſpot on the forehead, and the breaſt of the male is tinged with a fine roſe-colour. It is a common fraud in the bird-ſhops in London, when a male-bird is diſtinguiſhed from the female by a red-breaſt, as in the caſe of this bird, to ſtain or paint the feathers, ſo that the deceit is not eaſily diſcovered, without at leaſt cloſe inſpection. Theſe birds are frequent on our ſea-coaſts, and are often taken in flight-time near London: it is a familiar bird, and is cheerful in five minutes after it is caught.

8. The *linaria*, or LESSER RED-POLE, is about half the ſize of the laſt, with a rich ſpot of purpliſh red on the forehead: the breaſt is of the ſame colour, but leſs bright. The female is leſs lively in colour, has no red on the breaſt, and the ſpot on the forehead is of a ſaffron hue. This ſpecies is common enough in England; and lays four or five eggs of a pale blueiſh green, thickly ſprinkled near the blunt end with ſmall reddiſh ſpots. Mr. Pennant mentions an inſtance of this bird being ſo tenacious of her neſt, as to ſuffer herſelf to be taken off by the hand, and that when releaſed ſhe would not forſake it. This ſpecies is known about London by the name of *ſtone red-pole*. Linnæus, Kramer, and others, mention its being very fond of the ſeeds of alder. Whole flocks of them, mixed with the ſiſkin, frequent places where alders grow, for the fake of picking the catkins: they generally hang like the titmouſe, with the back downwards; and in this ſtate are ſo intent on their work, that they may be entangled one after another by dozens, by means of a twig, ſmeared with bird-lime, faſtened to the end of a fiſhing-rod or other long pole. This ſpecies ſeems to be in plenty throughout Europe, from the extreme parts of Ruſſia on the one hand to Italy on the other; is very common in Greenland, and was alſo met with by our late voyagers at Aoonalaſhka. In America it is likewiſe well known. Hence it ſeems to be a bird common to the whole of the northern part of the globe without exception.

9. The *montium*, or TWITE, is about the ſize of a linnet. It has the feathers of the upper part of the body duſky, thoſe on the head edged with aſh-colour, the others with browniſh red: the rump is pale crimſon; the wings and tail are duſky, the tips of the greater coverts and ſecondaries whitiſh; the legs pale brown. The female wants the red mark on the rump. Twites are taken in the flight-ſeaſon near London along with other linnets. It is probable that the name has been taken from their twittering note, having no muſic in it; and indeed the bird-catchers will tell, at ſome diſtance, whether there be any twites mixed among linnets merely from this circumſtance. The twite is ſuppoſed to breed in the more northern parts of our iſland.

10. The *amandava*, or AMADUVADE BIRD, is about the ſize of a wren. The colour of the bill is of a dull red; all the upper parts are brown, with a mixture of red; the under the ſame, but paler, the middle of the belly darkeſt; all the feathers of the upper wing-coverts, breaſt, and ſides, have a ſpot of white at the tip; the quills are of a grey brown; the tail is black; and the legs are of a pale yellowiſh white. It inhabits Bengal, Java, Malacca, and other parts of Aſia.

11. The *Senagala*, or SENEGAL FINCH, is a ſpecies very little bigger than a wren. The bill is reddiſh, edged all round with brown, and beneath the under mandible a line of brown quite to the tip; the ſame alſo is ſeen on the ridge of the upper mandible: the upper parts of the body are of a vinaceous red colour; the lower parts, with the thighs and under tail-coverts, of a greeniſh brown; the hind part of the head and neck, the back, ſcapulars, and wing-coverts, are brown; the tail is black; and the legs are pale grey. It inhabits Bengal; and, with the

former ſpecies, feeds on millet. This affords the natives an eaſy method of catching them: they have no more to do than to ſupport a large hollowed gourd, the bottom uppermoſt, on a ſtick, with a ſtring leading to ſome covered place, and ſtrewing under it ſome millet; the little birds, haſtening in numbers to pick it up, are caught beneath the trap, by the ſtick being pulled away by the obſerver at a diſtance. The females are ſaid to ſing nearly as well as the males. They are familiar birds; and, when once uſed to the climate, will frequently live five or ſix years in a cage. They have been bred in Holland by the fanciers of birds.

12. The *Canaria*, or CANARY-BIRD, has a whitiſh body and bill, with the prime feathers of the wings and tail greeniſh. It was originally peculiar to thoſe iſles to which it owes its name; the ſame that were known to the ancients by the addition of the *Fortunate*. Though the ancients celebrate the iſle of Canaria for the multitude of birds, they have not mentioned any in particular. It is probable, then, that our ſpecies was not introduced into Europe till after the ſecond diſcovery of theſe iſles, which was between the 13th and 14th centuries. We are uncertain when it firſt made its appearance in this quarter of the globe. Belon, who wrote in 1555, is ſilent in reſpect to theſe birds: Geſner is the firſt who mentions them; and Aldrovand ſpeaks of them as rarities, obſerving that they were very dear, on account of the difficulty attending the bringing them from ſo diſtant a country, and that they were purchaſed by people of rank alone. They are ſtill found on the ſame ſpot to which we were firſt indebted for the production of ſuch charming ſongſters; but they are now become ſo numerous in our own country, that we are under no neceſſity of croſſing the ocean for them. The Canary-bird will prove fertile with the ſiſkin and goldfinch; but in this caſe the produce, for the moſt part, proves ſterile: the pairs ſucceed beſt when the hen-bird is the Canary, and the cock of the oppoſite ſpecies. It will alſo prove prolific with the linnet, yellow-hammer, chaffinch, and even the houſe ſparrow; but the male Canary-bird will not aſſimilate with the female of theſe birds; the hen muſt be ever of the Canary ſpecies, and the young of theſe moſtly prove male birds. This bird is ſaid by ſome to live 10 or 15 years; by others, as far as 18.

FRIPPERY, a French term ſometimes uſed in our language to ſignify the trade or traffic of old ſecond-hand clothes and goods. The word is alſo uſed for the place where ſuch ſort of commerce is carried on, and even for the commodities themſelves. The company of frippiers, or fripperers, at Paris, were originally a regular corporation, of an ancient ſtanding, and made a conſiderable figure in that city.

FRIT, or FRITT, in the glaſs manufacture, is the matter or ingredients whereof glaſs is to be made, when they have been calcined or baked in a furnace. A ſalt drawn from the aſhes of the plant kali or from fern, or other plants, mixed with ſand or flint, and baked together, makes an opaque maſs called by glaſs-men *frit*; probably, from the Italian *frittare*, to fry; or becauſe the frit when melted runs into lumps, like fritters, called by the Italians *fritelli*. Frit, by the ancients, was called *ammonitrum*, of αμμ☉, *ſand*, and νιτρον, *nitre*; under which name it is deſcribed by Pliny thus: Fine ſand from the Volturnian ſea, mixed with three times the quantity of nitre, and melted, makes a maſs called *ammonitrum*; which being rebaked makes pure glaſs. Frit, Neri obſerves, is only the calx of the materials which make glaſs; which though they might be melted, and glaſs be made without thus calcining them, yet it would take up much more time. This calcining, or making of frit, ſerves to mix and incorporate the materials together, and to evaporate all the ſuperfluous humidity. The frit, once made, is readily fuſed and turned into glaſs.

There are three kinds of frit. The firſt, cryſtal frit, or that for cryſtal metal, is made with ſalt of pulverine and ſand. The ſecond and ordinary frit is made of the bare aſhes of pulverine or barilla, without extracting the ſalt from them. This makes the ordinary white or cryſtal metal. The third is frit for green glaſſes, made of common aſhes, without any preparation. This laſt frit will require ten or twelve hours baking. The materials in each are to be finely powdered, waſhed, and ſearced; then equally mixed, and frequently ſtirred together in the melting pot. For the reſt, ſee GLASS and CRYSTAL.

FRITH, in its moſt uſual acceptation, ſignifies the mouth or opening of a river into the ſea; ſuch are the Frith of Forth or of Edinburgh, the Frith of Clyde, Moray Frith, &c.

FRITILLARIA, FRITILLARY; a genus of the monogynia order, belonging to the hexandria claſs of plants; and in the natural method ranking under the 10th order, *Coronariæ*. The corolla is hexapetalous and campanulated, with a nectariferous cavity above the heel in each petal; the ſtamina are as long as the corolla. There are five ſpecies, all of them bulbous-rooted flowery perennials, producing annual ſtalks from about one foot to a yard or more high, terminated by large, bell-ſhaped, liliaceous flowers, of a great variety of colours. They are all propagated by offsets, which they furniſh abundantly from the ſides of their roots, and which may be ſeparated every ſecond or third year; they are hardy plants, and will thrive in any of the common borders.

FRIULI, a province of Italy, bounded on the N. by Carinthia, on the S. by the gulf of Venice, on the E. by the county of Goritz and the gulf of Trieſte, and on the W. by Treviſano and the Belluneſe. It is fertile in wine and fruits, and belongs partly to the Venetians, and partly to the houſe of Auſtria. Udina is the capital.

FRIZE, or FRIEZE, in architecture, a part of the entablature of columns, more uſually written and pronounced *freeze*. See FREEZE.

FRIZE, or FREEZE, in commerce, a kind of woollen cloth or ſtuff for winter wear, being frized or knapt on one ſide; whence, in all probability, it derives its name. Of frizes, ſome are croſſed, others not croſſed: the former are chiefly of Engliſh manufacture, the latter of Iriſh.

FRIZING of CLOTH, a term in the woollen manufactory, applied to the forming of the nap of cloth or ſtuff into a number of little hard burrs or prominences, covering almoſt the whole ground thereof. Some cloths are only frized on the back ſide, as black cloths; others on the right ſide, as coloured and mixed cloths, rateens, bays, friezes, &c. Frizing may be performed two ways. One with the hand, that is, by means of two workmen, who conduct a kind of plank that ſerves for a frizing inſtrument. The other way is by a mill, worked either by water or a horſe, or ſometimes by men. This latter is eſteemed the better way of frizing, by reaſon the motion being uniform and regular, the little knobs of the frizing are formed more equably and regularly. The ſtructure of this uſeful machine is as follows: The three principal parts are the frizer or criſper, the frizing table, and the drawer or beam. The two firſt are two equal planks or boards, each about 10 feet long and 15 inches broad; differing only in this, that the frizing-table is lined or covered with a kind of coarſe woollen ſtuff, of a rough ſturdy nap; and the frizer is incruſted with a kind of cement compoſed of glue, gum arabic, and a yellow ſand, with a little water, or urine. The beam, or drawer, thus called becauſe it draws the ſtuff from between the frizer and the frizing-table, is a wooden roller, beſet all over with little, fine, ſhort points or ends of wire, like thoſe of cards uſed in carding of wool.

The diſpoſition and uſe of the machine is thus: The table ſtands immoveable, and bears or ſuſtains the cloth to be frized, which is laid with that ſide uppermoſt on which the nap is to

be raifed: over the table is placed the frizer, at fuch a diftance from it as to give room for the ftuff to be paffed between them: fo that the frizer, having a very flow femicircular motion, meeting the long hairs or naps of the cloth, twifts and rolls them into little knobs or burrs; while, at the fame time, the drawer, which is continually turning, draws away the ftuff from under the frizer, and winds it over its own points. All that the workman has to do while the machine is going, is, to ftretch the ftuff on the table as faft as the drawer takes it off, and from time to time to take off the ftuff from the points of the drawer.

The defign of having the frizing-table lined with ftuff of a fhort, ftiff, ftubby nap, is, that it may detain the cloth between the table and the frizer long enough for the grain to be formed, that the drawer may not take it away too readily, which muft otherwife be the cafe, as it is not held by any thing at the other end. It were unneceffary to fay any thing particular of the manner of frizing ftuffs with the hand, it being the aim of the workmen to imitate, as near as they can with their wooden inftrument, the flow, equable, and circular motion of the machine: it needs only be added, that their frizer is about two feet long and one broad; and that to form the nap more eafily, they moiften the furface of the ftuff lightly with water in which is mingled fome whites of eggs or honey.

FROBENIUS (John), a famous and learned printer in the 16th century, was born at Hamelburgh in Franconia, and fettled at Bafil. He had before ftudied in that univerfity, where he acquired the reputation of being uncommonly learned; and, now fetting up a printing-houfe in that city, was the firft of the German printers who brought that admirable art to any degree of perfection. Being a man of great probity and piety as well as fkill, he was particularly choice in the works he printed; and would never, for the fake of profit, fuffer libels, or any thing that might hurt the reputation of another, to go through his prefs. The great character of this printer was the principal motive which induced Erafmus to refide at Bafil, in order to have his own works printed by him. A great number of valuable authors were printed by Frobenius with great care and accuracy; among which were the works of St. Jerome, Auguftine, and Erafmus. He defigned to have printed the Greek Fathers; but died in 1527, before he could execute his defign. Erafmus wrote his epitaph in Greek and Latin. John Frobenius left a fon, named *Jerome Frobenius*, and a daughter married to Nicholas Epifcopius; who, joining in partnerfhip, continued Frobenius's printing-houfe with reputation, and printed correct editions of the Greek Fathers.

FROBISHER, or Forbisher (Sir Martin), an excellent navigator and fea-officer in the 16th century, was born near Doncafter in Yorkfhire, and was from his youth brought up to navigation. He was the firft Englifhman who attempted to find a north-weft paffage to China, and in 1576 he failed with two barks and a pinnace in order to attempt that paffage. In this voyage he difcovered a cape, to which he gave the name of *Queen Elizabeth's Foreland*, and the next day difcovered a ftrait to which he gave his own name. This voyage proving unfuccefsful, he attempted the fame paffage in 1577; but difcovering fome ore in an ifland, and his commiffion directing him in this voyage only to fearch for ore, and to leave the farther difcovery of the north-weft to another time, he returned to England. He failed again, with 15 fhips and a great number of adventurers, to form a fettlement: but being obftructed by the ice, and driven out to fea by a violent ftorm, they, after encountering many difficulties, returned home without making any fettlement, but brought a large quantity of ore. He afterwards commanded the Aid in Sir Francis Drake's expedition to the Weft Indies, in which St. Domingo in Hifpaniola, Carthagena and Santa Juftina in Florida, were taken and facked. In 1588 he bravely exerted himfelf in defence of his country againft the Spanifh armada, when he commanded the Triumph, one of the largeft fhips in that fervice; and, as a reward for his diftinguifhed bravery, received the honour of knighthood from the lord high-admiral at fea. He afterwards commanded a fquadron which was ordered to cruife on the Spanifh coaft; and in 1592 took two valuable fhips and a rich carrack. In 1594 he was fent to the affiftance of Henry IV. king of France againft a body of the Leaguers and Spaniards, who had ftrongly entrenched themfelves at Croyzon near Breft; but in an affault upon that fort, on the 7th of November, Sir Martin was unfortunately wounded with a ball, of which he died foon after he had brought back the fleet to Plymouth, and was buried in that town.

Frobisher's *Straits*, lie a little to the northward of Cape Farewell in Weft Greenland, and were difcovered by Sir Martin Frobifher. W. lon. 48. 16. N. lat. 63. 12.

FRODSHAM, a town of Chefhire in England, 162 miles from London, is noted for its ancient caftle. It has a ftone-bridge over the river Weaver near its conflux with the Merfey, and a harbour for fhips of good burden. By the late inland navigation, it has communication with the rivers Dee, Ribble, Oufe, Trent, Darwent, Severn, Humber, Thames, Avon, &c. which navigation, including its windings, extends above 500 miles, in the counties of Lincoln, Nottingham, York, Lancafter, Weftmoreland, Stafford, Warwick, Leicefter, Oxford, Worcefter, &c.

FROG, in zoology. See Rana.

Bull-Frog. See Rana.

Frog-*Fifh* of Surinam, a very fingular animal, of which a figure is given by Mr. Edwards, in his *Hift. of Birds*, vol. 1. There is no fpecimen in the Britifh mufeum, nor in any private collection, except that of Dr. Fothergill. It was brought from Surinam in South America. Frogs, both in Afia and Africa, according to Merian, change gradually from fifhes to frogs, as thofe in Europe; but after many years revert again into fifhes, though the manner of their change has never been inveftigated. In Surinam thefe fifhes are called *jakjes*. They are cartilaginous, of a fubftance like our muftela, and exquifite food: they are formed with regular vertebræ, and fmall bones all over the body divided into equal parts; are firft darkifh, and then grey: their fcales make a beautiful appearance. Whether this animal is, in its perfect ftate, a fpecies of frog with a tail, or a kind of water-lizard, Mr. Edwards does not pretend to determine; but obferves, that when its fize is confidered, if it fhould be deemed a tadpole at firft produced from fpawn and in its progrefs towards a frog, fuch an animal, when full grown, if it bears the fame proportion to its tadpole as thofe in Europe do, muft be of enormous fize; for our full grown frogs exceed the tadpoles at leaft 50 times. See a reduced figure in plate 34.

FROME, or Froom, a river of Dorfetfhire, which comes from the S. W. part of the county to Dorchefter; whence, proceeding to Wareham, it empties itfelf into the bay that forms the harbour of Poole.

Frome, a river of Somerfetfhire, which flows by the town of Frome, and unites with the Avon at Briftol.

Frome, a town of Somerfetfhire, with a market on Wednefday. It is feated on the river Frome, and is well inhabited by clothiers. The article manufactured here is chiefly fecond cloth, the principal material of which is fine Englifh wool. It is 12 miles S. of Bath, and 104 W. by S. of London. W. lon. 2. 16. N. lat. 51. 10.

FRONDESCENTIA, from *frons*, "a leaf;" the precife time of the year and month in which each fpecies of plant unfolds its firft leaves. All plants produce new leaves every year; but all do not renew them at the fame time. Among woody plants, the elder, and moft of the honey-fuckles; among peren-

nial herbs, crocus and tulip, are the firſt that puſh or expand their leaves. The time of ſowing the ſeeds decides with reſpect to annuals. The oak and aſh are conſtantly the lateſt in puſhing their leaves: the greater number unfold them in ſpring; the moſſes and firs in winter. Theſe ſtriking differences, with reſpect to ſo material a circumſtance in plants as that of unfolding their leaves, ſeem to indicate that each ſpecies of plants has a temperature proper or peculiar to itſelf, and requires a certain degree of heat to extricate the leaves from their buds, and produce the appearance in queſtion. This temperature, however, is not ſo fixed or conſtant as it may appear to a ſuperficial obſerver. Among plants of the ſame ſpecies, there are ſome more early than others; whether that circumſtance depends, as it moſt commonly does, on the nature of the plants, or is owing to differences in heat, expoſure, and ſoil. In general, it may be affirmed, that ſmall and young trees are always earlier than larger or old ones. The puſhing of the leaves is likewiſe accelerated or retarded according to the temperature of the ſeaſon; that is, according as the ſun is ſooner or later in diſpenſing that certain degree of heat which is ſuitable to each ſpecies.

FRONT, the forehead, or that part of the face above the eyebrows. The word is formed of the Latin *frons*;" and that from the Greek φρονειν "to think, perceive;" of φρην *mens*, "the mind, or thought." Martinius, to make out this etymology, obſerves, that from the forehead of a perſon we perceive what he is, what he is capable of, and what he thinks of.

Front is alſo uſed where ſeveral perſons or things are ranged ſide by ſide, and ſhow their front or foreparts.

Front, in architecture, denotes the principal face or ſide of a building, or that preſented to the chief aſpect or view.

FRONTAL, in architecture, a little fronton or pediment, ſometimes placed over a ſmall door or window.

Frontal, *Frontlet*, or *Brow-band*, is alſo uſed in ſpeaking of the Jewiſh ceremonies. This frontal conſiſts of four ſeveral pieces of vellum, on each whereof is written ſome text of ſcripture. They are all laid on a piece of black calf's leather with thongs to tie it by. The Jews apply the leather with the vellum on their foreheads in the ſynagogue, and tie it round the head with the thongs.

FRONTIER, the border, confine, or extreme of a kingdom or province, which the enemies find in front when they would enter the ſame. Thus we ſay, a frontier town, frontier province, &c. Frontiers were anciently called *marches*. The word is derived from the French *frontiere*, and that from the Latin *frontaria*; as being a kind of front oppoſed to the enemy. Skinner derives *frontier* from *front*; inaſmuch as the frontier is the exterior and moſt advanced part of a ſtate, as the front is that of the face of a man.

FRONTIGNIAC wine, is ſo called from a town in the *ci-devant* province of Languedoc in France, ſituated 16 miles ſouth-weſt of Montpelier, remarkable for producing it.

FRONTINUS (Sextus Julius), an ancient Roman writer, was of conſular dignity, and flouriſhed under the emperors Veſpaſian, Titus, Domitian, Nerva, and Trajan. He commanded the Roman armies in Britain, was made city-prætor when Veſpaſian and Titus were conſuls, and Nerva made him curator of the aqueducts, which occaſioned his writing *De aquæductibus urbis Romæ*. He wrote four books upon the Greek and Roman art of war; a piece *De re agraria*, and another *De limitibus*. Theſe have been often ſeparately re-printed; but were all collected together in a neat edition at Amſterdam in 1661, with notes by Robertus Keuchenius. He died under Trajan.

FRONTISPIECE, in architecture, the principal face of a fine building. The word is formed of the Latin *frontiſpicium*, q. d. *frontis hominis inſpectio*. Hence alſo, by a figure, we ſay, the frontiſpiece of a book; meaning an ornament with an engraved title on the firſt page.

FRONTLET. See Frontal.

FRONTO (Marcus Cornelius), was choſen for his eloquence to inſtruct the emperors Marcus Aurelius and Lucius Verus in rhetoric; in recompenſe of which he was promoted to the conſulate, and a ſtatue was erected to his honour. He taught Marcus Aurelius not only eloquence, but the duty of kings, and excellent morals. Some ſay he wrote againſt the Chriſtians. A ſect was formed of thoſe who looked upon him as a model of perfect eloquence, and theſe were called *Frontoniani*. The Civilians, whoſe names were *Fronto*, mentioned in the pandects, were probably deſcended from him.

FROST, ſuch a ſtate of the atmoſphere as cauſes the congelation or freezing of water or other fluids into a ſolid ſubſtance.

The nature and effects of froſt in different countries are mentioned at ſome length under the article Freezing. In the more northern parts of the world, even ſolid bodies are affected by froſt, though this is ſolely or chiefly in conſequence of the moiſture they contain; which being frozen into ice, and ſo expanding as water is known to do when frozen, it burſts and rends any thing in which it is contained, as plants, trees, ſtones, and large rocks. Some fluids expand by froſt, as water, which expands about $\frac{1}{10}$th part, for which reaſon ice floats in water; but others again contract, as quickſilver, and hence frozen quickſilver ſinks in the fluid metal.

Froſt, being derived from the atmoſphere, naturally proceeds from the upper parts of bodies downwards, as the water and the earth: ſo, the longer a froſt is continued, the thicker the ice becomes upon the water in ponds, and the deeper into the earth the ground is frozen. In about 16 or 17 days froſt, Mr. Boyle found it had penetrated 14 inches into the ground. At Moſcow, in a hard ſeaſon, the froſt will penetrate 2 feet deep in the ground; and Capt. James found it penetrated 10 feet deep in Charlton iſland, and the water in the ſame iſland was frozen to the depth of 6 feet. Scheffer aſſures us, that in Sweden the froſt pierces 2 cubits or Swediſh ells into the earth, and turns what moiſture it finds there into a whitiſh ſubſtance, like ice; and ſtanding waters to 3 ells, or more. The ſame author alſo mentions ſudden cracks or rifts in the ice of the lakes of Sweden, 9 or 10 feet deep, and many leagues long; the rupture being made with a noiſe not leſs loud than if many guns were diſcharged together. By ſuch means, however, the fiſhes are furniſhed with air; ſo that they are rarely found dead.

The natural hiſtories of froſts furniſh very extraordinary effects of them. The trees are often ſcorched and burnt up, as with the moſt exceſſive heat, and ſplit or ſhattered. In the great froſt in 1683, the trunks of oak, aſh, walnut, &c. were miſerably ſplit and cleft, ſo that they might be ſeen through, and the cracks often took place with dreadful noiſes like the exploſion of fire arms. See the Philoſ. Tranſ. No. 165.

The cloſe of the year 1708, and the beginning of 1709, were remarkable, throughout the greateſt part of Europe, for a ſevere froſt. Dr. Derham ſays, it was the greateſt in degree, if not the moſt univerſal, in the memory of man; extending through moſt parts of Europe, though ſcarcely felt in Scotland or Ireland.

In very cold countries, meat may be preſerved by the froſt 6 or 7 months, and prove tolerably good eating. See Capt. Middleton's obſervations made in Hudſon's bay, in the Philoſ. Tranſ. No. 465, ſect. 2. In that climate the froſt ſeems never out of the ground, it having been found hard frozen in the two ſummer months. Brandy and ſpirit of wine, ſet out in the open air, freeze to ſolid ice in 3 or 4 hours. Lakes and ſtanding waters, not above 10 or 12 feet deep, are frozen to the ground in winter, and all their fiſh periſh. But in rivers, where the current of the tide is ſtrong, the ice does not reach ſo deep, and the fiſh are preſerved.

Some remarkable inſtances of froſt in Europe, and chiefly in England, we have here recorded.

In 220, a froſt in Britain laſted 5 months. 250, The Thames frozen 9 weeks. 291, Moſt rivers in Britain frozen 6 weeks. 359, Severe froſt in Scotland for 14 weeks. 508, The rivers in Britain frozen for 2 months. 558, The Danube quite frozen over. 695, Thames frozen 6 weeks, and booths built on it. 759, Froſt from Oct. 1 till Feb. 26, 760. 827, Froſt in England for 9 weeks. 859, Carriages uſed on the Adriatic ſea. 908, Moſt rivers in England frozen 2 months. 923, The Thames frozen 13 weeks. 987, Froſt laſted 120 days: began Dec. 22. 998, The Thames frozen 5 weeks. 1035, Severe froſt on June 24: the corn and fruits deſtroyed. 1063, The Thames frozen 14 weeks. 1076, Froſt in England from Nov. till April. 1114, Several wooden bridges carried away by ice. 1205, Froſt from Jan. 15 till March 22. 1407, Froſt that laſted 15 weeks. 1434, From Nov. 24 till Feb. 10. Thames frozen down to Graveſend. 1683, Froſt for 13 weeks. 170$\frac{8}{9}$, Severe froſt for many weeks. 1715, The ſame for many weeks. 1739, One for 9 weeks; began Dec. 24. 1742, Severe froſt for many weeks. 1747, Severe froſt in Ruſſia. 1754, Severe one in England. 1760, The ſame in Germany. 1776, The ſame in England. 1788, The Thames frozen below bridge; and booths erected on it.

Hoar Frost, is the dew frozen or congealed, early in cold mornings; chiefly in autumn. Though many Carteſians will have it formed of a cloud; and either congealed in the cloud, and ſo let fall, or ready to be congealed as ſoon as it arrives at the earth.

Hoar Froſt, M. Regis obſerves, conſiſts of an aſſemblage of little parcels of ice cryſtals, which are of various figures, according to the different diſpoſition of the vapours, when met and condenſed by the cold.

Melioration of Aromatic Spirits by Frost. Mr. Baumé obſerves, that aromatic ſpirituous waters have leſs ſcent when newly diſtilled than after they have been kept about ſix months: and he found that the good effects of age were produced in a ſhort time by means of cold; and that, by plunging quart-bottles of the liquor into a mixture of pounded ice and ſea-ſalt, the ſpirit, after having ſuffered for ſix or eight hours the cold hence reſulting, proves as grateful as that which hath been kept many years. Simple waters alſo, after having been frozen, prove far more agreeable than they were before. Geoffroy takes notice of this melioration by froſt; *Hiſt. Acad.* 1713.

FROTH, a white light ſubſtance, formed on the ſurface of fluids by vehement agitation, conſiſting of a multitude of little ſpherules or globules.

Froth-*Spit*, or *Cuckow-ſpit*, a name given to a white froth, or ſpume, very common in the ſpring and firſt months of ſummer, on the leaves of certain plants, particularly on thoſe of the common white field-lychnis or catch-fly; thence called by ſome *ſpatling poppy*. All writers on vegetables have taken notice of this froth, though few have underſtood the cauſe or origin of it till of late. It is formed by a little leaping animal, called by ſome the *flea graſs-hopper*, by applying its anus cloſe to the leaf, and diſcharging thereon a ſmall drop of a white viſcous fluid, which, containing ſome air in it, is ſoon elevated into a ſmall bubble: before this is well formed, it depoſits ſuch another drop; and ſo on, till it is every way overwhelmed with a quantity of theſe bubbles, which form the white froth which we ſee. Within this ſpume it is ſeen to acquire four tubercles on its back, wherein the wings are incloſed: theſe burſting, from a reptile it becomes a winged animal: and thus, rendered perfect, it flies to meet its mate, and propagate its kind. It has an oblong, obtuſe body, and a large head with ſmall eyes. The external wings, for it has four, are of a duſky brown colour, marked with two white ſpots: the head is black. It is a ſpecies of Cicada.

FROWDE (Philip), an Engliſh poet, was the ſon of a gentleman who had been poſt-maſter in the reign of queen Anne. He was ſent to the univerſity of Oxford, where he had the honour of being diſtinguiſhed by Addiſon, who took him under his protection. While he remained there, he became the author of ſeveral pieces of poetry, ſome of which in Latin were pure and elegant enough to entitle them to a place in the *Muſæ Anglicanæ*. He likewiſe wrote two tragedies: The Fall of Saguntum, dedicated to Sir Robert Walpole; and Philotas, addreſſed to the earl of Cheſterfield. He died at his lodgings in Cecil-ſtreet in the Strand in 1738, and in the London Daily-Poſt had the following character given him: "Though the elegance of Mr. Frowde's writings has recommended him to the general public eſteem, the politeneſs of his genius is the leaſt amiable part of his character; for he eſteemed the talents of wit and learning only as they were conducive to the excitement and practice of honour and humanity. Therefore, with a ſoul cheerful, benevolent, and virtuous, he was in converſation genteelly delightful, in friendſhip punctually ſincere, in death chriſtianly reſigned. No man could live more beloved, no private man could die more lamented." A fine eloge! and we have no reaſon to doubt the truth of it.

FRUCTESCENTIA, (from *fructus*, "fruit,") comprehends the preciſe time in which, after the fall of the flowers, the fruits arrive at maturity, and diſperſe their ſeeds. In general, plants which flower in ſpring ripen their fruits in ſummer, as rye; thoſe which flower in ſummer have their fruits ripe in autumn, as the vine; the fruit of autumnal flowers ripens in winter, or the following ſpring, if kept in a ſtove, or otherwiſe defended from exceſſive froſts. Theſe froſts, ſays M. Adanſon, are frequently ſo pernicious and violent as to deſtroy the greateſt part of the perennial plants of Virginia and Miſſiſſippi that are cultivated in France, even before they have exhibited their fruit. The plants which flower during our winter, ſuch as thoſe of the Cape of Good Hope, ripen their fruit in ſpring in our ſtoves.

FRUCTIFICATION of plants, is defined by Linnæus to be the temporary part of a vegetable appropriated to generation, terminating the old vegetable, and beginning the new. It conſiſts of the following ſeven parts; *viz.* the calyx, corolla, ſtamen, piſtillum, pericarpium, ſemen or ſeed, and receptaculum. See Botany, p. 32.

FRUIT, in its general ſenſe, includes whatever vegetable ſubſtances the earth produces for the nouriſhment and ſupport of animals; as herbs, grain, pulſe, hay, corn, flax, and every thing expreſſed by the Latins under the name *fruges*.

Fruit, in natural hiſtory, denotes the laſt production of a tree or plant, for the propagation or multiplication of its kind; in which ſenſe fruit includes all kinds of ſeeds, with their furniture, &c.

Fruit, in botany, is properly that part of a plant wherein the ſeed is contained; called by the Latins *fructus*; and by the Greeks καρπὸς. The fruit in the Linnæan ſyſtem is one of the parts of fructification, and is diſtinguiſhed into three parts, viz. the pericarpium, ſeed, and receptacle or *receptaculum ſeminum*. See Botany.

Bread-Fruit. See Artocarpus and Bread.

Fruits, with regard to commerce, are diſtinguiſhed into *recent* or *freſh*, and *dry*. Recent fruits, are thoſe ſold juſt as they are gathered from the tree, without any farther preparation; as are moſt of the productions of our gardens and orchards, ſold by the fruiterers. Dry fruits, are thoſe dried in the ſun, or by the fire, with other ingredients ſometimes added to them to make them keep; imported chiefly from beyond ſea, and ſold by th grocers. Such are raiſins, currants, figs, capers, olives, cloves, nutmegs, pepper, and other ſpices; which ſee under their reſpective articles. Under the denomination of *dry fruits* are alſo frequently included apples, pears, almonds, filberds, &c.

Fruit-*Flies*, a name given by gardeners and others to a ſort of ſmall black flies found in vaſt numbers among fruit-trees, in the ſpring ſeaſon, and ſuppoſed to do great injury to them. Mr. Lewenhoek preſerved ſome of theſe flies for his microſcopical obſervations. He found that they did not live longer than a day or two, but that the females during this time laid a great number of longiſh eggs. The gardeners who ſuppoſe that theſe flies wound the leaves of the trees are miſtaken: it is true that they feed on their juices; but they have no inſtruments wherewith they can extract theſe for themſelves: they feed on ſuch as are naturally extravaſated; and when there is not a ſufficient quantity of theſe for their purpoſe, they haunt the places to which the pucerons reſort, and feed on the juices which theſe little creatures extravaſate by means of the holes they bore in the leaves with their trunk.

Fruit-*Stones*. The miſchiefs that ariſe from the cuſtom which many people have of ſwallowing the ſtones of plums and other fruit are very great. The Philoſophical Tranſactions give an account of a woman who ſuffered violent pains in her bowels for 30 years, returning once in a month or leſs. At length, a ſtrong purge being given her, the occaſion of all theſe complaints was driven down from the bowels to the anus; where it gave a ſenſation of diſtenſion and ſtoppage, producing a continual deſire of going to ſtool, but without voiding any thing. On the aſſiſtance of a careful hand in this caſe, there was taken out with a forceps a ball of an oval figure, of about ten drachms in weight, and meaſuring five inches in circumference. This had cauſed all the violent fits of pain which ſhe had ſuffered for ſo many years; and, after voiding it, ſhe became perfectly well. The ball extracted looked like a ſtone, and felt very hard, but it ſwam in water. On cutting it through with a knife, there was found in the centre of it a plum-ſtone; round which, ſeveral coats of this hard and tough matter had gathered. Another inſtance given in the ſame papers is of a man, who, dying of an incurable colic which had tormented him many years, and baffled the effects of medicine, was opened after death; and in his bowels was found a ball ſimilar to that above mentioned, but ſomewhat larger, being ſix inches in circumference, and weighing an ounce and an half. In the centre of this, as of the other, there was found the ſtone of a common plum; and the coats were of the ſame nature with thoſe of the former. Theſe and ſeveral other inſtances mentioned in the ſame place, ſufficiently ſhow the folly of that common opinion, that the ſtones of fruits are *wholeſome*. Cherry-ſtones, ſwallowed in great quantities, have alſo in many inſtances occaſioned death.

Fruit-*Trees*. With regard to theſe it may be obſerved, 1. That cutting and pruning them when young diminiſh their bearing, though they contribute to the richneſs and flavour of the fruit, as well as to the beauty of the tree. 2. That kernel-fruit trees come later to bear than ſtone-fruit trees: the time required by the firſt, before they come to any fit age for bearing, being one with another five years; but when they do begin, they bear in greater plenty than ſtone-fruit. 3. That ſtone-fruit, figs, and grapes, commonly bear conſiderably in three or four years, and bear full crops the fifth and ſixth years; and hold it for many years, if well ordered. 4. That fruit-trees in the ſame neighbourhood will ripen a fortnight ſooner in ſome grounds than in others of a different temperature. 5. That, in the ſame country, hot or cold ſummers ſet conſiderably forwards, or put backwards, the ſame fruit. 6. That the fruit on wall-trees generally ripen before thoſe on ſtandards, and thoſe on ſtandards before thoſe on dwarfs. 7. That the fruit of all wall trees planted in the ſouth and eaſt quarters commonly ripen about the ſame time, only thoſe in the ſouth rather earlier than thoſe in the eaſt; thoſe in the weſt are later by eight or ten days; and thoſe in the north, by 15 or 20. For the planting, pruning, grafting, &c. of fruit-trees, ſee the articles Planting, Transplanting, Pruning, Grafting, Orchard, Nursery, &c.

FRUITERY, a place for the keeping of fruit, a fruit-houſe, or fruit-loft. A fruitery ſhould be inacceſſible to any thing of moiſture; and ſhould be as much ſo as poſſible, even to froſt.

FRUMENTACEOUS, a term applied by botaniſts to all ſuch plants as have a conformity with wheat, in reſpect of their fruits, leaves, ears, or the like.

FRUMENTARII, a kind of ſoldiers or archers under the weſtern empire. The firſt time we read of theſe officers is in the reign of the emperor Adrian, who made uſe of them to inform himſelf of whatever paſſed. They did not make any particular corps diſtinct from the reſt of the forces, but there was a certain number of them in each legion. It is ſuppoſed, that they were at firſt a number of young perſons, diſpoſed by Auguſtus throughout the provinces, particularly on all the grand roads, to acquaint the emperor, with all expedition, of every thing that happened. Afterwards they were incorporated into the troops themſelves, where they ſtill retained their ancient name. As their principal office was the giving intelligence, they were often joined with the curioſi, with whom they agreed in this part of their office. Their name of *frumentarii* is derived from their being alſo a ſort of purveyors to the armies, cities, &c. collecting all the corn from the ſeveral provinces to furniſh the commonwealth.

FRUMENTATION, in Roman antiquity, a largeſs of corn beſtowed on the people. This practice of giving corn to the people was very ancient among the Romans, and frequently uſed to ſoothe the turbulent humour of the populace. At firſt the number of thoſe to whom the largeſs was given was indeterminate, till Auguſtus fixed it at 200,000.

FRUSH, or *Running*-thrush. See Farriery, p. 447.

FRUSTUM, in mathematics, a part of ſome ſolid body ſeparated from the reſt. The fruſtum of a cone is the part that remains, when the top is cut off by a plane parallel to the baſe; and is otherwiſe called a *truncated cone*. See Conic *Sections*. The fruſtum of a pyramid is alſo what remains after the top is cut off by a plane parallel to its baſe. The fruſtum of a globe or ſphere is any part thereof cut by a plane, the ſolid contents of which may be found by this rule: To three times the ſquare of the ſemidiameter of the baſe add the ſquare of its height; then multiply that ſum by the height, and this product, multiplied by .5236, gives the ſolidity of the fruſtum.

FRUTEX, a shrub. Shrubs, according to Linnæus, make a branch of the ſeventh family in the vegetable kingdom; and are diſtinguiſhed from trees, in that they come up without buds. But this diſtinction is not univerſal, though it be generally juſt with regard to thoſe of Europe. Nature hath made no abſolute diſtinction between trees and ſhrubs. *Frutex*, in its general acceptation, is a plant whoſe trunk is perennial, gemmiparous, woody, dividing and ſubdividing into a great number of branches. In ſhort, it is the epitome of a tree, exemplified in the roſe-buſh.

FRY, in ichthyology, ſignifies the ſpawn, or rather young, of fiſh.

FRYTH (John), a martyr to the Proteſtant religion in the reign of Henry VIII. He was the ſon of an inn-keeper at Seven-oaks in Kent, and educated in the King's-college, Cambridge, where he took the degree of bachelor of arts. Thence he removed to Oxford, and was made a junior canon of Wolſey's college. He had not been long in this univerſity before he became acquainted with William Tyndale, a zealous Lutheran, with whom he converſed frequently on the abuſes in religion. Fryth became a convert to Lutheraniſm, and, with more zeal than prudence, attempting to make proſelytes, was ſoon apprehended by order of the chancellor Sir Thomas More, and

ſent priſoner to the Tower. Refuſing to recant his opinions, he was burnt in Smithfield, on the 4th of July 1533. He left ſeveral works behind him, which were printed in folio in 1573.

FUAGE, in old Engliſh writers, a tax of 12d. for every fire, levied in the time of Edward III.

FUCUS, a name given by the ancients to certain dyes and paints. By this name they called a purple ſea-plant uſed by them to die woollen and linen cloths of that colour. The dye was very beautiful, but not laſting: for it ſoon began to change, and in time went wholly off. This is the account Theophraſtus gives of it.

The women of thoſe times alſo uſed ſomething called *fucus*, to ſtain their cheeks red; and many have ſuppoſed, from the ſame word expreſſing both, that the ſame ſubſtance was uſed on both occaſions. But this, on a ſtrict inquiry, proves not to be the caſe. The Greeks called every thing *fucus*, that would ſtain or paint the fleſh. But this peculiar ſubſtance, uſed by the women to paint their cheeks, was diſtinguiſhed from the others by the name of *rizion* among the more correct writers, and was indeed a root brought from Syria into Greece. The Latins, in imitation of the Greek name, called this root *radicula*; and Pliny very erroneouſly confounds the plant with the *radix lunaria*, or *ſtruthion* of the Greeks.

The word *fucus* was in thoſe times become ſuch an univerſal name for paint, that the Greeks and Romans had a *fucus metallicus*, which was the cerus uſed for painting the necks and arms white; after which they uſed the *purpuriſſum*, or red fucus of the *rizium*, to give the colour to the cheeks. In after-times they alſo uſed a peculiar *fucus* or paint for the purpoſe, prepared of the *Creta argentaria*, or ſilver-chalk, and ſome of the rich purple dyes that were in uſe at that time: and this ſeems to have been very little different from our roſe-pink; a colour commonly ſold at the colour-ſhops.

Fucus, in the Linnæan ſyſtem of botany, is a genus of the order of algæ, belonging to the cryptogamia claſs of plants. The moſt remarkable ſpecies are,

1. The *ſerratus*, ſerrated fucus, or ſea-wrack. This is frequent at all ſeaſons of the year upon the rocks at low-water-mark, but produces its ſeeds in July and Auguſt. It conſiſts of a flat, radical, and dichotomous leaf, about two feet long; the branches half an inch wide, ſerrated on the edges with dents of unequal ſize, and at unequal diſtances, having a flat ſtalk or rib divided like the leaf, and running in the middle of it through all its various ramifications. A ſmall ſpecies of coralline, called by Linnæus *Sertularia pumila*, frequently creeps along the leaf. All the ſpecies of fucus afford a quantity of impure alkaline ſalt; but this much leſs than ſome others, eight ounces of the aſhes yielding only three of fixed ſalt. The Dutch cover their crabs and lobſters with this fucus, to keep them alive and moiſt, and prefer it to any other, as being deſtitute of thoſe mucous veſicles with which ſome of the reſt abound, and which would ſooner ferment and become putrid.

2. The *veſiculoſus*, bladder fucus, common ſea-wrack, or ſea-ware. It grows in great abundance on the ſea-rocks about low-water-mark; producing its fructifications in July and Auguſt. It has the ſame habit, colour, and ſubſtance as the foregoing; but differs from it in the following reſpects: the edges of the leaf have no ſerratures, but are quite entire. In the diſc or ſurface are immerſed hollow, ſpherical, or oval air-bladders, hairy within, growing generally in pairs, but often ſingle in the angles of the branches, which are moſt probably air-bladders deſtined to buoy up the plant in the water. Laſtly, on the ſummits or extreme ſegments of the leaves, appear tumid veſicles about three quarters of an inch long, ſometimes oval and in pairs, ſometimes ſingle and bifid, with a clear viſcid mucus interſperſed with downy hairs. This ſpecies is an excellent manure for land; for which purpoſe it is often applied in the maritime parts of Scotland and other countries. In the iſlands of Jura and Skye it frequently ſerves as a winter-food for cattle, which regularly come down to the ſhores at the receſs of the tides to ſeek for it. And ſometimes even the ſtags have been obſerved, after a ſtorm, to deſcend from the mountains to the ſea-ſides to feed upon this plant.

Linnæus informs us, that the inhabitants of Gothland in Sweden boil this fucus in water, and, mixing therewith a little coarſe meal or flour, feed their hogs with it; for which reaſon they call the plant *ſwinetang*. And in Scania, he ſays, the poor people cover their cottages with it, and ſometimes uſe it for fuel. In Jura, and ſome other of the Hebrides, the inhabitants dry their cheeſes without ſalt, by covering them with the aſhes of this plant; which abounds with ſuch a quantity of ſalts, that from five ounces of the aſhes may be procured two ounces and a half of fixed alkaline ſalts, that is, half of their whole weight. But the moſt beneficial uſe to which the fucus veſiculoſus is applied, in the way of economy, is in making pot-aſh or kelp, a work much practiſed in the Weſtern Iſles. There is great difference in the goodneſs and price of this commodity, and much care and ſkill required in properly making it. That is eſteemed the beſt which is hardeſt, fineſt grained, and free from ſand or earth. The price of kelp in Jura is 3l. 10s. *per* ton, and about 40 or 50 tons are exported annually from that iſland. So great a value is ſet upon this fucus by the inhabitants of that place, that they have ſometimes thought it worth their while to roll fragments of rocks and huge ſtones into the ſea, in order to invite the growth of it.

Its virtues in the medical way have been much celebrated by Dr. Ruſſel, in his Diſſertation concerning the uſe of Sea-water in the Diſeaſes of the Glands. He found the ſaponaceous liquor or mucus in the veſicles of this plant to be an excellent reſolvent, extremely ſerviceable in diſperſing all ſcorbutic and ſcrophulous ſwellings of the glands. He recommends the patient to rub the tumour with theſe veſicles bruiſed in his hand, till the mucus has thoroughly penetrated the part, and afterwards to waſh with ſea-water. Or otherwiſe, to gather two pounds of the tumid veſicles, in the month of July, when they are full of mucus, and infuſe them in a quart of ſea-water, in a glaſs-veſſel, for the ſpace of 15 days, when the liquor will have acquired nearly the conſiſtence of honey. Then ſtrain it off through a linen cloth, and rub this liquor with the hand, as before, three or four times a-day, upon any hard or ſcrophulous ſwellings, waſhing the parts afterwards with ſea-water; and nothing can be more efficacious to diſperſe them. Even ſcirrhoſities, he ſays, in women's breaſts, have been diſpelled by this treatment. The ſame author, by calcining the plant in the open air, made a very black ſalt powder, which he called *vegetable æthiops*; a medicine much in uſe as a reſolvent and deobſtruent, and recommended alſo as an excellent dentifrice, to correct the ſcorbutic laxity of the gums, and to take off the foulneſs of the teeth.

3. The *plicatus*, matted or Indian-graſs fucus, grows on the ſea-ſhores in many places both of Scotland and England. It is generally about three or four, but ſometimes ſix, inches long. Its colour, after being expoſed to the ſun and air, is yellowiſh, or auburn; its ſubſtance pellucid, tough, and horny, ſo as to bear a ſtrong reſemblance to what anglers call *Indian-graſs*, that is, the tendrils iſſuing from the ovary of the dog-fiſh.

4. The *palmatus*, palmated or ſweet fucus, commonly called *dulſe* or *dilſe*. This grows plentifully on the ſea coaſts of Scotland, and the adjoining iſlands. Its ſubſtance is membranaceous, thin, and pellucid; the colour red, ſometimes green with a little mixture of red; its length generally about five or ſix inches, but varies from three inches to a foot; its manner of growth fan-ſhaped, or gradually dilated from the baſe upwards.

Its diviſions are extremely various. The inhabitants both of Scotland and England take pleaſure in eating this plant, without expecting any medical virtues from it. The inhabitants of the Archipelago alſo are fond of it, as we learn from Steller. They ſometimes eat it raw, but eſteem it moſt when added to ragouts, oglios, &c. to which it gives a red colour; and, diſſolving, renders them thick and gelatinous. In the Iſle of Skye it is ſometimes uſed in fevers to promote a ſweat, being boiled in water with the addition of a little butter. In this manner it alſo frequently purges. The dried leaves, infuſed in water, exhale the ſcent of violets.

5. The *eſculentus*, eatable fucus, or bladder-locks, commonly called *tangle* in Scotland, is likewiſe a native of the Britiſh ſhores. It is commonly about four feet long, and ſeven or eight inches wide; but is ſometimes found three yards or more in length, and a foot in width. Small ſpecimens are not above a cubit long, and two inches broad. The ſubſtance is thin, membranaceous, and pellucid; the colour green or olive. The root conſiſts of tough cartilaginous fibres. The ſtalk is about ſix inches long and half an inch wide, nearly ſquare, and pinnated in the middle between the root and origin of the leaf, with ten or a dozen pair of thick, cartilaginous, oval-obtuſe, foliaceous ligaments, each about two inches long, and crowded together. The leaf is of an oval-lanceolate, or long elliptic form, ſimple and undivided, waved on the edges, and widely ribbed in the middle from bottom to top, the ſtalk running through its whole length, and ſtanding out on both ſides of the leaf. This fucus is eaten in the north both by men and cattle. Its proper ſeaſon is in the month of September, when it is in greateſt perfection. The membranous part is rejected, and the ſtalk only is eaten. It is recommended in the diſorder called *pica*, to ſtrengthen the ſtomach and reſtore the appetite.

6. The *ſaccharinus*, ſweet fucus, or ſea-belt, is very common on the ſea-coaſt. The ſubſtance of this is cartilaginous and leathern, and the leaf is quite ribleſs. By theſe characters it is diſtinguiſhed from the preceding, to which it is nearly allied. It conſiſts only of one ſimple, linear, elliptic leaf, of a tawny-green colour, about five feet long, and three inches wide in its full-grown ſtate; but varies ſo exceedingly as to be found from a foot to four yards in length. The ordinary length of the ſtalk is two inches; but it varies even to a foot. The root is compoſed of branched fibres, which adhere to the ſtones like claws. This plant is often infeſted with the fertularia ciliata. The inhabitants of Iceland make a kind of pottage of this fucus; boiling it in milk, and eating it with a ſpoon. They alſo ſoak it in freſh water, dry it in the ſun, and then lay it up in wooden veſſels, where in a ſhort time it is covered with a white eſfloreſcence of ſea-ſalt, which has a ſweet taſte like ſugar. This they eat with butter; but, if taken in too great a quantity, the ſalt is apt to irritate the bowels and bring on a purging. Their cattle feed and get fat upon this plant, both in its recent and dry ſtate; but their fleſh acquires a bad flavour. It is ſometimes eaten by the common people on the coaſt of England, being boiled as a pot-herb.

7. The *ciliatus*, ciliated or ligulated fucus, is found on the ſhores of Icna and other places, but is not common. The colour of this is red, the ſubſtanee membranous and pellucid, without rib or nerve; the ordinary height of the whole plant about four or five inches. It is variable in its appearance, according to the different ſtages of its growth. This fucus is eaten by the Scots and Iriſh promiſcuouſly with the fucus palmatus or dilſe.

8. The *prolifer*, or proliferous fucus, is found on the ſhores of the weſtern coaſt, adhering to ſhells and ſtones. The colour is red; the ſubſtance membranaceous, but tough, and ſomewhat cartilaginous, without rib or nerve, though thicker in the middle than at the edges. The whole length of the plant is about four or five inches; the breadth of each leaf about a quarter of an inch. The growth of this fucus, when examined with attention, appears to be extremely ſingular and wonderful. It takes its origin either from a ſimple, entire, narrow, elliptic leaf, about an inch and a half long; or from a dilated forked one of the ſame length. Near the extremity of the elliptic leaf, or the points of the forked one (but out of the ſurface, and not the edge), ariſes one or more elliptic or forked leaves, which produce other ſimilar ones, in the ſame manner, near the ſummits; and ſo on continually one or more leaves from near the ends of each other, in a proliferous and dichotomous order, to the top of the plant; which in the manner of its growth reſembles in a good meaſure the cactus opuntia, or flat-leaved Indian fig. Sometimes two or three leaves, or more, grow out of the middle of the diſc of another leaf; but this is not the common order of their growth. The fructifications are red, ſpherical, rough warts, leſs than the ſmalleſt pin's head, ſcattered without order on the ſurface of the leaves. Theſe warts, when highly magnified, appear to be the curled rudiments of young leaves, which in due time either drop off and form new plants, or continue on and germinate upon the parent. This plant is very much infeſted with the fluſtra piloſa, the mandrepora verrucaria, and other corallines, which make it appear as if covered with white ſcabs.

9. The *pinnatifidus*, jagged fucus, or pepper-dilſe, is frequent on ſea-rocks which are covered by the tides, both on the eaſtern and weſtern coaſts. It is of a yellow olive-colour, often tinged with red. The ſubſtance is cartilaginous, but yet tender and tranſparent; the height about two or three inches. This fucus has a hot taſte in the mouth, and is therefore called *pepper-dilſe* by the people in Scotland, who frequently eat it as a ſalad, in the ſame manner they do the fucus palmatus.

10. The *plocamium*, or pectinated fucus, is frequent on the ſea-rocks, and in baſins of water left by the receſs of the tides. Its natural colour is a moſt beautiful bright red or purple, but is often variegated with white or yellow. Its ſubſtance is cartilaginous, but extremely thin, delicate, and tranſparent; its height commonly about three or four inches. The ſtalk is compreſſed, about half a line in diameter, erect, but waved in its growth, and divided almoſt from the baſe into many widely-expanded branches. Theſe primary branches are very long, alternate, exactly like the ſtalk, and ſubdivided into alternate ſecondary branches, which are again frequently compounded in like manner, and theſe diviſions decorated with ſubulated teeth growing in alternate rows, curiouſly pectinated or finely toothed on the upper ſide like a comb, the ſmalleſt of theſe teeth ſcarcely viſible to the naked eye. The fructifications are minute ſpherical capſules, or ſmooth dark-red globules, ſcattered without order on the ſides of the branches; generally ſeſſile, but ſome few of them ſupported on ſhort peduncles. This fucus, on account of its elegant colours and fine diviſions, is the ſpecies moſt admired by the ladies who are fond of pictures and mimic landſcapes compoſed of marine vegetables.

11. The *filum*, thread-fucus, or ſea-laces, is found on the ſea-rocks, and waving under the water like long ſtrings, frequent on many parts of the coaſt. The ſubſtance of this is opaque and cartilaginous, but not difficult to be broken. The colour, when recent, a dull olive-green; when dry, fuſcous, or nearly black; and, when expoſed for ſome time on the ſhores to the ſun and air, it becomes yellow, ſtraw-coloured, or white. It conſiſts only of a ſimple, unbranched, naked, cylindrical ſtalk, three or four yards long, more or leſs, from the ſize of a large fiddle-ſtring to that of a thick whip-cord; ſmalleſt at the baſe and ſummit; ſmooth on the outſide, full of mucus within; often twiſted, and always intercepted by numerous tranſverſe diaphragms, viſible when the plant is held between

the eye and the light. The fructifications have not yet been diſcovered; but, from the tranſverſe ſepta in its ſtructure, it is reaſonable to ſuppoſe this plant to belong rather to the genus of conferva than that of fucus. The ſtalks, ſkinned when half dry, and twiſted, acquire ſo conſiderable a degree of ſtrength and toughneſs, that we are informed the Highlanders ſometimes uſe them for the ſame purpoſes as Indian-graſs.

12. The *giganteus*, or gigantic fucus, is a native of the Straits Le Maire, and grows on rocky ground, which in thoſe countries is diſtinguiſhed from ſand or ooze by the enormous length of the ſea-weeds that grow upon it. The leaves are four feet long, and ſome of the ſtalks, though not thicker than a man's thumb, are 120. Sir Joſeph Banks and Dr. Solander ſounded over ſome of them which were 84 feet long: and, as they made a very acute angle with the bottom, they were thought to be at leaſt one half longer.

FUEGO, or Fogo, one of the Cape de Verd Iſlands, in the Atlantic Ocean. It is much higher than any of the reſt, and ſeems to be one ſingle mountain at ſea, though on the ſides there are deep valleys. There is a volcano at the top of it, which burns continually, and may be ſeen a great way off at ſea. It vomits a great deal of fire and ſmoke, and throws out huge pieces of rock to a vaſt height; and ſometimes torrents of brimſtone run down the ſides. The Portugueſe, who firſt inhabited it, brought negroes with them, and a ſtock of cows, horſes, and hogs; but the chief inhabitants now are blacks, of the Romiſh religion. It is 300 miles W. of Cape de Verd, and 100 W. of St. Jago. Lon. 24. 30. W. Lat. 14. 54. N.

FUEL, whatever is proper to burn or make a fire; as wood, turf, peat, bituminous earths, coal, &c. Count Rumford has of late publiſhed an account of the means of ſaving fuel, by altering the form of the fire-places now in general uſe. See the articles Fire-place and Heat.

FUEN-hoa, a city of China, in the province of PE-tcheli, celebrated for its extent and the number of its inhabitants, as well as for the beauty of its ſtreets and triumphal arches. It is ſituated near the great wall, amidſt mountains; and has under its juriſdiction, beſides two cities of the ſecond and eight of the third claſs, a great number of fortreſſes, which bar the entrance of China againſt the Tartars.

FUGALIA, in Roman antiquity, a feaſt ſuppoſed by ſome to be the ſame with the *refugium*, held on the 24th of February, in memory of the expulſion of the kings and the aboliſhing of monarchical government. Others again diſtinguiſh the fugalia from the regifuge. And others think, that the fugalia was the ſame with the *poplifugia*, or the feaſt of Fugia, the goddeſs of joy, occaſioned by the rout of an enemy, which was the reaſon the people abandoned themſelves to riot and debauchery.

FUGITIVE, a perſon obliged to fly his country, or remove from a place where he had ſome abode or eſtabliſhment, on account of his crimes, debts, or other occaſions.

Fugitive *Pieces*, among the learned, denote thoſe little compoſitions which are printed on looſe ſheets or half ſheets; thus called, becauſe eaſily loſt and ſoon forgot.

FUGUE, in muſic, (from the Latin *fuga*, "a chaſe:") a piece of muſic, ſometimes longer and ſometimes ſhorter, in which, agreeable to the rules of harmony and modulation, the compoſer treats a ſubject; or, in other words, what expreſſes the capital thought or ſentiment of the piece, in cauſing it to paſs ſucceſſively and alternately from one part to another.

Theſe are the principal rules of the fugue; of which ſome are peculiar to itſelf, and others common to it with what the French call *imitation*. 1. The ſubject proceeds from the tonic to the dominant, or from the dominant to the tonic, in riſing or deſcending. 2. Every fugue finds its reſponſe in the part immediately following that which commenced. 3. That reſponſe ought to reſume the ſubject in the interval of a fourth or fifth above or below the key, and to purſue it as exactly as the laws of harmony will admit; proceeding from the dominant to the tonic when the ſubject is introduced from the tonic to the dominant, and moving in a contrary direction when the ſubject is introduced from the dominant to the tonic. One part may likewiſe reſume the ſame ſubject in the octave or uniſon of the preceding; but, in that caſe, it is a repetition rather than a real reſponſe. 4. As the octave is divided into two unequal parts, of which the one contains four gradations aſcending from the tonic to the dominant, and the other only three in continuing the aſcent from the dominant to the tonic; this renders it neceſſary to have ſome regard to this change in the expreſſion of the ſubject, and to make ſome alterations in the reſponſe, that we may not quit the chords that are eſſential to the mode. It is a different caſe when the compoſer intends to alter the modulation; for there the exactneſs of the reſponſe itſelf, when taken in a different tone, produces the alteration proper for this change. 5. It is neceſſary that the fugue ſhould be planned in ſuch a manner, that the reſponſe may commence before the cloſe of the firſt air, ſo that both the one and the other may be in part heard at the ſame time; that, by this anticipation, the ſubject may be, as it were, connected with itſelf, and that the art of the compoſer may diſcover itſelf in this concourſe. It is abſolute mockery, inſtead of a fugue, to impoſe upon the hearers the ſame air, merely tranſpoſed from one key to another, without any other reſtraint than an accompaniment afterwards formed at pleaſure. This deſerves at beſt no better name than what the French call *imitation*. See Imitation.

Beſides theſe rules, which are fundamental, there are others which, though preſcribed by taſte alone, are not leſs eſſential. Fugues, in general, render muſic more noiſy than agreeable: it is for this reaſon that they are more agreeable in the chorus than any where elſe. Now, as their chief merit conſiſts in fixing the ear on the principal air or ſubject, which for this reaſon is made to paſs inceſſantly from part to part, and from mode to mode, the compoſer ought to exert his care in preſerving that air always diſtinct; or to prevent it from being abſorbed in, or confounded with, the other parts. To produce this effect, there are two different ways: one in the movement, which muſt be inceſſantly contraſted with itſelf; ſo that, if the procedure of the fugue be accelerated, the other parts move gravely and with protracted notes; or, on the contrary, if the motion of the fugue be ſlow and ſolemn, the accompaniments muſt have more and quicker buſineſs. The other method is to extend the harmony, by removing the parts at a greater diſtance one from the other; leſt the others, too nearly approximated to that which contains the ſubject, ſhould be confounded with it, and prevent it from being diſtinguiſhed with ſufficient clearneſs; ſo that what would be an imperfection any where elſe becomes here a beauty.

The unity of melody ſhould be preſerved: this is the great and general rule, which muſt frequently be practiſed by different means. The chords muſt be choſen, and the intervals, ſo that one particular ſound may produce the chief effect: this can only reſult from the unity of the melody. It will ſometimes be neceſſary to employ voices and inſtruments of different kinds, that the part which ought to prevail may be moſt eaſily diſtinguiſhed: this again ſhows the neceſſity of preſerving the unity of the melody. Another object of attention no leſs neceſſary is, in the different connections of modulation which are introduced by the procedure and progreſs of the fugue, to cauſe all theſe modulations to correſpond at the ſame time in all the parts, to connect the whole in its progreſs by an exact conformity of modes; leſt, if one part be in one mode, and another in another, the general harmony ſhould be in none at all, and for that reaſon ſhould no longer be able to produce ſimple effects upon the ear, nor ſimple ideas in the mind; which is another reaſon for preſerving unity

of melody. In a word, in every fugue the confufion of melodies and modulations is at once what a compofer has moft to fear, and will find the greateft difficulty in avoiding; and as this kind of mufic never produces a pleafure above mediocrity, one may fay that a fine fugue is, though the mafterpiece of an excellent harmonift, ungrateful to his toil.

There are ftill feveral other kinds of fugues; fuch as the perpetual fugue (fee CANON), the double fugue, the inverted fugue. The *inverted* fugue is a manner of compofition, in which the flying part proceeds in a contrary direction to the other fugue, which had been formerly fixed in the fame piece of mufic. Thus, when the firft fugitive part is heard in afcending from the tonic to the dominant, or from the dominant to the tonic, the counter fugue ought to be heard in defcending from the dominant to the tonic, or from the tonic to the dominant, and *vice verfa*. Its other rules are exactly like thofe of the common fugue.

FULCRUM, in mechanics, the prop or fupport by which a lever is fuftained.

FULDE, a confiderable town of Germany, in the circle of the upper Rhine, and in the Buchow, with a celebrated abbey; whofe abbot is primate of the abbeys of the empire, perpetual chancellor of the emperor, and fovereign of a fmall territory lying between Heffe, Franconia, and Thuringia. It is feated on the river Fulde, 55 miles fouth of Caffel, and 58 north-eaft of Francfort. E. lon. 9. 53. N. lat. 50. 40.

FULGORA, in zoology, a genus of infects belonging to the order of hemiptera; the characters of which are thefe: The front, or fore-part of the head, is drawn extended and empty; the antennæ are feated below the eyes, having two articulations, whereof the exterior is larger, and of a globular form; the roftrum is inflected, or bent inwards under the body; and the feet are made for walking. There are nine fpecies, the moft remarkable of which is the candelaria, or lantern-fly. The head and thorax are generally of a ruddy brown; and the ground colour of the elytra is frefh green, but quaintly figured with fpots of a yellowifh clay colour, fometimes pale, at other feafons of a deeper hue. The wings are of a deep and beautiful yellow, with a broad band of gloffy black bordering the extremities. The tarfi of the feet are compofed of three articulations, and are of a paler colour than the legs and thighs, which are brown. When the infect is on the wing, the waving of the elytra (whofe thinnefs renders the fpots thereon tranfparent), affifted by the luminous quality peculiar to the tribe, and the golden yellow of the under-wings, bordered with black, occafion, in Mr. Barbut's opinion, the flafhes they dart around in the night, and create images beyond probability in the minds of perfons too ready to credit hyperboles. It is an inhabitant of China.

FULHAM, a village of Middlefex, four miles W. of London, feated on the river Thames, over which is a wooden bridge to Putney. It has been the demefne of the bifhops of London ever fince the Conqueft: here they have a palace; and in the church-yard are the tombs of fome of the prelates of that fee.

FULICA, the GALLINULE and COOT, in ornithology; a genus of birds of the order of grallæ. It has a convex bill, with the upper mandible fornicated over the lower at the edge; the lower mandible is gibbous behind the tip. The forehead is bald; and the feet have four toes, fubpinnated. There are 25 fpecies; 18 of which belong to the gallinule divifion, diftinguifhed by having the toes furnifhed with broad fcalloped membranes; and 7 comprehend the coots which have the toes divided to their origin. The following fpecies are among the moft noted.

1. The *chloropus*, or COMMON GALLINULE, is in length about 14 inches, and has a bald forehead and broad flat toes. It gets its food on graffy banks, and borders near frefh waters, and in the very waters if they be weedy. It builds upon low trees and fhrubs by the water-fide; breeding twice or thrice in a fummer; and, when the young are grown up, drives them away to fhift for themfelves. They lay feven eggs, of a dirty white thinly fpotted with ruft-colour. This bird ftrikes with its bill like a hen, and in the fpring has a fhrill call. In flying, it hangs down its legs; in running, it often flirts up its tail, and fhows the white feathers. We may obferve, that the bottoms of its toes are fo very flat and broad (to enable it to fwim), that it feems to be the bird which connects the cloven-footed aquatics with the next tribe, viz. the fin-toed. It is pretty common on the continent, though in fome parts more fcarce than in others. It is alfo an inhabitant of America, from New York to Carolina; and is recorded as a native of Jamaica and other iflands in the Weft Indies. It is faid to feed on plants and fmall fifh; and the flefh is for the moft part pretty good.

2. The *porphyrio*, or PURPLE GALLINULE, is about the fize of a fowl, or 17 inches in length. The bill is an inch and a half long, and of a deep red colour. The forehead is bare and red; the head and hind part of the neck are gloffy violet; the legs are very ftout, and of the colour of the bill. This bird is more or lefs common in all the warmer parts of the globe. On the coafts of Barbary they abound, as well as in fome of the iflands of the Mediterranean. In Sicily they are bred in plenty, and kept for their beauty; but whether indigenous there, is uncertain. It is frequently met with in various parts of the fouth of Ruffia and weftern parts of Siberia, among reedy places; in the neighbourhood of the Cafpian Sea it is not uncommon; but in the cultivated rice grounds of Ghilar in Perfia it is in great plenty and high plumage. The female makes her neft among the reeds in the middle of March; lays three or four eggs, and fits from three to four weeks. That it is common in China, the paper-hangings from thence will every where teftify. It is alfo met with in the Eaft Indies, the iflands of Java, Madagafcar, and many others. Our late navigators faw them at Tongataboo in vaft numbers, as well as in the ifland of Tanna and other parts. It is alfo common in the fouthern parts of America. In refpect to its manners, it is a very docile bird, being eafily tamed, and feeding with the poultry, fcratching the ground with the foot like the cock and hen. It will feed on many things, fuch as fruit, roots of plants, and grain; but will eat fifh with avidity, dipping them into the water before it fwallows them. It will frequently ftand on one leg, and lift the food to its mouth with the other like a parrot. A pair of thefe kept in an aviary in France made a neft of fmall fticks mixed with a quantity of ftraw, and laid fix white eggs, perfectly round; but the hen was carelefs of them, and they came to nothing. The flefh is faid to be exquifite in flavour.

3. The *atra*, or COMMON COOT, has a bald forehead, a black body, and lobated toes; and is about 15 inches in length. They frequent lakes and ftill rivers; making their nefts among the rufhes, with grafs, reeds, &c. floating on the water, fo as to rife and fall with it. They lay five or fix large eggs, of a dirty whitifh hue, fprinkled over with minute deep ruft-coloured fpots; and it is faid that fometimes they will lay 14 or more eggs. The young when juft hatched are very deformed, and the head mixed with a red coarfe down. In winter they often repair to the fea; and the channel near Southampton is fometimes obferved almoft covered with them. They are often brought to that market, where they are expofed to fale without their feathers, and fcalded like pigs. This fpecies is not fo numerous as might be expected; for we find that vaft numbers fall a prey while young to the buzzards, which frequent the marfhes. Their food is fmall fifh and water-infects; but they will fometimes eat the roots of the bulrufh, and with it feed the young; they are faid likewife to eat grain. This fpecies is fuppofed to extend throughout the old continent, and perhaps the

new alſo. Authors record it as inhabiting Greenland, Sweden, Norway, Ruſſia, Siberia, Perſia, and China, and many of the intermediate parts. It is alſo met with in Jamaica, Carolina, and other parts of North America. The Indians about Niagara dreſs the ſkins of theſe birds, and uſe them for pouches. They are called in Carolina *fluſterers*.

4. The *aterrima*, or GREATER COOT, is of a larger ſize than the laſt, and its plumage is blacker. This ſpecies is ſaid to be found in Lancaſhire and Scotland; but is more plentiful on the continent, being found in Ruſſia and the weſtern parts of Siberia very common. They are alſo in plenty at Sologne and the neighbouring parts, where they call it *judelle*. The people eat this bird on maigre days, and its fleſh is much eſteemed.

FULIGINOUS, whatever proceeds from a thick ſooty ſmoke, ſuch as lamp-black, &c.

FULIGO, in natural hiſtory, a ſpecies of pumice-ſtone. See PUMICE.

FULK (William), a learned and eminent divine of the church of England, in the 16th century. He was patroniſed by the earl of Leiceſter, who in 1571 preſented him to the living of Warley in Eſſex, and ſoon after to that of Diddington in Suffolk. He attended his patron when he went ambaſſador to France; and on his return was made maſter of Pembroke-hall, and Margaret profeſſor of divinity at Cambridge. His works are very numerous, levelled chiefly at the Papiſts. The moſt conſiderable of them is his Comment on the Rhemiſh Teſtament. He died in 1589.

FULLAN, a country in the interior parts of Africa, on the W. of the kingdom of Caſhna. Its boundaries have not yet been aſcertained, nor has the face of the country been deſcribed. All the information obtained of it by the African aſſociation is, that the dreſs of the natives reſembles the cloth of which the plaids of the Scotch Highlanders are made.

FULLER (Nicholas), prebendary of Saliſbury, and a learned Engliſh critic; who publiſhed in 1617 *Miſcellanea Theologica*, in four books, and afterward two more of *Miſcellanea Sacra*. He died in 1623; and there are ſome MSS. of his, remaining in the Bodleian library, that ſhow his great ſkill in Hebrew and philology.

FULLER (Dr. Thomas), a learned Engliſh divine, was born at Alvinckle, near Oundle, in Northamptonſhire, about the year 1608, and ſtudied at Cambridge. He was choſen miniſter of St. Bennet's there; and, at about 23 years of age, his merit procured him a fellowſhip in Sidney-college, and a prebend in Saliſbury cathedral. It is ſaid, his memory was ſo amazingly tenacious and comprehenſive, that he could make uſe of a ſermon *verbatim* if he once heard it. He once undertook, in paſſing to and from Temple-bar to the Poultry, to tell at his return every ſign as it ſtood in order on both ſides of the way, repeating them either backwards or forwards; and this taſk he actually performed. He wrote, 1. A Hiſtory of the Holy War. 2. The Church-hiſtory of Britain, in folio. 3. Andronicus, or the Unfortunate Politician, in 8vo. 4. A Piſgah-ſight of Paleſtine. 5. A Hiſtory of Engliſh Worthies; and other works. He died in Auguſt 1661, and was interred in the chancel of Cranford-church in Middleſex, whither his body was attended by at leaſt 200 of his brethren of the miniſtry.

FULLER, a workman employed in the woollen manufactories to mill or ſcour cloths, ſerges, and other ſtuffs, in order to render them more thick, compact, and durable. See FULLING.

FULLER'S *Earth*, in natural hiſtory, a ſpecies of clay, of a greyiſh aſh-coloured brown, in all degrees from very pale to almoſt black, and it has generally ſomething of a greeniſh caſt. It is very hard and firm, of a compact texture, of a rough and ſomewhat duſty ſurface that adheres ſlightly to the tongue. It is very ſoft to the touch, not ſtaining the hands, nor breaking eaſily between the fingers. It has a little harſhneſs between the teeth, and melts freely in the mouth. Thrown into water, it makes no ebullition or hiſſing; but ſwells gradually in bulk, and falls into a fine ſoft powder. It makes no effervеſcence with nitrous acid.

The greateſt quantity and the fineſt earth of this kind in the world is dug in the pits at Wavedon, near Woburn in Bedfordſhire. The ſtrata in theſe pits lie thus: From the ſurface to the depth of ſix feet, there are ſeveral layers or beds of ſand, all reddiſh, but ſome lighter coloured than others. Under theſe there is a thin ſtratum of a ſand-ſtone, which they break through, and then there is the fuller's earth. The upper ſtratum of this is about a foot thick: the workmen call it *cledge*, and throw it aſide as uſeleſs; being commonly fouled with the ſand which originally covered it, and which infinuates itſelf a good way into it. After this, they come to the fine fuller's earth for ſale, which lies to the depth of eight feet more. The matter of this is divided into ſeveral layers, there being commonly about a foot and an half between one horizontal fiſſure and another. Of theſe ſeveral layers, the upper half, where the earth breaks itſelf, is tinged red; which ſeems to be owing to the running of the water upon it from among the ſands above; ſome of which are probably of a ferruginous nature, or have ferruginous matter among them. This reddiſh fuller's earth the workmen call *crop*; and between the cledge and this there is a thin ſtratum of matter, of leſs than an inch, which in taſte, colour, and external appearance, reſembles the terra Japonica of the ſhops. The lower half of the ſtrata of fuller's earth they call *wall-earth*. This is untinged with the red colour of the other, and ſeems the moſt proper for fulling. Under the fuller's earth there is a ſtratum of white and coarſe ſtone about two feet thick. They ſeldom dig through this; but if they do, they find more ſtrata of ſand. This earth is of great uſe in ſcouring cloths, ſtuffs, &c. imbibing all the greaſe and oil uſed in preparing, dreſſing, &c. of the wool; for which reaſon it is made a contraband commodity, and is not to be exported under the penalty of 1s. for every pound weight. See FULLING.

FULLER'S *Weed*, or *Teazle*. See DIPSACUS.

FULLERY, a place where cloths, &c. are fulled. See the next article.

FULLING, the art or act of cleanſing, ſcouring, and preſſing cloths, ſtuffs, and ſtockings, to render them ſtronger, cloſer, and firmer: called alſo *milling*. Pliny (lib. vii. cap. 56.) aſſerts, that one Nicias, the ſon of Hermias, was the firſt inventor of the art of fulling: and it appears by an inſcription, quoted by Sir G. Wheler in his Travels through Greece, that this ſame Nicias was a governor in Greece in the time of the Romans. The fulling of cloths and other ſtuffs is performed by a kind of water-mill, thence called a *fulling* or *ſcouring-mill*. Theſe mills, except in what relates to the mill-ſtones and hopper, are much the ſame with corn-mills: and there are even ſome which ſerve indifferently for either uſe; corn being ground, and cloths fulled, by the motion of the ſame wheel. Whence in ſome places, particularly in France, the fullers are called *millers*; as grinding corn and milling ſtuffs at the ſame time.

The principal parts of the fulling-mill are: The wheel, with its trundle; which gives motion to the tree or ſpindle, whoſe teeth communicate it to the peſtles or ſtampers, which are hereby raiſed and made to fall alternately, according as its teeth catch on or quit a kind of latch in the middle of each peſtle. The peſtles and troughs are of wood; each trough having at leaſt two, ſometimes three peſtles, at the diſcretion of the maſter, or according to the force of the ſtream of water. In theſe troughs are laid the cloths, ſtuffs, &c. intended to be fulled: then, letting the current of water fall on the wheel, the peſtles are ſucceſſively let fall thereon, and by their weight and velocity ſtamp and preſs the ſtuffs very ſtrongly, which by this means

become thickened and condenſed. In the courſe of the operation, they ſometimes make uſe of urine, ſometimes of fuller's earth, and ſometimes of ſoap. To prepare the ſtuffs to receive the firſt impreſſions of the peſtle, they are uſually laid in urine; then in fuller's earth and water; and, laſtly, in ſoap diſſolved in hot water. Soap alone would do very well; but this is expenſive: though fuller's earth, in the way of our dreſſing, is ſcarce inferior thereto; but then it muſt be well cleared of all ſtones and grittineſſes, which are apt to make holes in the ſtuff. As to urine, it is certainly prejudicial, and ought to be entirely diſcarded; not ſo much on account of its ill ſmell, as of its ſharpneſs and ſaltneſs, which qualities are apt to render the ſtuffs dry and harſh. The true method of fulling with ſoap is delivered by Monſ. Colinet, in an authentic memoir on that ſubject, ſupported by experiments made by order of the marquis de Louvois, then ſuperintendant of the arts and manufactories of France; the ſubſtance of which we ſhall here ſubjoin.

The Method of FULLING *Cloths and Woollen Stuffs with Soap* is this:—A coloured cloth, of about 45 ells, is to be laid in the uſual manner in the trough of a fulling-mill; without firſt ſoaking it in water, as is commonly practiſed in many places. To full this trough of cloth, 15 pounds of ſoap are required; one-half of which is to be melted in two pails of river or ſpring water, made as hot as the hand can well bear it. This ſolution is to be poured by little and little upon the cloth, in proportion as it is laid in the trough: and thus it is to be fulled for at leaſt two hours; after which, it is to be taken out and ſtretched. This done, the cloth is immediately returned into the ſame trough, without any new ſoap, and there fulled two hours more. Then taking it out, they wring it well, to expreſs all the greaſe and filth. After the ſecond fulling, the remainder of the ſoap is diſſolved as in the former, and caſt four different times on the cloth; remembering to take out the cloth every two hours, to ſtretch it, and undo the plaits and wrinkles it has acquired in the trough. When they perceive it ſufficiently fulled, and brought to the quality and thickneſs required, they ſcour it for good in hot water, keeping it in the trough till it be quite clean. As to white cloths, in regard theſe full more eaſily and in leſs time than coloured ones, a third part of the ſoap may be ſpared.

The FULLING *of Stockings, Caps*, &c. ſhould be performed ſomewhat differently; viz. either with the feet or the hands; or a kind of rack, or wooden machine, either armed with teeth of the ſame matter, or elſe horſes or bullocks teeth. The ingredients made uſe of herein are, urine, green ſoap, white ſoap, and fuller's earth. But the urine alſo is reckoned prejudicial here. Woven ſtockings, &c. ſhould be fulled with the ſoap alone: for thoſe that are knit, earth may be uſed with the ſoap. Indeed it is common to full theſe kinds of works with the mill, after the uſual manner of cloth, &c. But that is too coarſe and violent a manner, and apt to damage the work unleſs it be very ſtrong.

FULMAR, in ornithology. See PROCELLARIA.

FULMAR, or *Foumart*. See MUSTELA.

FULMINATING, ſomething that thunders or reſembles thunder.

FULMINATING *Gold, Silver, Copper, Quickſilver*, &c. See CHEMISTRY, p. 446 and 447.

FULMINATION, in chemiſtry, the ſame with detonation. See DETONATION and NITRE.

FULMINATION, in the Romiſh canon law, a ſentence of a biſhop, official, or other eccleſiaſtic appointed by the pope, by which it is decreed that ſome bull ſent from the pope ſhall be executed.

FUMARIA, FUMITORY; a genus of the pentandria order, belonging to the diadelphia claſs of plants; and in the natural method ranking under the 24th order, *Corydales*. The calyx is diphyllous; the corolla ringent; and there are two membranaceous filaments, each of which has three antheræ. There are a number of different ſpecies; all of them low, ſhrubby, and deciduous and evergreen plants, growing from two to ſix or ſeven feet high, adorned with ſmall ſimple leaves, and papilionaceous flowers of different colours. The moſt remarkable is the officinalis, or common fumitory; which grows naturally in ſhady cultivated grounds, and produces ſpikes of purpliſh flowers in May and June. It is very juicy, of a bitter taſte, without any remarkable ſmell. The medical effects of this herb are, to ſtrengthen the tone of the bowels, gently looſen the belly, and promote the urinary and other natural ſecretions. The old phyſicians recommended it in melancholic, ſcorbutic, and cutaneous diſorders, for opening obſtructions of the viſcera, attenuating and promoting the evacuation of viſcid juices. Frederic Hoffman had a very great opinion of it as a purifier of the blood; and aſſures us, that in this intention ſcarce any plant exceeds it. Cows and ſheep eat this plant; goats are not fond of it; horſes and ſwine refuſe it.

FUMIGATION, in chemiſtry, a kind of calcination, when metals or other hard bodies are divided or ſoftened by receiving certain fumes applied for that purpoſe.

FUMIGATION, in medicine. By the ſubtile fumes produced by burning certain ſubſtances, much benefit or prejudice may be produced, according to the nature of the caſe, and the conſtitution on which the effects are to be exerted; as is evident from the palſies produced among water gilders, workers in lead-mines, &c. and alſo from the benefits received in many caſes when the air is impregnated with ſalutary materials. Catarrhs and colds, for inſtance, are relieved by fumes received with the breath; and, by the ſame means, expectoration is aſſiſted in the aſthma; and even ulcers in the lungs are ſaid to have been relieved by this method. But this is ſtill more ſtrongly exemplified by the common practice of curing venereal ulcers, and exciting the general action of quickſilver in the ſyſtem, by incloſing the naked body of the patient in a box fitted to receive the fumes of quickſilver, raiſed by ſprinkling cinnabar upon a red hot iron, or, what is ſtill better, the *Hydrargyrus præcipitatus cinereus* of the Pharmacopœia Chirurgica, which, not emitting any ſulphureous vapours like the other, proves leſs inconvenient to the patient.

FUMITORY, in botany. See FUMARIA.

FUNAMBULUS, among the Romans, was what we call a *rope-dancer*, and the Greeks *ſchœnobates*. See *Rope*-DANCER. There was a funambulus, it ſeems, who performed at the time when the Hecyra of Terence was acted; and the poet complains, that the ſpectacle prevented the people from attending to his comedy. *Ita populus ſtudio ſtupidus in* funambulo, *animum occuparat*. At Rome, the funambuli firſt appeared under the conſulate of Sulpicius Pæticus and Licinius Stolo, who were the firſt introducers of the ſcenic repreſentations. It is added, that they were firſt exhibited in the iſland of the Tyber, and that the cenſors Meſſala and Caſſius afterwards promoted them to the theatre. In the *Floralia*, or *ludi Florales*, held under Galba, there were funambulatory elephants, as we are informed by Suetonius. Nero alſo ſhowed the like, in honour of his mother Agrippina. Vopiſcus relates the ſame of the time of Carinus and Numerianus.

FUNCHAL, the capital of Madeira, ſituated round a bay, on the gentle aſcent of the firſt hills, in form of an amphitheatre. Its public and private buildings are, in general, entirely white. On the ſea-ſide are ſeveral batteries. An old caſtle, which commands the road, ſtands on the top of a ſteep black rock, ſurrounded by the ſea at high water, and called by the Engliſh Loo Rock. On a neighbouring eminence above the town, is another, called St. John's Caſtle. The hills beyond the town are covered

with vineyards, inclosures, plantations, and groves, interspersed with country-houses and churches. The streets are narrow, ill-paved, and dirty. The houses are built of freestone, or of brick; but they are dark, and only a few of the best, belonging to the English merchants, or the principal inhabitants, are provided with glass windows: all the others have a kind of lattice-work in their stead, which hangs on hinges, and may be lifted up occasionally. Lon. 17. 6. W. Lat. 32. 38. N.

FUNCTION, the act of fulfilling the duties of any employment. This term, being also applied to the actions of the body, is by physicians divided into vital, animal, and natural. The *vital* functions are those necessary to life, and without which the individual cannot subsist; as the motion of the heart, lungs, &c. The *natural* functions are such as it cannot subsist any considerable time without; as the digestion of the aliment, and its conversion into blood. Under *animal* functions are included the senses of touching, tasting, &c. memory, judgment, and voluntary motion; without any or all of which an animal may live, but not very comfortably. The animal functions perform the motion of the body by the action of the muscles; and this action consists chiefly in the shortening the fleshy fibres, which is called *contraction*, the principal agents of which are the arteries and nerves distributed in the fleshy fibres. All parts of the body have functions or actions peculiar to themselves. Life consists in the *exercise* of these functions, and health in the *free* and *ready* exercise of them.

FUND, in general, signifies any sum of money appropriated for a particular purpose. Thus, that part of the national revenue which is set aside for the payment of the national debt is called the *sinking fund*. But, when we speak of *the funds*, we generally mean the large sums which have been lent to government, and constitute the national debt; and for which the lenders, or their assignees, receive interest from revenues allotted for that purpose. The term *stock* is used in the same sense, and is also applied to the sums which form the capital of the bank of England, the East India and South-Sea companies; the proprietors of which are entitled to a share of the profits of the respective companies.

The practice of funding was introduced by the Venetians and Genoese in the 16th century, and has been adopted since by most of the nations in Europe. Princes had often borrowed money, in former times, to supply their exigencies, and sometimes mortgaged their territories in security: but these loans were generally extorted, and their payment was always precarious; for it depended on the good faith and success of the borrower, and never became a regular burden on posterity. The origin of funds is derived from the peculiar manners and circumstances of modern Europe. Since the invention of gunpowder and the progress of commerce, the military occupation has become a distinct employment in the hands of mercenaries; the apparatus of war is attended with more expence; and the decision of national quarrels has often been determined by command of money rather than by national bravery. Ambitious princes have therefore borrowed money, in order to carry on their projects with more vigour. Weaker states have been compelled, in self-defence, to apply to the same resource; the wealth introduced by commerce has afforded the means; the regularity of administration, established in consequence of the progress of society, has increased the confidence of individuals in the public security; the complicated system of modern policy has extended the scenes of war, and prolonged their duration; and the colonies established by the mercantile nations have rendered them vulnerable in more points, and increased the expence of defending them.

When a greater sum has been required for the annual expence than could easily be supplied by annual taxes, the government have proposed terms, to their own subjects or to foreigners, for obtaining an advance of money, by mortgaging the revenue of future years for their indemnification. This mortgage may either be for a limited period, or perpetual. If the sum allotted annually for the benefit of those who advance the money be considerably greater than the interest of the sums advanced, they may agree to accept of such allowance for a limited time, as a full equivalent. Thus, they may either agree for the casual produce of the revenue assigned; or a fixed annuity for a greater or less number of years; or a life-annuity to themselves or nominees; or an annuity for two or more lives, or an annuity, with the benefit of survivorship, called a *tontine*, in which scheme, the whole sum to which the original annuitants were entitled continues to be distributed among the survivors.

The establishment of the funds was introduced in Britain at the Revolution, and has since been gradually enlarged, and carried to an amazing extent. The various methods above mentioned have been used in their turns, but perpetual annuities have been granted for the greatest part; and, even when the money was originally advanced on other conditions, the lenders have been sometimes induced, by subsequent offers, to accept of perpetual annuities, instead of the former terms. The debt for which perpetual annuities are granted is called the *redeemable debt*, and the other is called the *irredeemable debt*. Although the debts thus contracted by government are seldom paid for a long term of years, yet any creditor of the public may obtain money for what is due to him when he pleases, by transferring his property in the funds to another; and regular methods are appointed for transacting these transfers in an easy manner. By means of this, the stocks become a kind of circulating capital: and have the same effect, in some respects, as the circulating money in the nation. When a stockholder transfers his share, he may sometimes be able to obtain a greater price than the original value, and at other times be obliged to accept of a less one. The value of the funds depends on the proportion between the interest they bear, and the benefit which may be obtained by applying the money to other purposes. It is influenced by the plenty or scarcity of money, and by the quantity of the public debt; and it is impaired by any event which threatens the safety, or weakens the credit, of the government.

The business of *stock-jobbing* is founded on the variation of the prices of stock. Persons possessed of real property may buy or sell stock, according to their notion that the value is likely to rise or fall, in expectation of making profit by the difference of price: and a practice has taken place among persons who often possess no property in the funds, to contract for the sale of stock against a future day, at a price now agreed on. For instance: A agrees to sell B 1000l. of bank-stock, to be transferred, in 20 days, for 1200l. A has, in fact, no such stock; but if the price of bank-stock, on the day appointed for the transfer, should be only 118 *per cent.*, A may purchase as much as will enable him to fulfil his bargain for 1180l. and thus gains 20l. by the transaction: on the contrary, if the price of bank-stock be 125 *per cent.* he will lose 50l. The business is generally settled without any actual purchase or transfer of stock, by A paying to B, or receiving from him, the difference between the current price of the stock on the day appointed and the price bargained for.

This practice, which is really nothing else than a wager concerning the price of stock, is contrary to law; yet it is carried on to a great extent. In the language of Exchange alley, where matters of this kind are transacted, the buyer is called a *bull*, and the seller a *bear*. As neither party can be compelled by law to make good these bargains, their sense of honour, and the disgrace and loss of future credit which attend a breach of contract, are the principles by which the business is supported. When a person declines to pay his loss, he is called a *lame duck*.

and dare never afterwards appear in the Alley. This opprobrious appellation, however, is not beſtowed on thoſe whoſe failure is owing to want of ability, providing they make the ſame ſurrender of their property voluntarily, which the law would have exacted if the debt had been entitled to its ſanction.

The intereſt or dividend on the ſtock is paid half-yearly; and the purchaſer has the benefit of the intereſt due on the ſtock he buys, from the laſt term to the time of purchaſe. Therefore the prices of the ſtocks riſe gradually, *cæteris paribus*, from term to term, and fall at the term when the intereſt is paid. In comparing the prices of the different ſtocks, it is neceſſary to advert to the term when the laſt intereſt was paid; and, allowance being made for this circumſtance, the prices of all the government ſtocks, which bear intereſt at the ſame rate, muſt be nearly the ſame, as they all depend on the ſame ſecurity.

When a loan is propoſed, ſuch terms muſt be offered to the lenders as may render the tranſaction beneficial; and this is now regulated by the prices of the old ſtocks. If the ſtocks, which bear intereſt at 4 *per cent.* ſell at par, or rather above, the government may expect to borrow money at that rate; but, if theſe ſtocks are under par, the government muſt either grant a higher intereſt, or ſome other advantage to the lenders, in compenſation for the difference. For this purpoſe, beſides the perpetual annuity, another annuity has ſometimes been granted for life, or for a term of years. Lotteries have frequently been employed to facilitate the loan, by entitling the ſubſcribers to a certain number of tickets, for which no higher price is charged than the exact value diſtributed in prizes, though their market-price is generally 2l. or 3l. higher. Sometimes an abatement of a certain proportion of the capital has been granted, and a lender intitled to hold 100l. ſtock, though in reality he advanced no more perhaps than 95l.

It belongs to the Chancellor of the Exchequer to propoſe the terms of the loan in parliament; and he generally makes a previous agreement with ſome wealthy bankers or merchants, who are willing to advance the money on the terms propoſed. The ſubſcribers to the loan depoſit a certain part of the ſum ſubſcribed, and are bound to pay the reſt by inſtalments or ſtated proportions, on appointed days, under pain of forfeiting what they have depoſited. For this they are entitled, perhaps, not only to hold their ſhare in the capital, but to an annuity for 10 years, and to the right of receiving a certain number of lottery-tickets on advantageous terms. They may ſell their capital to one perſon, their annuity to a ſecond, and their right to the tickets to a third. The value of all theſe intereſts together is called *omnium*; and, in order to obtain a ready ſubſcription, it ought to amount to 102l. or upwards, on 100l. of capital. This difference is called the *bonus* to the ſubſcribers.

The capital advanced to the public, in the form of transferable ſtocks, and bearing intereſt from taxes appropriated for that purpoſe, is called the *funded debt*. Beſides, there is generally a conſiderable ſum due by government, which is not diſpoſed of in that manner, and therefore is diſtinguiſhed by the appellation of the *unfunded debt*. This may ariſe from any ſort of national expence, for which no proviſion has been made, or for which the proviſion has proved inſufficient. The chief branches are,

1ſt, *Exchequer Bills.* Theſe are iſſued from the exchequer, generally by appointment of parliament, and ſometimes without ſuch appointment, when exigencies require. They bear intereſt from the time when iſſued, and are taken in by the bank of England, which promotes their circulation.

2d, *Navy-Bills.* The ſums annually granted for the navy have always fallen ſhort of what that ſervice required. To ſupply that deficiency, the admiralty iſſues bills in payment of victuals, ſtores, and the like, which bear intereſt ſix months after the time iſſued. The debt of the navy thus contracted is diſcharged, from time to time, by parliament.

In time of war, the public expences, ſince the revolution, have always been much greater than the annual revenue; and large ſums have conſequently been borrowed. In time of peace, the revenue exceeds the expence, and part of the public debts have frequently been paid off. But, though there have been more years of peace than of war ſince the funds were eſtabliſhed, the debts contracted during each war have much exceeded the payments during the ſubſequent peace. This will appear by the following abſtract of the progreſs of the national debt.

Debt at the peace of Ryſwick, 1697	L. 21,515,472
Debt at the beginning of the war 1701	16,394,701
Diſcharged during peace 1697 to 1701	5,121,071
Debt at the peace of Utrecht 1714, including value of annuities afterwards ſubſcribed to South-Sea ſtock - -	55,282,978
Contracted in war 1701 to 1714	38,888,277
Debt at beginning of war 1740, including L. 1,000,000 charged on civil liſt	47,954,623
Diſcharged during peace 1714 to 1739	7,328,355
Debt at peace of Aix-la-Chapelle, 1748	79,193,313
Contracted during war 1740 to 1748	31,238,690
Debt at beginning of war 1756	73,289,673
Paid off during peace 1748 to 1756	5,903,640
Debt funded at the peace 1763, including L. 9,839,597 then owing, which was funded in the ſubſequent years -	133,957,270
Beſides this, there was about L. 6,000,000 of debt paid off, without ever being funded.	
Funded debt, 1775 -	125,000,000
Paid off during peace 1763 to 1775, beſides unfunded debt above-mentioned. -	8,959,270
Funded debt at the peace 1783 -	211,363,254

The unfortunate and deſtructive war which we at preſent wage againſt the French Republic has added moſt enormouſly to the public debt. Some even ſuppoſe it increaſed by a ſum little ſhort of one hundred millions.

FUNDAMENT, in anatomy, the loweſt part of the inteſtinum rectum, called by anatomiſts the *anus*. See ANATOMY, page 189.

FUNDAMENTAL, in general, ſomething that ſerves as a baſe or foundation for another.

FUNDAMENTAL, in muſic. A *fundamental ſound* is that which forms the loweſt note of the CHORD, and from whence are deduced the harmonical relations of the reſt; or, which ſerves for a key to the tone. The *fundamental baſs* is that which ſerves for a foundation to the harmony. A *fundamental chord* is that whoſe baſs is fundamental, and in which the ſounds are ranged in the ſame order as when they are generated, according to the experiment ſo often repeated by M. d'Alembert, in his Preliminary Diſcourſe and Elements of Muſic. But as this order removes the parts to an extreme diſtance one from the other, they muſt be approximated by combinations or inverſions; but if the baſs remains the ſame, the chord does not for this reaſon ceaſe to bear the name of *fundamental*. Such an example is this chord, *ut mi ſol*, included in the interval of a fifth: whereas in the order of its generation, *ut ſol mi*, it includes a tenth, and even a ſeventeenth; ſince the fundamental *ut* is not the fifth of *ſol*, but the octave of that fifth.

FUNDAMENTAL *Baſs*. This part in muſic is, according to Rouſſeau, and indeed according to all authors who have proceeded upon M. Rameau's experiment, in its primary idea, that baſs which is formed by the fundamental notes of every perfect chord that conſtitutes the harmony of the piece; ſo that under each chord it cauſes to be heard, or underſtood, the fundamental ſound of that particular chord; that is to ſay, the ſound from

whence it is derived by the rules of harmony. From thence we may fee, that the fundamental bafs can have no other contexture than that of a regular and fundamental fucceffion, without which the procedure of the upper parts would be illegitimate.

To underftand this well, it is neceffary to be known, that, according to the fyftem of Rameau, which Rouffeau has followed in his Dictionary, every chord, though compofed of feveral founds, can only have one which is its fundamental, *viz.* that which produces this chord, and which is its bafs according to the direct and natural order. Now the bafs which prevails under all the other parts does not always exprefs the fundamental founds of the chords: for, amongft all the founds which form a chord, the compofer is at liberty to transfer to the bafs that which he thinks preferable; regard being had to the procedure of that bafs, to the beauty of the melody, and above all to the expreffion, as may afterwards be explained. In this cafe the real fundamental found, inftead of retaining its natural ftation, which is in the bafs, will either be transferred to fome of the other parts, or perhaps even entirely fuppreffed, and fuch a chord is called an *inverted* chord.

In reality, fays Rameau, a chord inverted does not differ from the chord in its direct and natural order from which it was produced: but, as thefe founds form different combinations, thefe combinations have long been taken for fundamental chords: different names have been given them, which may be feen at the word Accord, in Rouffeau's Dictionary. Thefe names, by the perfons who beftowed them, were thought to create and fanctify their diftinctions; as if a difference in names could really produce a difference in the fpecies.

M. Rameau in his Treatife of Harmony has fhown, and M. d'Alembert in his Elements of Mufic has ftill more clearly evinced, that many of thefe pretendedly different chords were no more than inverfions of one fingle chord. Thus the chord of the fixth is no more than the perfect chord of the third transferred to the bafs; by adding a fifth, we fhall have the chord of the fixth and fourth. Here there are three combinations of a chord, which only confifts of three founds; thofe which contain four founds are fufceptible of four combinations, fince each of thefe founds may be transferred to the bafs. But, in adding beneath this another bafs which, under all the combinations of one and the fame chord, always prefents the fundamental found, it is evident, that confonant chords are reduced to the number three, and the number of diffonant chords to four. Add to this all the chords by fuppofition, which may likewife be reduced to the fame fundamentals, and you will find harmony brought to a degree of fimplicity in which no perfon could ever hope to fee it, whilft its rules remained in that ftate of confufion where M. Rameau found them. It is certainly, as that author obferves, an aftonifhing occurrence, that the practice of this art could be carried fo far as it really was, without knowing its foundation, and that all the rules were fo exactly found, without having difcovered the principle on which they depended.

After having fhown what is the fundamental bafs beneath the chords, let us now fpeak of its procedure, and of the manner in which it connects thefe chords among themfelves. Upon this point the precepts of the art may be reduced to the fix following rules. 1. The fundamental bafs ought never to found any other notes than thofe of the feries or tone in which the compofer finds himfelf, or at leaft thofe of the feries or tone to which he choofes to make a tranfition. This of all the rules for the fundamental bafs is the firft and moft indifpenfable. 2. By the fecond, its procedure ought to be fo implicitly fubjected to the laws of modulation, as never to fuffer the idea of a former mode to be loft till that of a fubfequent one can be legitimately affumed; that is to fay, that the fundamental bafs ought never to be devious, or fuffer us to be one moment at a lofs in what mode we are. 3. By the third, it is fubjected to the connection of chords and the preparation of diffonances: a manœuvre which, as we fhall afterwards fee, is nothing elfe but a method of producing this connection, and which of confequence is only neceffary when the connection cannot fubfift without it. See Connection, Preparation. 4. By the fourth, it is neceffitated, after every diffonance, to purfue that career which the refolution of the diffonance indifpenfably prefcribes. See Resolution. 5. By the fifth, which is nothing elfe but a confequence of the former, the fundamental bafs ought only to move by confonant intervals; except alone in the operation of a broken cadence, or after a chord of the feventh diminifhed, where it rifes diatonically. Every other motion of the fundamental bafs is illegitimate. 6. By the fixth, in fhort, the fundamental bafs or harmony ought not to be fyncopated; but to diftinguifh the bars and the times which they contain, by changes of chords properly marked with cadences; in fuch a manner, for inftance, that the diffonances which ought to be prepared may find their preparation in the imperfect time, but chiefly that all the repofes may happen in the perfect time. This fixth rule admits of an infinite number of exceptions; but the compofer ought, however, to be attentive to it, if he would form a mufic in which the movements are properly marked, and in which the bars may end gracefully. Wherever thefe rules are obferved, the harmony fhall be regular and without fault: this, however, will not hinder the mufic from being deteftable. See Composition.

A word of illuftration on the fifth rule may not be ufelefs. Whatever turn may be given to a fundamental bafs, if it is properly formed, one of thefe alternatives muft always be found: either perfect chords moving by confonant intervals, without which thefe chords would have no connection; or, diffonant chords in operations of cadence: in every other cafe, the diffonance can neither be properly placed nor properly refolved. From thence it follows, that the fundamental bafs cannot move regularly but in one of thefe three manners. 1ft, To rife or defcend by a third or by a fixth. 2dly, By a fourth or a fifth. 3dly, To rife diatonically by means of the diffonance which forms the connection, or by a licence upon a perfect chord. With refpect to a diatonic defcent, it is a motion abfolutely prohibited to the fundamental bafs; or, at moft, merely tolerated in cafes where two perfect chords are in fucceffion, divided by a clofe expreffed or underftood. This rule has no other exception: and it is from not difcerning the foundation of certain tranfitions, that M. Rameau has caufed the fundamental bafs to defcend diatonically under chords of the feventh; an operation which is impracticable in legitimate harmony. See Cadence, and Dissonance.

The fundamental bafs, which they add for no other reafon than to ferve as a proof of the harmony, muft be retrenched in execution, and often in practice it would have a very bad effect; for it is, as M. Rameau very properly obferves, intended for the judgment, and not for the ear. It would at leaft produce a monotony extremely naufeous, by frequent returns of the fame chord, which they difguife and vary more agreeably by combining it in different manners upon the continued bafs, without reckoning upon the different inverfions of harmony, which furnifh a thoufand means of adding new beauties to the mufic, and new energy to the expreffion. See Chord, and Inversion.

But it will be objected, If the fundamental bafs is not ufeful in compofing good mufic, if it muft even be retrenched in practice, what good purpofe, then, can it ferve? We anfwer, that, in the firft place, it ferves for a rule to fcholars, upon which they may learn to form a regular harmony, and to give to all the parts fuch a diatonic and elementary procedure as is prefcribed them by that fundamental bafs. It does more, as we have already faid; it proves whether a harmony already formed

be juſt and regular; for all harmony which cannot be ſubjected to the teſt of a fundamental baſs muſt, according to all rules, be bad. Finally, it ſerves for the inveſtigation of a continued baſs under a given air: though, in reality, he who cannot directly form a continued baſs will ſcarcely be able to form a fundamental baſs, which is better; and much leſs ſtill will he be able to transform that fundamental baſs into a legitimate continued baſs. Theſe which follow are, however, the principal rules which M. Rameau preſcribes for finding the fundamental baſs of a given air: 1. To aſcertain with preciſion the mode in which the compoſer begins, and thoſe through which he paſſes. There are alſo rules for inveſtigating the modes; but ſo long, ſo vague, ſo incomplete, that, with reſpect to this, the ear may be formed long before the rules are acquired; and the dunce who ſhould try to uſe them would gain no improvement but the habit of proceeding always note by note, without even knowing where he is. 2. To try in ſucceſſion under each note the principal chords of the mode, beginning by thoſe which are moſt analogous, and paſſing even to the moſt remote, when the compoſer ſees himſelf under a neceſſity of doing ſo. 3. To conſider whether the chord choſen can ſuit the upper part in what precedes and in what follows, by a juſt fundamental ſucceſſion; and, when this is impracticable, to return the way he came. 4. Not to change the note of the fundamental baſs till after having exhauſted all the notes which are allowed in ſucceſſion in the upper part, and which can enter into its chord; or till ſome ſyncopated note in the air may be ſuſceptible of two or a greater number of notes in the baſs, to prepare the diſſonance which may be afterwards reſolved according to rule. 5. To ſtudy the intertexture of the phraſes; the poſſible ſucceſſion of cadences, whether full or avoided; and, above all, the pauſes which for ordinary return at the end of every four, or of every two bars, ſo that they may always fall upon perfect and regular cadences. 6. In ſhort, to obſerve all the rules formerly given for the compoſition of the fundamental baſs.—Theſe are the principal obſervations to be made for finding one under any given air; for there are ſometimes ſeveral different ones which may be inveſtigated. But, whatever may be ſaid to the contrary, if the air has accent and character, there is only one juſt fundamental baſs which can be adapted to it.

After having given a ſummary explication of the manner in which a fundamental baſs ſhould be compoſed, it ſhould remain to ſuggeſt the means of transforming it into a continued baſs; and this would be eaſy, if it were only neceſſary to regard the diatonic procedure and the agreeable air of this baſs. But let us not imagine that the baſs, which is the guide and ſupport of the harmony, the ſoul, and, as it were, the interpreter, of the air, ſhould be limited to rules ſo ſimple: there are others which depend upon principles more certain and more radical; fruitful but latent principles, which have been felt by every artiſt of genius, without having been detected by any one. Rouſſeau hopes, that in his letter upon French muſic he inſinuated this principle. For thoſe who underſtand him, he imagines he has ſaid enough concerning it, and can never ſay enough of it for thoſe who do not. See *Rouſſeau's Miſcellanies*, vol. ii. p. 1. He does not here mention the ingenious ſyſtem by M. Serre of Geneva, nor his double fundamental baſs; becauſe the principles which, with a ſagacity meritorious of praiſe, he had half detected, have afterwards been unfolded by M. Tartini, in a work of which Rouſſeau has given an account in his article SYSTEM.

FUNDY, a bay of N. America, between New England and Nova Scotia, remarkable for its tides, which riſe to the height of 50 or 90 feet, and flow ſo rapidly as to overtake animals which feed upon the ſhore.

FUNEN, an iſland in Denmark, ſeparated from Jutland by a ſtrait called the Little Belt, and from the iſland of Zealand by another called the Great Belt. It is about 340 miles in circumference, is remarkably fertile in paſture and grain, and exports annually to Norway, barley, oats, rye, and peaſe. The paſſage acroſs the Little Belt is nine miles. Odenſee is the capital town.

FUNERAL RITES, ceremonies accompanying the interment or burial of any perſon. The word is formed of the Latin *funus*, and that of *funalia*, on account of the torches (which were *funes cera circumdati*) uſed in the funerals of the Romans; though others derive *funus* from the Greek φονος, *death* or *ſlaughter*. Theſe rites differed among the ancients according to the different genius and religion of each country. The firſt people who ſeem to have paid any particular reſpect to their dead were the Egyptians, the poſterity of Ham. The firſt cultivators of idolatrous worſhip and ſuperſtition after the flood; they were alſo the firſt who aſſerted the immortality of the ſoul, its migration into all kinds of animals in earth, air, and ſea, and its return to the human body; which they ſuppoſed to be within the term of 3000 years. Hence proceeded their very great care in embalming of their dead bodies, and their being at ſuch vaſt expence, as they were, in building proper repoſitories for them; for they were more ſolicitous about their graves than their houſes. This gave birth to thoſe wonders of the world, the pyramids, which were built for the burial of their kings, with ſuch vaſt charges, and almoſt incredible magnificence. See PYRAMID.

Whenever a perſon died among the *Egyptians*, his parents and friends put on mournful habits, and abſtained from all banquets and entertainments. This mourning laſted from 40 to 70 days, during which time they embalmed the body. See EMBALMING. When this ceremony was finiſhed, the embalmed body was reſtored to the friends, who placed it in a kind of open cheſt, which was preſerved either in their houſes, or in the ſepulchres of their anceſtors. But before the dead were allowed to be depoſited in the tomb, they underwent a ſolemn judgment, which extended even to their kings. Of this remarkable cuſtom we have a particular account in the firſt book of Diodorus Siculus. "Thoſe who prepare to bury a relation give notice of the day intended for the ceremony to the judges, and to all the friends of the deceaſed; informing them, that the body will paſs over the lake of that diſtrict to which the dead belonged: when, on the judges aſſembling, to the number of more than 40, and ranging themſelves in a ſemi-circle on the farther ſide of the lake, the veſſel is ſet afloat, which thoſe who ſuperintend the funeral have prepared for this purpoſe. This veſſel is managed by a pilot, called in the Egyptian language Charon; and hence they ſay, that Orpheus, travelling in old times into Egypt, and ſeeing this ceremony, formed his fable of the infernal regions, partly from what he ſaw, and partly from invention. The veſſel being launched on the lake before the coffin which contains the body is put on board, the law permits all, who are ſo inclined, to produce an accuſation againſt it. If any one ſteps forth, and proves that the deceaſed has led an evil life, the judges pronounce ſentence, and the body is precluded from burial; but, if the accuſer is convicted of injuſtice in his charge, he falls himſelf under a conſiderable penalty. When no accuſer appears, or when the accuſer is proved to be an unfair one, the relations, who are aſſembled, change their expreſſions of ſorrow into encomiums on the dead; yet do not, like the Greeks, ſpeak in honour of his family, becauſe they conſider all Egyptians as equally well-born; but they ſet forth the education and manners of his youth, his piety and juſtice in maturer life, his moderation, and every virtue by which he was diſtinguiſhed; and they ſupplicate the infernal deities to receive him as an aſſociate among the bleſſed. The multitude join their acclamations of applauſe in this celebration of the dead, whom they conſider as going to paſs an eternity

among the juſt below." Such is the deſcription which Diodorus gives of this funeral judicature, to which even the kings of Egypt were ſubject. The ſame author aſſerts, that many ſovereigns had been thus judicially deprived of the honours of burial by the indignation of their people: and that the terrors of ſuch a fate had the moſt ſalutary influence on the virtue of their kings.

The funeral rites among the *Hebrews* were ſolemn and magnificent. When any perſon was dead, his relations and friends rent their clothes; which cuſtom is but faintly imitated by the modern Jews, who only cut off a bit of their garment, in token of affliction. It was uſual to bend the dead perſon's thumb into the hand, and faſten it in that poſture with a ſtring; becauſe the thumb then having the figure of the name of God, they thought the devil would not dare to approach it. When they came to the burying-place, they made a ſpeech to the dead in the following terms: "Bleſſed be God, who has formed thee, fed thee, maintained thee, and taken away thy life!—O dead! he knows your numbers, and ſhall one day reſtore your life, &c." Then they ſpoke the elogium, or funeral oration, of the deceaſed; after which they ſaid a prayer, called the *righteouſneſs of judgment*; then turning the face of the deceaſed towards heaven, they called out, "Go in peace."

Among the ancient *Greeks* it was uſual ſometimes before the interment, to put a piece of money into the mouth of the deceaſed, which was thought to be Charon's fare for waſting the departed ſoul over the infernal river. This ceremony was not uſed in thoſe countries which were ſuppoſed to be ſituated in the neighbourhood of the infernal regions, and to lead thither by a ready and direct road. The corpſe was likewiſe furniſhed with a cake, compoſed of flour, honey, &c. which was deſigned to appeaſe the fury of Cerberus, the door-keeper of hell, and to procure the ghoſt a ſafe and quiet entrance. During the time the corpſe continued in the houſe, there ſtood before the door a veſſel of water, the deſign of which was, that thoſe concerned about the body might purify themſelves by waſhing; it being the opinion of the Greeks, as well as of the Jews, that pollution was contracted by touching a dead body.

The ceremonies by which they expreſſed their ſorrow for the death of their friends were various; but it ſeems to have been a conſtant rule to recede as much as poſſible in habit and behaviour from their ordinary cuſtoms. For this reaſon they abſtained from banquets and entertainments; they diveſted themſelves of all ornaments; they tore, cut off, or ſhaved their hair, which they caſt into the funeral pile, to be conſumed with the body of their deceaſed friend. Sometimes they threw themſelves on the ground, and rolled in the duſt, or covered their head with aſhes; they beat their breaſts, and even tore their fleſh with their nails, upon the loſs of a perſon they much lamented. When perſons of rank, ſuch as public magiſtrates or great generals, died, the whole city put on a face of mourning; all public meetings were intermitted; the ſchools, baths, ſhops, temples, and all places of concourſe, were ſhut up.

After interment followed the *epulæ* or feaſts, at which the company uſed to appear crowned, when they ſpoke in praiſe of the dead, ſo far as they could go with truth, it being eſteemed a notorious wickedneſs to lie upon ſuch an occaſion. And not only at thoſe feaſts, but even before the company departed from the ſepulchre, they were ſometimes entertained with a panegyric upon the dead; eiſ n.

The Grecian ſoldiers who died in war had not only their tombs adorned with inſcriptions ſhowing their names, parentage, and exploits, but were alſo honoured with an oration in their praiſe. Particularly the cuſtom among the Athenians in the interment of their ſoldiers was as follows, namely, "They uſed to place the bodies of their dead in tents three days before the funeral, that all perſons might have opportunity to find out their relations, and pay their laſt reſpects to them. Upon the fourth day, a coffin of cypreſs was ſent from every tribe, to convey the bones of their own relations; after which went a covered hearſe, in memory of thoſe whoſe bodies could not be found. All theſe, accompanied with the whole body of the people, were carried to the public burying-place called *Ceramicus*, and there interred. One oration was ſpoken in commendation of them all, and their monuments adorned with pillars, inſcriptions, and all other ornaments uſual about the tombs of the moſt honourable perſons. The oration was pronounced by the fathers of the deceaſed perſons who had behaved themſelves moſt valiantly. Thus, after the famous battle at Marathon, the fathers of Callimachus and Cynægyrus were appointed to make the funeral oration. And, upon the return of the day upon which the ſolemnity was firſt held, the ſame oration was conſtantly repeated every year."

Interring or laying the dead in the ground ſeems to have been the moſt ancient practice among the Greeks, though burning came afterwards to be generally uſed among them. It was cuſtomary to throw into the funeral pile thoſe garments the deceaſed uſually wore. The pile was lighted by one of the deceaſed's neareſt relations or friends, who made prayers and vows to the winds to aſſiſt the flames, that the body might quickly be reduced to aſhes; and, during the time the pile was burning, the dead perſon's friends ſtood by it, pouring libations of wine, and calling upon the deceaſed.

The funeral rites among the *ancient Romans* were very numerous. The deceaſed was kept ſeven days, and every day waſhed with hot water, and ſometimes with oil, that, in caſe he were only in a ſlumber, he might be thus waked; and every now and then his friends meeting made a horrible outcry or ſhout, with the ſame view; which laſt action they called *conclamatio*. The third conclamation was on the ſeventh day; when, if no ſigns of life appeared, the defunct was dreſſed and embalmed by the pollinctores; placed in a bed near the door, with his face and heels towards the ſtreet; and the outſide of the gate, if the deceaſed were of condition, was garniſhed with cypreſs boughs. In the courſe of theſe ſeven days, an altar was raiſed near his bed-ſide, called *acerra*, on which his friends every day offered incenſe; and the libitinarii provided things for the funeral.

On the ſeventh day a crier was ſent about the city, to invite the people to the ſolemnization of the funeral in theſe words: *Exequias L. Tit. L. filii, quibus eſt commodum ire, jam tempus eſt. Ollus* (i. e. *ille*) *ex ædibus effertur.* The people being aſſembled, the laſt conclamation ended, and the bed was covered with purple: a trumpeter marched forth, followed by old women called *præficæ*, ſinging ſongs in praiſe of the deceaſed: laſtly, the bed followed, borne by the next relations; and, if the perſon were of quality and office, the waxen images of all his predeceſſors were carried before him on poles. The bed was followed by his children, kindred, &c. *atrati*, or in mourning: from which act of following the corpſe theſe funeral rites were called *exequiæ*. The body thus brought to the roſtra, the next of kin *laudabat defunctum pro roſtris*, made a funeral oration in his praiſe and that of his anceſtors. This done, the body was carried to the *pyra* or funeral pile, and there burnt: his friends firſt cutting off a finger, to be buried with a ſecond ſolemnity. The body conſumed, the aſhes were gathered; and the prieſt ſprinkling the company thrice with clean water, the eldeſt of the *præficæ* crying aloud, *ilicet*, diſmiſſed the people, who took their leave of the deceaſed in this form: *Vale, vale, vale: nos te ordine quo natura permiſerit, ſequemur.*—The aſhes, incloſed in an urn, were laid in the ſepulchre or tomb.

The *ancient Chriſtians* teſtified their abhorrence of the Pagan cuſtom of burning the dead, and always depoſited the body entire in the ground: and it was uſual to beſtow the honour of

embalming upon the martyrs at leaſt, if not upon others. They prepared the body for burial, by waſhing it with water, and dreſſing it in a funeral attire. The exportation or carrying forth of the body was performed by near relations, or perſons of ſuch dignity as the circumſtances of the deceaſed required. Pſalmody, or ſinging of pſalms, was the great ceremony uſed in all funeral proceſſions among the ancient Chriſtians.

In the *Romiſh church*, when a perſon is dead, they waſh the body, and put a crucifix in its hand. At its feet ſtands a veſſel full of holy water, and a ſprinkler, that they who come in may ſprinkle both themſelves and the deceaſed. In the mean time ſome prieſt ſtands by the corpſe, and prays for the deceaſed till it is laid in the earth. In the funeral proceſſion, the exorciſt walks firſt, carrying the holy water; next the croſs-bearer, afterwards the reſt of the clergy, and laſt of all the officiating prieſt. They all ſing the *miſerere*, and ſome other pſalms; and at the end of each pſalm a *requiem*. We learn from Alet's ritual, that the faces of deceaſed laymen muſt be turned towards the altar, when they are placed in the church; and thoſe of the clergy towards the people. The corpſe is placed in the church ſurrounded with lighted tapers: after the office for the dead, maſs is ſaid; then the officiating prieſt ſprinkles the corpſe thrice with holy water, and as often throws incenſe on it. The body being laid in the grave, the friends and relations of the deceaſed ſprinkle the grave with holy water.

The funeral ceremonies of the *Greek church* are much the ſame with thoſe of the Latin. It needs only be obſerved, that, after the funeral ſervice, they kiſs the crucifix, and ſalute the mouth and forehead of the deceaſed; after which each of the company eats a bit of bread and drinks a glaſs of wine in the church, wiſhing the ſoul a good repoſe, and the afflicted family all conſolation.

Funeral-*Games*, a part of the ceremony of the ancient funerals. It was cuſtomary for perſons of quality among the ancient Greeks and Romans, to inſtitute games, with all ſorts of exerciſes, to render the death of their friends more remarkable. This practice was generally received, and is frequently mentioned by ancient writers. Patroclus's funeral games take up the greater part of one of Homer's Iliads; and Agamemnon's ghoſt is introduced by the ſame poet, telling the ghoſt of Achilles, that he had been a ſpectator at a great number of ſuch ſolemnities. The celebration of theſe games among the Greeks moſtly conſiſted of horſe-races; the prizes were of different ſorts and value, according to the quality and magnificence of the perſon that celebrated them. The garlands given to victors on this occaſion were uſually of parſley, which was thought to have ſome particular relation to the dead. Thoſe games, among the Romans, conſiſted chiefly of proceſſions; and ſometimes of mortal combats of gladiators around the funeral pile. They, as well as the Greeks, had alſo a cuſtom, though very ancient, of cutting the throats of a number of captives before the pile, as victims to appeaſe the manes of the deceaſed. Cæſar relates, that the Gauls had this cuſtom. The funeral games were aboliſhed by the emperor Claudius.

Funeral *Oration*, a diſcourſe pronounced in praiſe of a perſon deceaſed, at the ceremony of his funeral. This cuſtom is very ancient. In the latter part of the account above given of the Egyptian ceremonies of interment may be perceived the firſt rudiments of funeral orations, and what was the ſubject of them, which were afterwards moulded into a more polite and regular form by other nations who adopted this cuſtom. Nor can we omit remarking, that thoſe funeral ſolemnities were attended not only with orations in praiſe of the deceaſed, but with prayers for him; which prayers, it ſeems, were made by one who perſonated the deceaſed: an entire form of one of them is preſerved by Porphyry, and perhaps it may in ſome meaſure gratify the reader's curioſity to recite it from him. "When (ſays he) they (the Egyptians) embalm their deceaſed nobles, they privately take out the entrails, and lay them up in an ark or cheſt: moreover, among other things which they do in favour of the deceaſed, lifting up the ark or cheſt to the ſun, they invoke him; one of the *Libitinarii* making a prayer for the deceaſed, which Euphantus has tranſlated out of the Egyptian language, and is as follows:—O lord, the ſun, and all the gods who give life to men, receive me, and admit me into the ſociety of the immortal ones; for as long as I lived in this world, I religiouſly worſhipped the gods whom my parents ſhowed me, and have always honoured thoſe who begat my body: nor have I killed any man, nor have I defrauded any of what has been committed to my truſt, nor have I done any thing which is inexpiable. Indeed, whilſt I was alive, if I have ſinned either by eating or drinking any thing which was not lawful; not through myſelf have I ſinned, but through theſe (ſhowing the ark and cheſt where the entrails were). And having thus ſpoke, he caſts it into the river; but the reſt of the body he embalms as pure."

The Grecians received the ſeeds of ſuperſtition and idolatrous worſhip from the Egyptians, through the coming of Cecrops, Cadmus, Danaus, and Erechtheus, into Greece; and among other cuſtoms tranſplanted from Egypt were the ſolemnities uſed at the burial of the dead. Of theſe, an encomium on the deceaſed always formed a part, as particularly noticed under the preceding article.

From the Egyptians and Grecians, eſpecially from the latter, the Romans received many of their laws and cuſtoms, as well as much of their polytheiſm and idolatrous worſhip. It is well known, that the cuſtom of making funeral orations in praiſe of the dead obtained among them; and the manner in which their funeral ſervices were performed has been already deſcribed. The corpſe being brought into their great oratory, called the *Roſtra*, the next of the kin *laudabat defunctum pro roſtris*, that is, made a funeral oration, in the commendation principally of the party deceaſed, but touching the worthy acts alſo of thoſe of his predeceſſors whoſe images were there preſent. The account given by Dr. Kennett is in theſe words: "In all the funerals of note, eſpecially in the public or indictive, the corpſe was firſt brought with a vaſt train of followers into the Forum: here one of the neareſt relations aſcended the roſtra, and obliged the audience with an oration in praiſe of the deceaſed. If none of the kindred undertook the office, it was diſcharged by ſome of the moſt eminent perſons in the city for learning and eloquence, as Appian reports of the funeral of Sylla: and Pliny the younger reckons it as the laſt addition to the happineſs of a very great man, that he had the honour to be praiſed at his funeral by the moſt eloquent Tacitus, then conſul; which is agreeable to Quintilian's account of this matter, *Nam et funebres*, &c. For the funeral orations (ſays he) depend very often on ſome public office, and by order of ſenate are many times given in charge to the magiſtrates to be performed by themſelves in perſon. The invention of this cuſtom is generally attributed to Valerius Poplicola, ſoon after the expulſion of the regal family. Plutarch tells us, that, honouring his colleague's obſequies with a funeral oration, it ſo pleaſed the Romans, that it became cuſtomary for the beſt men to celebrate the funerals of great perſons with ſpeeches in their commendations." Thus Julius Cæſar, according to cuſtom, made an oration in the roſtra, in praiſe of his wife Cornelia and his aunt Julia, when dead; wherein he ſhowed, that his aunt's deſcent by her mother's ſide was from kings, and by her father's from the gods. Plutarch ſays, that "he approved of the law of the Romans, which ordered ſuitable praiſes to be given to women as well as to men after death:" although by what he ſays in another place, it ſeems that the old Roman law was, that funeral orations ſhould be made only for the

elder women; and therefore he ſays, that Cæſar was the firſt that made one upon his own wife, it not being then uſual to take notice of younger women in that way: but by that action he gained much favour from the populace, who afterwards looked upon him and loved him as a very mild and good man. The reaſon why ſuch a law was made in favour of the women, Livy tells us, was this: That when there was ſuch a ſcarcity of money in the public treaſury, that the ſuni agreed upon to give the Gauls to break up the ſiege of the city and capitol could not be raiſed, the women collected among themſelves and made it up; who hereupon had not only thanks given them, but this additional honour, that after death they ſhould be ſolemnly praiſed as well as the men: which looks as if, before this time, only the men had thoſe funeral orations made for them.

This cuſtom of the Romans very early obtained among the Chriſtians. Some of their funeral ſermons or orations are now extant, as that of Euſebius on Conſtantine; and thoſe of Nazianzen on Baſil and Cæſarius; and of Ambroſe on Valentinian, Theodoſius, and others. Gregory, the brother of Baſil, made ἐπικήδειον λογον, a funeral oration, for Melitius biſhop of Antioch: in which orations, they not only praiſed the dead, but addreſſed themſelves to them, which ſeems to have introduced the cuſtom of praying to departed ſaints. Now theſe orations were uſually made before the bodies of the deceaſed were committed to the ground; which cuſtom has been more or leſs continued ever ſince, to this day. Thus it appears, that thoſe rites and ceremonies among the heathens, which have been delivered from one people to another, are what have given birth to

FUNERAL *Sermons and Orations* among Chriſtians. In all compoſitions of this ſort from the pulpit, there is one thing which we ſhould take care to follow the ancients in; and that is, not to make ſermons or orations indiſcriminately, but for thoſe only whoſe characters are diſtinguiſhed, and who have been eminently uſeful in the world. The old heathens honoured thoſe alone with this part of the funeral ſolemnity who were men of probity and juſtice, renowned for their wiſdom and knowledge, or famous for warlike exploits: this, as Cicero informs us, being part of the law for burials, which directs that the praiſes only of honourable perſons ſhall be mentioned in the oration. It would be much more agreeable, therefore, if our funeral diſcourſes were not ſo common, and if the characters given of the deceaſed were ſtrictly juſt, and devoid of that fulſome flattery with which they are too often interlarded.

FUNGI, from σφογγος, *fungus*, the name of the 4th order of the 24th claſs of vegetables, in the Linnæan ſyſtem; comprehending all thoſe which are of the muſhroom kind, and which, in Tournefort, conſtitute the 2d, 3d, 4th, 5th, 6th, 7th, and 8th genera of the firſt ſection in the claſs xvii. This order in Linnæus contains 10 genera. See AGARICUS, BOLETUS, CLAVARIA, LYCOPERDON, &c.

FUNGI, an order of plants in the *Fragmenta Methodi Naturalis* of Linnæus. See BOTANY, page 54. The ancients called fungi *children of the earth*, meaning, no doubt, to indicate the obſcurity of their origin. The moderns have likewiſe been at a loſs in what rank to place them; ſome referring them to the animal, ſome to the vegetable, and others to the mineral kingdom. Meſſrs. Wilck and Münchauſen have not ſcrupled to rank theſe bodies in the number of animal productions; becauſe, when fragments of them or their ſeeds were macerated in water, theſe gentlemen perceived a quantity of animalcules diſcharged, which they ſuppoſed capable of being changed into the ſame ſubſtance. It was the ancient opinion, that beef could produce bees; but it was reſerved for Meſſrs. Wilck and Münchauſen to ſuppoſe, that bees could produce beef. Wilck aſſerts, that fungi conſiſt of innumerable cavities, each inhabited by a polype; and he does not heſitate to aſcribe the formation of them to their inhabitants, in the ſame way as it has been ſaid that the coral, the lichen, and the mucor were formed. Hedwig has lately ſhown how ill founded this opinion is with reſpect to the lichen; and M. Durande has demonſtrated its falſity with regard to the corallines. "Indeed (ſays M. Bonnet, talking of the animality of fungi) nothing but the rage for paradox could induce any one to publiſh ſuch a fable; and I regret that poſterity will be able to reproach our times with it. Obſervation and experiment ſhould enable us to overcome the prejudices of modern philoſophy; now that thoſe of the ancient have diſappeared and are forgotten."

It cannot be denied that the muſhroom is one of the moſt periſhable of all plants, and it is therefore the moſt favourable for the generation of inſects. Conſidering the quickneſs of its growth, it muſt be furniſhed with the power of copious abſorption; the extremities of its veſſels muſt be more dilated than in other plants. Its root ſeems, in many caſes, to be merely intended for its ſupport; for ſome ſpecies grow upon ſtones or moveable ſand, from which it is impoſſible that they can draw much nouriſhment. We muſt therefore ſuppoſe, that it is chiefly by the ſtalk that they abſorb. Theſe ſtalks grow in a moiſt and tainted air, in which float multitudes of eggs, ſo ſmall, that the very inſects they produce are with difficulty ſeen by the microſcope. Theſe eggs may be compared to the particles of the Byſſus, 100,000 of which, as M. Gleditſch ſays, are not equal to the fourth of a grain. May we not ſuppoſe, that a quantity of ſuch eggs are abſorbed by the veſſels of the fungus, that they remain there, without any change, till the plant begins to decay? Beſides, the eggs may be only depoſited on the ſurface of the plant, or they may exiſt in the water into which they are thrown for examination. Do not we ſee that ſuch eggs, diſperſed through the air, are hatched in vinegar, in paſte, &c. and wherever they find a convenient nidus for their development? Can it be ſurpriſing then, that the corruption of the muſhroom ſhould make the water capable of diſcloſing certain beings that are really foreign to both?

It is not more eaſy to acquieſce in the opinions of thoſe naturaliſts who place the fungi in the mineral kingdom, becauſe they are found growing on porous ſtones, thence called *Lapides Fungarii*; which, however, muſt be covered with a little earth, and be watered with tepid water, in order to favour the growth. Such muſhrooms are no more the produce of the ſtone, than the lichen is of the rock to which it adheres, or the moſs of the tree on which it is found. We have only to obſerve the growth of muſhrooms to be convinced, that this happens by development, and not by addition or combination of parts as in minerals. The opinion of Boccone, who attributed them to an unctuous matter performing the function of ſeed, and acquiring extenſion by appoſition of ſimilar parts, and that of Moriſon, who conceived that they grew ſpontaneouſly out of the earth by a certain mixture of ſalt and ſulphur, joined with oils from the dung of quadrupeds, have now no longer any adherents. Fungi are produced, they live, they grow, by development; they are expoſed to thoſe viciſſitudes natural to the different periods of life which characterize living ſubſtances; they periſh and die. They extract, by the extremity of their veſſels, the juices with which they are nouriſhed; they elaborate and aſſimilate them to their own ſubſtance. They are, therefore, organized and living beings, and conſequently belong to the vegetable kingdom. But whether they are real plants, or only the production of plants, is ſtill a matter in diſpute with the ableſt naturaliſts.

Some ancient authors have pretended to diſcover the ſeed of muſhrooms; but the opinion was never generally received. Petronius, when he is laughing at the ridiculous magnificence of his hero Trimalcio, relates, that he had written to the Indies for the ſeed of the morelle.

Theſe productions were generally attributed to the ſuperfluous humidity of rotten wood, or other putrid ſubſtances. The opinion took its riſe from obſerving that they grew moſt copiouſly in rainy weather. Such was the opinion of Tragus, of Bauhin, and even of Columna, who, talking of the peziza, ſays, that its ſubſtance was more ſolid and harder, becauſe it did not originate from rotten wood, but from the *pituita* of the earth. It is not ſurpriſing that, in times when the want of experiment and obſervation made people believe that inſects could be generated by putrefaction, we ſhould find the opinion general, that fungi owed their origin to the putreſcence of bodies, or to a viſcous humour analogous to putridity.

Malpighi could not ſatisfy himſelf as to the exiſtence of ſeeds which other botaniſts had pretended to diſcover. He only ſays, that theſe plants muſt have them, or that they perpetuate themſelves and ſhoot by fragments. Micheli, among the moderns, appears to have employed himſelf moſt ſucceſsfully on this ſubject. He imagined, that he not only ſaw the ſeeds, but even the ſtamina, as well as the little tranſparent bodies deſtined to favour the diſſemination and the ſecundation of theſe ſeeds. Before this author, Liſter thought he perceived ſeeds in the *Fungus poroſus craſſus magnus* of John Bauhin: the little round bodies that are found in the pezizæ and helvellæ, at that time, paſſed for ſeeds; which did not appear at all probable to Marſigli, conſidering that the eye, when aſſiſted with the very beſt microſcopes, could perceive nothing ſimilar in much larger fungi. Indeed theſe bodies may be the capſules or covers of the ſeeds, if they are not the ſeeds themſelves. However this may be, Marſigli, obſerving that fungi were often without roots or branches, and that they wanted flowers and ſeeds, the means which nature employs for the production of perfect plants, thought himſelf warranted in doubting whether theſe beings could be ranked in the number of vegetables.

The doubts of Marſigli prompted him to obſerve the formation of fungi. Their matrix he called *Situs:* he imagined they grew in places where they met with an unctuous matter, compoſed of an oil mixed with nitrous ſalt, which, by fermentation, produced heat and moiſture, and inſinuated itſelf between the fibres of wood; that is, he imagined them the production of a viſcous and putreſcent humour. Lanciſi, in like manner, conſidered fungi as owing their exiſtence to the putrefaction of vegetables, and ſuppoſed them a diſeaſe in the plant; but he imagined, "that the fibres of the tree were neceſſary to their production," as is the caſe in the formation of galls; he compared them to the warts and other excreſcences of the human body. He added, that ſuch fungous vegetable tumours muſt neceſſarily aſſume various forms and figures, from the fluids which diſtend the tubes and veſſels relaxed by putreſcence, from the ductility of the fibres and their direction, and from the action of the air.

This opinion has been refuted by the celebrated naturaliſt M. de Juſſieu, in the Memoirs of the Academy of Sciences for the year 1728. He maintains, that the fungi have a great analogy with the lichen, which is allowed to be a vegetable; that, like the lichen, they are diveſted of ſtalk, branches, and leaves: that, like it, they grow and are nouriſhed upon the trunks of trees, on pieces of rotten wood, and on all ſorts of putrid vegetables; that they reſemble the lichen too in the rapidity of their growth, and the facility with which many of them may be dried and reſtored to their former figure, upon being immerſed in water; and, laſtly, that there is a great ſimilarity in the manner in which their ſeeds are produced. He affirms, that only the warts and excreſcences which grow on animal bodies, and the knots and other tumours that are to be found on trees, can be compared with one another; for they are compoſed equally of the ſolid and liquid ſubſtance of the plant or animal on which they grow; whereas the matter of the fungi is not only quite diſtinct from that of the plants on which they are found, but often entirely ſimilar to the ſubſtance of thoſe that ſpring immediately from the earth.

The organization, ſays M. de Juſſieu, which diſtinguiſhes plants and other productions of nature, is viſible in the fungi; and the particular organization of each ſpecies is conſtant at all times and in all places; a circumſtance which could not happen if there were not an animal re-production of ſpecies, and conſequently a multiplication and propagation by ſeed. This is not, he ſays, an imaginary ſuppoſition; for the ſeeds may be felt like meal upon muſhrooms with gills, eſpecially when they begin to decay; they may be ſeen with a magnifying glaſs, in thoſe that have gills with black margins: and, laſtly, ſays he, botaniſts can have no doubt that fungi are a diſtinct claſs of plants, becauſe, by comparing the obſervations made in different countries with the figures and deſcriptions of ſuch as have been engraven, the ſame genera and the ſame ſpecies are every where found.

Notwithſtanding this refutation by M. de Juſſieu, another naturaliſt, M. de Necker, has lately maintained, in his work entitled *Mycitologia*, That the fungi ought to be excluded from the three kingdoms of nature, and be conſidered as intermediate beings. He has obſerved, like Marſigli, the matrix of the fungi: and has ſubſtituted the word *carchte* (initium faciens) inſtead of *ſitus*; imagining that the rudiment of the fungus cannot exiſt beyond that point in which the development of the filaments or fibrous roots is perceived. He allows that fungi are nouriſhed and grow like vegetables; but he thinks that they differ very much from them in reſpect of their origin, ſtructure, nutrition, and rapidity of growth. He ſays, that the various veſſels which compoſe the organization of vegetables are not to be found in the fungi, and that they ſeem entirely compoſed of cellular ſubſtance and bark: ſo that this ſimple organization is nothing more than an aggregation of veſſels endowed with a common nature, that ſuck up the moiſture in the manner of a ſponge; with this difference, that the moiſture is aſſimilated into a part of the fungus. Laſtly, that the fructification, the only eſſential part of a vegetable, and which diſtinguiſhes it from all other organized bodies, being wanting, fungi cannot be conſidered as plants. This he thinks confirmed by the conſtant obſervation of thoſe people who gather the morelle and the muſhroom, and who never find them in the ſame ſpots where they had formerly grown. As the generation of fungi, ſays M. Necker, is always performed when the parenchymatous or cellular ſubſtance has changed its nature, form, and function, we muſt conclude that it is the degeneration of that part which produces theſe bodies.

But, if fungi were owing merely to the degeneration of plants, they would be ſtill better entitled to conſtitute a new kingdom. They would then be a decompoſition, not a new formation or new bodies. Beſides, we cannot deny that, in thoſe bodies which form the limit between the animal and vegetable kingdoms, the organization becomes ſimple, as the organs deſtined for nutrition are multiplied; but, as the laſt in the claſs of inſects belongs to the animal kingdom, fungi ought, notwithſtanding the ſimplicity of their organization, ſtill to belong to the vegetable kingdom. The parenchymatous or cellular ſubſtance, which, as Mr. Bonnet ſays, is univerſally extended, embraces the whole fibrous ſyſtem, and becomes the principal inſtrument of growth, muſt naturally be more abundant in theſe productions; and this accounts for the rapidity of their enlargement. Beſides, growth, whether ſlow or rapid, never was employed to determine the preſence or abſence of the vegetable or animal character. The *draba verna*, which in a few weeks ſhoots, puts forth its leaves, its flowers, and fruit, is not leſs a plant than the palm. The inſect that exiſts but for a day is as much an animal as the elephant that lives for centuries. As to the ſeeds of

the fungi, it is probable that nature meant to withdraw from our eyes the diſſemination of theſe plants, by making the feeds almoſt imperceptible; and it is likewiſe probable, that naturaliſts have ſeen nothing but their capſules. Since, however, from the imperfection of our ſenſes, we are unable to perceive theſe ſeeds, ought we to infer that they do not exiſt? Are we authorized to conclude this, becauſe we do not find muſhrooms where we have found them a year before? Undoubtedly not; for the greater part of plants require a particular ſoil, and the ſame mould that this year will foſter a rare plant will next year allow it to periſh. Neither are we at liberty to deny the exiſtence of theſe ſeeds, becauſe thoſe bodies which have been called their ſeeds, and the fragments or cuttings of the plants themſelves, have not produced others of the ſame ſpecies. Nature ſeems to have reſerved for herſelf the care of diſſeminating certain plants: it is in vain, for inſtance, that the botaniſt ſows the duſt found in the capſules of the orchis, which every one allows to be the ſeed. But, after all, what are thoſe parts in the fungi caſually obſerved by naturaliſts, and which they have taken for the parts of fructification? Theſe are quite diſtinct from the other parts; and whatever may be their uſe, they cannot have been formed by a prolongation of the cellular ſubſtance, or of the fibres of the tree on which the fungus grows: they are therefore owing, like flower and fruit, to the proper organization of the plant. Theſe plants, therefore, have a particular exiſtence, independent of their putrefying nidus. The gills of certain fungi, which differ eſſentially from the reſt of the plant in their conformation, would he ſufficient to authorize this latter opinion. But can putrefaction create an organic ſubſtance?

Nature undoubtedly diſſeminates through the air, and over the ſurface of the earth, innumerable ſeeds of fungi, as well as eggs of inſects. The plant and the animal are excluded, when the nidus or the temperature is favourable for their development. No fortuitous concourſe, either of atoms or fluids, could produce bodies ſo exquiſitely and ſo regularly organized. It is ſufficient to throw one's eyes on the beautiful plates which Schæffer has publiſhed of them, and compare them, by the glaſs, with the warts and other excreſcences of animals, to be convinced that they have not the ſame origin. The function of the cellular ſubſtance in vegetables muſt be greatly ſuperior to that in animals, if it could produce any thing but deformities.

The greater part of fungi exhibit a configuration much too regular, conſtant, and uniform, to be the effect of chance or putrefaction. As this form is preſerved the ſame in all places where fungi have been found, it follows, that they contain in themſelves the principles of their re-production. They reſemble the miſletoe and other paraſitic plants, which are perfectly diſtinct from the trees on which they grow. The fungi, therefore, are organized and living ſubſtances, or true plants. If the manner of their production is unknown, that of ſome inſects is ſo too.

FUNGITÆ, in natural hiſtory, a kind of foſſile coral, of a conic figure, though ſometimes flat and ſtriated longitudinally.

FUNGUS, in ſurgery, denotes any ſpongy excreſcence. See SURGERY.

FUNNEL *of a* CHIMNEY, the ſhaft or ſmalleſt part of the waſte, where it is gathered into its leaſt dimenſions. Palladio directs, that the funnels of chimneys be carried through the roof four or five feet at leaſt, that they may carry the ſmoke clear from the houſe into the air. He alſo adviſes, that chamber chimneys be not made narrower than 10 or 11 inches, nor broader than 15; for if too narrow, the ſmoke will not be able to make its way; and, if too wide, the wind will drive it back into the room. See the articles CHIMNEY and FIREPLACE.

FUR, or FURR, in commerce. See FURR.

FURBISHER, a perſon who furbiſhes, poliſhes, or cleans arms, as guns, ſwords, piſtols, &c.; which is chiefly performed with emery. See the article EMERY.

FURCA, in antiquity, a piece of timber reſembling a fork, uſed by the Romans as an inſtrument of puniſhment. The puniſhment of the furca was of three kinds: the firſt only ignominious, when a maſter, for ſmall offences, forced a ſervant to carry a furca on his ſhoulders about the city. The ſecond was penal, when the party was led about the circus, or other place, with the furca about his neck, and whipped all the way. The third was capital, when the malefactor having his head faſtened on the furca, was whipped to death.

FURCHE', in heraldry, a croſs forked at the ends.

FURETIERE (Antony), an ingenious and learned Frenchman, was born at Paris in 1620, and after a liberal education became eminent in the civil and canon law. He was firſt an advocate in the parliament; and, afterwards taking orders, was preſented with the abbey of Chalivoy and the priory of Chuines. Many works of literature recommended him to the public: but what he is chiefly known by and valued for, is his Univerſal Dictionary of the French Tongue, in which he explains the terms of art in all ſciences. He had not, however, the pleaſure of ſeeing this uſeful work publiſhed before his death, which happened in 1688. He was of the French academy; and the diſputes and quarrels which he had with certain members of it made a great noiſe in the world.

FURIA, in zoology, a genus of inſects belonging to the order of vermes zoophyta. There is but one ſpecies, viz. the infernalis. This has a linear ſmooth body ciliated on each ſide, with reflexed feelers preſſed to its body. In Finland, Bothnia, and the northern provinces of Sweden, it was not unfrequently that people were ſeized with a pungent pain, confined to a point, in the hand or other expoſed part of the body, which preſently increaſed to a moſt excruciating degree, and even ſometimes proved ſuddenly fatal. This diſorder was more particularly obſerved in Finland, eſpecially about boggy and marſhy places, and always in autumn. At length it was diſcovered that this pain inſtantly ſucceeded ſomething that dropped out of the air, and in a moment penetrated and buried itſelf in the fleſh. The Finlanders had tried variety of applications to no purpoſe, until at length a poultice of curds or cheeſe was found the moſt effectual in eaſing the pain: and the event diſcovered that the inſect was allured by this application to leave the fleſh; as, on its removal, this worm, no longer than the ſixth of an inch, was found in it, and thus the cauſe of this painful diſeaſe appeared. But by what means this creature is raiſed into the air is as yet unknown.

FURIES, in Pagan antiquity, certain goddeſſes whoſe office it was to puniſh the guilty after death. They were three in number: Alecto, Megæra, and Tiſiphone; who were deſcribed with ſnakes inſtead of hair, and eyes like lightning, carrying iron chains and whips in one hand, and in the other flaming torches; the latter to diſcover, and the former to puniſh, the guilty: and they were ſuppoſed to be conſtantly hovering over ſuch perſons as had been guilty of any enormous crime. Mythologiſts ſuppoſe, that Tiſiphone puniſhed the crimes which ſprang from hatred or anger; Megæra, thoſe from envy: and Alecto, thoſe from an inſatiable purſuit after riches and pleaſure. They were worſhipped at Caſina in Arcadia, and at Carmia in Peloponneſus. They had a temple at Athens near the Areopagus, and their prieſts were choſen from amongſt the judges of that court. At Telphuſia, a city in Arcadia, a black ewe was ſacrificed to them.

FURIUS (Bibaculus), a Latin poet who flouriſhed about 103 B.C. He wrote annals in verſe, of which Macrobius recites ſome fragments. Suetonius alſo relates ſome verſes of his on Valerius Cato, in his Illuſtrious Grammarians.

FURLING, in the ſea language, ſignifies the wrapping up

and binding any fail clofe to the yard; which is done by hawling upon the clew-lines, bunt-lines, &c. which wraps the fail clofe together, and being bound faft to the yard the fail is furled.

FURLONG, a long meafure, equal to one-eighth of a mile, or 40 poles. It is alfo ufed in fome law-books for the eighth part of an acre.

FURLOUGH, in the military language, a licence granted by an officer to a foldier, to be abfent for fome time from his duty.

FURNACE, an utenfil or veffel proper to contain fire, or to raife and maintain a vehement fire in, whether of coal or wood. Of thefe there are a great variety, according to the different ufes to which they are applied. In all furnaces the principal things to be attended to are, 1. To confine the heat as much as poffible to the matter to be operated upon; 2. To prevent its being diffipated; 3. To produce as much heat with as little fuel as poffible; and, 4. To have it in our power to regulate the degree of heat according to our pleafure.

To anfwer the firft intention, the fire is ufually confined in a chamber or cavity built on purpofe for it, and furnifhed with a door for putting in the fuel; a grate for fupporting it, and allowing air to pafs through, as well as the afhes to drop down into a cavity provided on purpofe, and called the *afh-pit*. Thus the heat produced by the inflamed fuel is confined by the fides of the furnace, and obliged to fpend great part of its force upon the fubject inclofed.

The fecond intention, *viz.* to prevent the diffipation of the heat, is obtained by fhutting the door of the furnace; taking care that the chimney be not too wide, and that the matter to be acted upon be placed in fuch a manner that the fire may have its full effect upon it as it goes up the chimney.

The third intention, which is the moft important, is at the fame time the moft difficult to anfwer, and depends entirely upon the proportion between the fpaces betwixt the furnace bars and the widenefs and height of the chimney. This will appear from a confideration of the principles on which the degrees of inflammation are produced. Thefe depend entirely on the current of air which paffes through the inflamed fuel. As foon as the fuel is fet on fire, a certain degree of heat is produced; but unlefs a conftant influx of air is admitted through the burning fuel, the fire is inftantly extinguifhed; nor is it poffible by any means to renew the inflammation until we admit a ftream of frefh air among the fuel. When this is done, a rarefaction commences in the air of the fire-place of the furnace; fo that it is no longer a counterpoife to the external air, and is therefore driven up the chimney by that which enters at the afh-pit. This again paffing through the fuel is rarefied in its turn; and giving place to frefh quantities, there is a conftant flow of air up the chimney. In proportion to the rarefaction of the air in the fire-place, the greater is the heat. But by a certain conftruction of the furnace, the under part of the chimney will become almoft as ftrongly heated as the fire-place; by which means, though a very ftrong current of air is forced through the fuel, yet as great part of the heat is fpent on the chimney, where it can be of no ufe, the fuel is wafted in a very confiderable degree. To avoid this, we have no other method than to contract the throat of the chimney occafionally by a fliding plate; which when put quite in fhuts up the whole vent, and, by being drawn out more or lefs, leaves a larger or fmaller vent at pleafure. This plate ought to be quite drawn out till the fuel is thoroughly kindled, and the furnace well heated, fo that a current of air may flow ftrongly through the fuel. After this the plate is to be put in a certain length, fo as juft to prevent the fmoke from coming out at the door of the furnace. The rarefaction of the air in the fire-place will folicit a very confiderable draught of air, which will keep the fuel inflamed to a great degree; at the fame time that the heat, being reflected from every part of the furnace excepting that narrow paffage where the fmoke goes up, becomes very intenfe. A large quantity of fuel may be put in at once, which will confume flowly, and thus require but little attention in comparifon with thofe furnaces where no fuch precaution is ufed. The fliding-plate may be made of caft-iron in thofe furnaces where no great heat is excited; but in others fire-clay will be more convenient. The contrivance, however, is fcarce applicable to thofe furnaces where great quantities of metal are to be melted; and accordingly the wafte of fuel there is immenfe. It is computed, that the iron works of Carron in Stirlingfhire confume annually as many coals as would be fufficient for a city containing 700,000 inhabitants.

The fourth intention, *viz.* that of regulating the heat, is accomplifhed by allowing only a certain quantity of air to pafs through the fuel. For this purpofe, according to Dr. Black, it is neceffary to have the command of the furnace below; the parts above being frequently filled with fmall quantities of foot. The beft method of managing this is to fhut up the door of the afh-hole perfectly clofe, and to have a fet of round holes bearing a certain proportion to one another; and their areas being as 1, 2, 4, 8, 16, &c. Seven or eight of thefe ought to be made in the door of the afh-pit, which will give a fufficient command over the fire. When the fire is to be increafed to the utmoft, all the paffages both above and below are to be thrown open, and the height of the vent augmented; which, by increafing the height of the column of rarefied air, increafes alfo the motion of that through the fuel, and of confequence alfo the heat of the furnace. Macquer recommends another tube applied to the afh-pit, wideft at the end fartheft from the furnace, and tapering gradually towards it. The intention of this is to augment the current and velocity of the air by its being made to pafs from a wider into a narrower vent; but though this is no doubt true, the air will not ultimately move with greater velocity than if the tube were not there. It can only be ufeful, therefore, in cafes where the furnace is placed in a fmall room, and the tube itfelf has a communication with the external air.

Effay or Cupelling FURNACE (fee plate 35.) This furnace is defcribed in Cramer's Art of Effaying, in the following manner: 1. Make with iron plates a hollow quadrangular prifm, eleven inches broad and nine inches high *aa*, *bb*, ending at top in a hollow quadrangular pyramid *bb*, *cc*, feven inches high, terminating in an aperture at top feven inches fquare. This prifm muft be clofed at bottom with another iron plate, which ferves as a bafis or bottom to it, *aa*. 2. Near the bottom make a door *e*, three inches high, and five inches broad, that leads to the afh-hole. 3. Above this door, and at the height of fix inches from the bafis, make another door *f*, of the figure of a fegment of a circle, four inches broad at its bafis, and three inches and a half high in the middle. 4. Then faften three iron plates on the forepart of this furnace. Let the firft of them *gg*, eleven inches long and half an inch high, be faftened fo that its lower edge fhall reft againft the bottom of the furnace, with three or four rivets; and in fuch a manner, that there may be between the upper edge of the faid plate and the fide of the furnace a groove fo wide, as that the fliders of the lower door *kk* may be put into it, and freely move backwards and forwards therein: thefe muft be made of a thicker iron-plate. The fecond iron-plate *hh*, eleven inches long, three inches high, and perfectly parallel to the foregoing plate, muft be faftened in the fpace between the two doors, in fuch manner that both the upper and the lower edges of it may form a hollow groove with the fide of the furnace. One of thefe grooves, which is turned downwards, ferves to receive the upper edge of the fliders that fhut the lower door No. 2. The other, that turns upwards, is to receive the inferior edges of the fliders of the fmall door above, No. 3.

The third plate *ii*, which is like the firſt, muſt be riveted cloſe above the upper door, in ſuch a manner that it may form a groove turning downwards, and contiguous to the upper edge of the upper door No. 3. 5. In order to ſhut both doors No. 2, 3, you muſt adapt to each of them two ſliders made of iron-plates, that may move within the above-mentioned grooves *kk*, *ll*. But the two ſliders belonging to the upper door No. 3 muſt have each a hole near the top; that is, one a ſmall hole one-fifth part of an inch broad, and one inch and a half long *m*; and the other a ſemicircular aperture, one inch high and two inches broad *n*. Let, beſides, each ſlider have a handle, that they may be laid hold of when they are to be moved. 6. Moreover, let five round holes, one inch broad, be bored in the furnace; two of which muſt be made in the fore-part of the furnace *oo*, two others in the back part; all at the height of five inches from the bottom, but three inches and a half diſtant from each ſide of the furnace; and, finally, a fifth hole *p*, at the height of one inch above the upper edge of the door *f*. 7. In ſhort, let the inſide of the furnace be armed with iron-hooks, jutting out half an inch, and about three inches diſtant from each other, to faſten the lute with which the furnace is to be covered over within. 8. Let then an iron, moveable, hollow, quadrangular pyramid *g*, three inches high, be adapted to the upper ſquare aperture *d* of the furnace, at the baſis ſeven inches broad, ending upwards in a hollow tube *r*, three inches in diameter, two inches high, almoſt cylindrical, though ſomewhat convergent at top. This prominent tube ſerves to ſupport a funnel or flue, which is almoſt cylindrical, hollow, made of iron-plates, and two feet high; and which, when a very ſtrong fire is required, is put perpendicularly upon the ſhorter tube, in ſuch a manner, that it enters cloſe into it, one inch and a half or two inches deep, and may again be taken off at pleaſure, when there is no need of ſo ſtrong a fire. But this pyramidal cover *q* muſt beſides have two handles *ss* adapted to it, that it may be laid hold of, and thus be taken away or put on again: and that this, being put on the aperture *d* of the furnace, may not be eaſily thrown down, let an iron plate be riveted to the right and left upper edge of the furnace *cc*, and be turned down towards the inſide, ſo as to make a furrow open before and behind, into which the lateral edges of the cover may enter and be faſtened, and at pleaſure be moved backwards and forwards, whenever it muſt be put on or moved. 9. Let a ſquare ledge, made of a thick iron-plate, be faſtened at top of the upper edge of the lower door *e*: this is deſigned to ſupport the grate and the lute; but it muſt be made of two pieces, that it may be eaſily introduced into the cavity of the furnace. Thus you will have an aſſay oven, which muſt afterwards be covered over on the inſide with lute. This you are to do as follows:

That the fire may be better confined, and that the iron may not be deſtroyed by growing red-hot, the whole inſide of the furnace muſt be covered over with lute, one finger or one finger and a half thick. The lute fit for this is deſcribed under CHEMISTRY, p. 397. But before you employ this lute, you muſt firſt put within the furnace ſmall iron bars, equal in length to the diameter of the oven, quadrangular, priſmatical, half an inch thick, having their extremities ſupported by a ſquare iron ledge, and three-fourths of an inch diſtant from each other; and you muſt faſten them ſo, that their flat ſides may be oblique with regard to the tranſverſe ſection of the furnace, and that the two oppoſite angles may look one upwards and the other downwards: the bars muſt not be laid flat, but edgewiſe; by which ſituation you hinder the aſhes of the fuel of the fire from being detained too long between the interſtices of the ſaid iron-bars, and from making an obſtruction that would oppoſe the free draught of the air. The furnace being then covered over with lute, and dried up by a gentle heat, is at laſt fit for docimaſtical operation, and eſpecially for ſuch as muſt be performed in the aſſay-oven.

If then an operation is to be made in the furnace hitherto deſcribed, you muſt let through the four lower holes above deſcribed of the furnace *oo* placed before and behind, and directly oppoſite to each other, two iron-bars one inch thick, and long enough that their extremities on every ſide may jut out of the holes a ſmall matter. Theſe ſerve to ſupport the muffle and its bottom. You then introduce the muffle through the upper aperture of the furnace *d*, and place it upon the above deſcribed iron-bars, in ſuch a manner, that the open fore-ſide of it be contiguous to the inward border of the upper door *f*. The fuel of the fire is introduced through the top of the furnace *d*; the cover of which *g*, on this account, muſt be moveable, and not very heavy. The beſt fuel for the fire is charcoal made of the hardeſt wood, eſpecially of beech, broken into ſmall pieces of the bigneſs of an inch, wherewith the muffle muſt be covered over ſome inches high. We then reject larger bits of coals, becauſe they cannot fall through the narrow interſtices between the ſides of the muffle and thoſe of the furnace, and cannot of courſe ſufficiently ſurround the circumference of the muffle. Whence it happens, that there are on every ſide places void of fuel, and the fire is either not ſtrong enough or unequal. But if, on the contrary, you uſe coals too ſmall, then a great part fall immediately through the interſtices of the grate into the aſh-hole; and the tendereſt particles of them turn too ſoon into aſhes, and, by increaſing the heap of aſhes, obſtruct the free draught of the air, which is here greatly requiſite.

A perfect management of the fire is moſt materially neceſſary in the performing of operations in this furnace; therefore the chemical reader muſt give attention to what follows. If the door of the aſh-hole *e* is quite open, and the ſliders of the upper door *f* drawn towards each other, ſo as to touch one another in the middle of the door; and if beſides the cover *q*, and the funnel adapted to its tube *r*, is upon the top *q* of the furnace; the fire will be then in the higheſt degree poſſible; though, in the mean time, it is hardly ever neceſſary to put the funnel on, except in a very cold ſeaſon: but if, after having diſpoſed the furnace in the manner juſt deſcribed, you put red burning coals into the open upper door *f* of it, the fire is ſtill more increaſed thereby: however, this artifice is never, or very ſeldom, neceſſary. When you ſhut the upper door with only that ſlider that has a narrow oblong hole in it *m*, then the heat becomes a little leſs; but it diminiſhes ſtill more when you ſhut the door with the other ſlider that has in it the ſemicircular hole *n*, which is larger than that of the firſt ſlider: nay, the heat again is leſs when you take away the funnel put at the top of the cover: finally, the door of the aſh-hole being either in part or totally ſhut, the heat is ſtill diminiſhed; becauſe the draught of air ſo neceſſary to excite the fire is thereby hindered: but if, beſides all theſe, you likewiſe open the upper door quite, then the air, ruſhing into the muffle, cools the bodies put under it, that are to be changed, to a degree never required in any operation, and ſuch as will entirely hinder the boiling of lead. If, during the operation, the fire begins to decay, or to grow unequal, it is a ſign that there are places void of coals between the ſides of the furnace and thoſe of the muffle: therefore, in this caſe, you muſt ſtir your coals on every ſide with an iron rod, which is to be introduced through the upper hole *p* of the furnace, that they may fall together, and thus act in a proper manner and equality.

However, you are to obſerve concerning the regimen of the fire juſt deſcribed, that though the apparatus is made with all the exactneſs mentioned, nevertheleſs the effect does not always anſwer it: the cauſe of which difference has moſt commonly its origin in the various diſpoſitions of the air; for as every fire is more excited by coals in proportion as the air, more con-

denfed and more quickly agitated, ftrikes them more violently (which the effect of the bellows plainly fhows); it thence appears, that in warm and wet weather, when the atmofphere is light, the fire muft be lefs efficacious in furnaces; that likewife, when feveral furnaces, fituated near each other, are burning at the fame time, the fire is in part fuffocated, becaufe the ambient air is thereby rendered more rare and lighter. The fame effect is produced by the fun, efpecially in fummer-time, when it fhines upon the place where the furnace is fituated. The atmofphere, on the contrary, being heavier in cold dry weather, excites a very great fire.

The heat of the fire acts the ftronger upon the bodies to be changed, as the muffle put in the furnace is lefs; as the faid muffle has more and larger fegments cut out of it; as the fides of this muffle are thinner; in fhort, as there are more veffels placed in the hinder part of the muffle; and on the contrary. In this cafe, when many of the conditions requifite for the exciting of fire are wanting, then indeed the artificer, with all his fkill, will hardly be able to excite the fire to a fufficient degree, in order to perform operations well, in common affay-ovens, even though he ufes bellows, and puts coals into the upper door of the furnace. For this reafon, the grate ought to be put almoft three inches below the muffle, left the air, rufhing through the afh-hole, fhould cool the bottom of the muffle, which happens in common affay-ovens; and again, that the fmaller coals, almoft already confumed, and the afhes, may more eafily fall through the interftices of the grate, and the larger coals, ftill fit to keep up the fire, be retained. Laftly, the above-mentioned funnel is added, that the blowing of the fire being, by means of it, increafed as much as poffible, this might at laft be carried to the requifite degree; for the fire may always be diminifhed, but not always be increafed at pleafure, without the affiftance of a proper apparatus.

Reverberatory Furnace ufed in the fmelting of ores. Fig. 2. reprefents a longitudinal fection of one. 1. The mafonry. 2. The afh-hole. 3. A channel for the evaporation of the moifture. 4. The grate. 5. The fire-place. 6. The inner part of the furnace. 7. A bafon formed of fand. 8. The cavity where the melted metal is. 9. A hole through which the fcoria is to be removed. 10. The paffage of the flame and fmoke, or the lower part of the chimney; which is to be carried up to a height of about 30 feet. 11. A hole in the roof, through which the ore is thrown into the furnace. This furnace is 18 feet long, 12 feet broad, and $9\frac{1}{2}$ high.

Refining Furnace. Fig. 3. reprefents a longitudinal fection of one. 1. The mafonry of the pillars and walls furrounding the furnace. 2. The channels for carrying off the moifture. 3. Other fmall channels which join in the middle of the bafon. 4. The bafon made of bricks. 5. A bed of afhes. 6. The hollow or bafon in which the metal is melted and refined. 7. The great flame-hole. 8. The two openings for the entry of the tuyeres of the bellows. 9. The vault or dome of the furnace. 10. The fire-place. 11. The grate. 12. The draught-hole. 13. A hole in the vault, which, being opened, ferves to cool the furnace.

Other furnaces for chemical operations are defcribed under the article Chemistry, p. 395 and 478.

Steam-Engine Furnace. A furnace of this fort is defcribed in the fpecification of the patent obtained for the invention by Mr. Watt of Birmingham. His "improved methods of conftructing furnaces or fire-places confift in caufing the fmoke or flame of the frefh fuel, in its way to the flues or chimney, to pafs, together with a current of frefh air, through, over, or among, fuel which has already ceafed to fmoke, or which is converted into coaks, charcoal, or cinders, and which is intenfely hot; by which means the fmoke and groffer parts of the flame, by coming into clofe contact with, or by being brought near unto, the faid intenfely-hot fuel, and by being mixed with the current of frefh or unburnt air, are confumed, or converted into heat, or into pure flame free from fmoke." This is done, "firft, by ftopping up every avenue or paffage to the chimney or flues, except fuch as are left in the interftices of the fuel, by placing the frefh fuel above, or nearer to, the external air than that which is already converted into coaks or charcoal; and by conftructing the fire-places in fuch manner that the flame, and the air which animates the fire, muft pafs downwards, or laterally, or horizontally, through the burning fuel, and pafs from the lower part, or internal end or fide, of the fire-place, to the flues or chimney. In fome cafes, after the flame has paffed through the burning fuel, it is made to pafs through a very hot funnel, flue, or oven, before it comes to the bottom of the boiler, or to the part of the furnace where it is propofed to melt metal, or perform other office, by which means the fmoke is ftill more effectually confumed. In other cafes, the flame is carried immediately from the fire-place into the fpace under a boiler, or into the bed of a melting or other furnace. The drawing fig. 1 (plate 35.) fhews a fection of a fire-engine boiler, and its furnace or fire-place, which has been chofen for an example of the application of this new method to the heating and evaporating of water. A A is the boiler, which may be made of any form fuitable to its ufe. B B is a flue, furrounding the boiler as ufual. C is the uptake, or paffage from the fpace under the boiler to the flues. D D is a funnel or flue for the flame to come from the fire-place to the boiler. E E is a place to contain the afhes; and F is a door to take them out at, which muft be kept continually fhut during the time of working. G H is the fire-place: the frefh fuel is put in at G, and gradually comes down as the fuel below confumes. The part at H is very hot, being filled with the coaks or coals which have ceafed to fmoke. I is an opening or openings, to admit frefh air and regulate the fire. K is a door into the fpace under the boiler; which, being opened, admits air, and ftops the draught of the chimney when the operation is wanted to ceafe. Fig. 2. is a fection of the fame fire-place in the other direction; in which M M is the back of the fire-place; L the brick arch on which the fuel lies; and E the afh-hole. Fig. 3 is an outfide view of the fame fire-place, fhewing the air-holes I I, and the afh-hole door F; and fig. 4 is a plan of the fame, with part of the boiler feating, taken in the line Z Z of fig. 1. The dotted lines reprefent the flues, and the darts point out the direction of the flame. The fire is firft kindled upon the brick arch L (fig. 1.); and, when well lighted, more fuel is gradually added until it is filled up to G; and care is taken to leave proper interftices for the air to pafs, either among the fuel, or between the fuel and the front wall N; and as much air is admitted at I I as can be done without caufing the fmoke to afcend perpendicularly from G, which it will do if too much air is admitted at II. The dimenfions of this fire-place are fhewn by the fcale, and are properly adjufted for burning about eighty-four pounds weight of coals in an hour; where greater or lefs quantities are required to be burnt, the furnaces muft be enlarged or diminifhed accordingly; or, if much greater, more furnaces than one muft be employed. Fig. 5 reprefents this new fire-place as applied to a furnace for melting iron and other metals, and conftructed without the funnel or perpendicular flue D in fig. 1. In this defcription, the fame letters refer to the fame parts in all the preceding figures.

Mr. Watt alfo conftructs thefe new fire places fo that the part GH lies floping, or horizontal, and otherwife varies the figure or form, and proportions; but in all cafes the principle is the fame; the frefh or raw fuel being placed next the external air, and fo that the fmoke or flame paffes over or through the coaked or charred part of the fuel. He alfo occafionally covers the opening G, and caufes the air to enter only, or principally, at I I.

In particular cafes, he places the frefh fuel on a grate as ufual, as at A A fig. 6, and beyond that grate, at or near the place where the flame paffes into the flues or chimneys, he places another fmaller grate B, on which he maintains a fire of charcoal, coaks, or coals which have been previoufly burnt until they have ceafed to fmoke; which, by giving intenfe heat and admitting fome frefh air, confumes the fmoke of the firft fire. Laftly, he ftates his new invention to confift only in the method of confuming the fmoke, and increafing the heat, by caufing the fmoke and flame of the frefh fuel to pafs through very hot funnels or pipes, or among, through, or near, fuel which is intenfely hot, and which has ceafed to fmoke; and by mixing it with frefh air when in thefe circumftances; and in the form and nature of the fire-places above mentioned: the boilers and other parts of the furnaces being fuch as are in common ufe. Thefe new-invented fire-places are alfo applicable to furnaces for almoft every other purpofe.

In vol. iv. of the Repertory is given the following account of a furnace of this fort by Mr. W. Thompfon, who defcribes his invention to be " a furnace which will effectually confume the fmoke arifing from it, without requiring more coals than ufual, as has been the cafe with former contrivances for that purpofe. It may be adapted to any boiler or copper already fet up, and at a very fmall expence. Fig. 1, is a fection of an oblong boiler and fire-place. *a a a a*, The brick work in which boilers are ufually fet. A A, The boiler. Two iron flues run through this boiler, and alfo go round it. B B, The fire-place; which muft be about one-third longer than they are generally made. C, An arch, which runs acrofs the fire-place, two inches lower than the bottom of the flue under the boiler, and about the middle of the fire-place. D D D D, Flues through which the hot air afcends, and fpends its heat on the boiler. E. The door of the fire-place; which muft have a fmall fhutter in it. Through this fhutter the coals muft be gently ftirred up, by the flice or poker, taking care not to injure the arch, nor to raife too great a quantity of coals at once. F is a fmall fpace left behind the fire for a current of air to come through, as in the patent lamps. G. A brick placed with its whole length acrofs the fire-place, to hinder the coals from falling down the fpace F, and choking it. Fig. 2, is a front-view of the fame boiler and fire-place, in which the fame letters reprefent the fame parts. H H are two flides, the one fhifting backwards, the other forwards, to make the fpace F, for the current of air, larger or fmaller, as by practice may be found beft.

The manner in which this furnace operates is thus:—The arch C hinders the fmoke from going up the chimney, and obliges it to pafs through the fire behind it; which has a very ftrong draught, and burns the fmoke as it paffes through it. The air which comes up through the fpace F gives frefh vigour to the flame, which confumes any fmoke that may be left. It muft be obferved that too much air will have a very bad effect, as it will cool the flame; therefore the flides H H muft be regulated in fuch manner as the operator may find moft advantageous. The fhutter in the door E muft alfo be of a proper fize; as its being too large or too fmall will be prejudicial.

Machines for Blowing Air into FURNACES. The earlieft method of animating large fires in the furnaces where ores were fmelted feems to have been by expofing them to the wind. Such was the practice of the Peruvians before the arrival of the Spaniards among them. Alonfo Barba relates, that their furnaces, called *guairas*, were built on eminences, where the air was freeft; that they were perforated on all fides with holes, through which the air was driven in when the wind blew, which was the only time when the work could be carried on; that under each hole was made a projection of the ftone-work, on which were laid burning coals, to heat the air before it entered the furnace. Some authors fpeak of feveral thoufands of thefe guairas burning at once on the fides and tops of the hills of Potofi; and feveral remains of this practice are to be found in different parts of Great Britain.

This method of fupplying air being found generally ineffectual and precarious, the inftruments called *bellows* fucceeded. Thefe were at firft worked by the ftrength of men; but as this was found to be very laborious and expenfive, the force of running water was employed to give motion to thefe machines. Thus a much greater quantity of metal could be procured than formerly, and the feparation was likewife more complete; infomuch, that in many places the flags or cinders from which the iron had formerly been extracted were again ufed as frefh ore, and yielded plenty of metal.

But though this method was found to be greatly preferable to the others, yet great improvements were ftill wanted. In order to melt very large quantities of ore at a time, it was neceffary to ufe bellows of an immenfe fize; and in proportion to their fize they ftood in need of the more frequent and expenfive repairs. The oil alfo, which the bellows required in large quantity, becoming rancid, was found to generate a kind of inflammable vapour, which fometimes burft the bellows with explofion, and thus rendered them totally ufelefs. A new method, therefore, of blowing up fires, altogether free from the abovementioned inconveniencies, was fallen upon by means of water. It depends on the following principle, viz. That a ftream of water, running through a pipe, if by any means it is mixed with air at its entrance into the pipe, will carry that air along with it, and part with it again as foon as it comes out of the pipe; and if the air is then collected by a proper apparatus, it may with fuccefs be ufed for exciting the moft violent degrees of heat.

In plate 35 is reprefented a machine of this kind. AB fhows the ftream of water falling into the funnel, whofe throat is contracted at B; after which the ftream runs through the perpendicular pipe EF, in the upper part of which there are fome fmall holes reprefented by *cdef*. Through thefe holes the air has accefs to mix itfelf with the defcending water, which being dafhed againft the fides of the pipe is reduced to froth, and thus fills the whole cavity of the pipe EF, which is confiderably larger than the throat of the funnel B. When this frothy ftream enters the veffel C, the air extricates itfelf from the water; and as it cannot return through the pipe EF, becaufe it is continually filled with a ftream of liquid matter, it flies off with confiderable force through the fmaller pipe D, by which it is conveyed to the furnace.

From this defcription, it is evident that the principal thing to be kept in view in the conftruction of thefe machines is, to mix the defcending ftream of water with as great a quantity of air as poffible. For this purpofe the contrivance reprefented in the left-hand machines anfwers much better than the former. By this the water defcending from the refervoir A falls into a kind of cullender B, perforated with a great number of holes in its fides. Thus the water being forced out in a number of fmall ftreams is very effectually dafhed againft the fides of the wide defcending pipe, when it enters the condenfing veffel C, and is fent off by the pipe D, as in the former.

In fome machines of this kind the conftructors feem to have been of opinion, that a great height was required in the waterfall; but Dr. Lewis, who hath made a great number of experiments upon the fubject, fhows, that an excefs in height can never make up for a deficiency in the quantity of the water. Four or five feet, he thinks, is a fufficient height for the waterfall; where there is a greater height, however, it may be rendered ufeful, by joining two or more machines together in the manner reprefented in the plate; where the water, after having once emitted its air in the condenfing veffel C, flows out into a new refervoir E. From thence it defcends through another cullender F, and defcending from it into a condenfing veffel

G, the air is extricated, and carried off through the pipe H. The upper figure reprefents the cullender, with the fhapes of the holes and their proportional diftances, according to Dr. Lewis.

Thus, with very little expence, where there is a fufficient quantity of water, as ftrong a blaft of air as can be defired may be readily obtained; for feveral machines may be conftructed, and joined together in a manner fomewhat fimilar to that above mentioned, until all the quantity of water is employed. It is proper to obferve, however, that as by this method the air is loaded with moifture, it is proper to make the condenfing veffel as high as conveniently may be, that the air may arrive at the furnace in as dry a ftate as poffible. The long flender pipes in the left-hand machines reprefent a gage filled with mercury or water, by which the ftrength of the blaft may be determined.

In the large iron founderies another method is ufed for blowing up the fires by means of a kind of air-pumps. Thefe confift of caft-iron cylinders of about three feet diameter, exactly fitted with a pifton moved up and down by means of a water-wheel. In the bottom of the cylinder is a large valve like that of a bellows, which rifes as the pifton is lifted up, and thus admits the air into the cavity of the cylinder from below. Immediately above the bottom is a tube which goes to the furnace; and as it proceeds from the cylinder is furnifhed with a valve opening outward. Thus, when the pifton is drawn up, the valve in the bottom rifes and admits the air that way into the cylinder; while the lateral valve fhuts, and prevents any air from getting into it through the pipe. When the pifton is thruft down, the valve in the bottom fhuts, while the air being compreffed in the cavity of the cylinder is violently forced out through the lateral tube into the furnace. In the great foundery at Carron, four of thefe large cylinders were a few years ago employed at their principal furnace, and fo contrived that the ftrokes of the piftons, being made alternately, produced an almoft uninterrupted blaft. Some little intermiffion might indeed be perceived by the air, but it was too trifling to produce any fenfible effect on the heat of the furnace. Even this could have been prevented by means of a large refervoir into which all the four cylinders might difcharge their blaft. This fhould be furnifhed with a heavy pifton; whofe weight, being fupported by the air of the cylinder alone, would force it out through its lateral tube in a manner perfectly equable, without any of that puffing or interruption in the blaft, perceptible though but in a fmall degree in the other.

FURR, in commerce, fignifies the fkins of different wild beafts, dreffed in alum with the hair on, and ufed as a part of drefs, by princes, magiftrates, and others. The kinds moft in ufe are thofe of the ermine, fable, caftor, hare, rabbit, &c. See MUSTELA.

It was not till the later ages that the furrs of beafts became an article of luxury. The more refined nations of ancient times never made ufe of them: thofe alone whom the former ftigmatifed as barbarians were clothed in the fkins of animals. Strabo defcribes the Indians covered with the fkins of lions, panthers, and bears; and Seneca, the Scythians clothed with the fkins of foxes and the leffer quadrupeds. Virgil exhibits a picture of the favage Hyperboreans, fimilar to that which our late circumnavigators can witnefs to in the clothing of the wild Americans, unfeen before by any polifhed people.

> *Gens effræna virûm Riphæo tunditur Euro;*
> *Et pecudum fulvis velantur corpora fetis.*

Moft part of Europe was at this time in fimilar circumftances. Cæfar might be as much amazed with the fkin-dreffed heroes of Britain, as our celebrated Cook was at thofe of his new-difcovered regions. What time hath done to us, time, under humane conquerors, may effect for them. Civilization may take place; and thofe fpoils of animals, which are at prefent effential for clothing, become the mere objects of ornament and luxury.

It does not appear that the Greeks or old Romans ever made ufe of furrs. It originated in thofe regions where they moft abounded, and where the feverity of the climate required that fpecies of clothing. At firft it confifted of the fkins only, almoft in the ftate in which they were torn from the body of the beaft; but as foon as civilization took place, and manufactures were introduced, furrs became the lining of the drefs, and often the elegant facing of the robes. It is probable that the northern conquerors introduced the fafhion into Europe. We find that, about the year 522, when Totila king of the Vifigoths reigned in Italy, the Suethons (a people of modern Sweden) found means, by help of the commerce of numberlefs intervening people, to tranfmit, for the ufe of the Romans, *faphilinas pelles*, the precious fkins of the fables. As luxury advanced, furrs, even of the moft valuable fpecies, were ufed by princes as linings for their tents: thus Marco Polo in 1252 found thofe of the Cham of Tartary lined with ermines and fables. He calls the laft *Zibelines* and *Zambolines*. He fays that thofe and other precious furrs were brought from countries far north; from the *land of Darknefs*, and regions almoft inacceffible by reafon of moraffes and ice. The Welch fet a high value on furrs as early as the time of Howel Dda, who began his reign about 940. In the next age, furrs became the fafhionable magnificence of Europe. When Godfrey of Boulogne and his followers appeared before the emperor Alexis Comnene, on their way to the Holy Land, he was ftruck with the richnefs of their dreffes, *tam ex oftro quam aurifrigio et niveo opere harmelino et ex mardrino grifioque et vario.* How different was the advance of luxury in France from the time of their great monarch Charlemagne, who contented himfelf with the plain furr of the otter! Our Henry I. wore furrs; yet in his diftrefs was obliged to change them for warm Welch flannel. However, in the year 1337 luxury had got to fuch a head, that Edward III. enacted, that all perfons who could not fpend a hundred a-year fhould abfolutely be prohibited the ufe of this fpecies of finery. Thefe, from their great expence, muft have been foreign furrs, obtained from the Italian commercial ftates, whofe traffic was at this period boundlefs. How ftrange is the revolution in the furr-trade! The north of Afia at that time fupplied us with every valuable kind; at prefent we fend, by means of the poffeffion of Hudfon's Bay, furrs to an immenfe amount, even to Turkey and the diftant China.

The late Captain Cook's laft voyage to the Pacific Ocean, befides the various fcientific advantages to be derived from it, opened a new fource of wealth to future navigators, by trading for furrs of the moft valuable kind on the north-weft coaft of America. The firft veffel which engaged in that new branch of trade was equipped by fome gentlemen in China. She was a brig of 60 tons and 20 men, commanded by James Hanna. She failed from the Typa the end of April 1785; proceeded to the northward along the coaft of China; paffed through Diemen's Straits, the fouth end of Japan; and arrived at Nootka in Auguft following. Soon after her arrival, the natives, whom Captain Cook had left unacquainted with the effects of fire-arms, tempted probably by the diminutive fize of the veffel (fcarce longer than fome of their own canoes) and the fmall number of her people, attempted to board her in open day; but were repulfed with confiderable flaughter. This was the introduction to a firm and lafting friendfhip. Captain Hanna cured fuch of the Indians as were wounded; an unreferved confidence took place; they traded fairly and peaceably; a valuable cargo of furrs was procured; and the bad weather fetting in, he left the coaft in the end of September, touched at the Sandwich Iflands,

and arrived at Macao the end of December of the ſame year. Several voyages were afterwards undertaken with a view of promoting this trade, which of late years has become an uninterrupted and advantageous ſyſtem of traffic.

FURSTENBURGH, a town and caſtle of Germany, the capital of a county of the ſame name, 30 miles north-weſt of Conſtance. E. lon. 8. 30. N. lat. 47. 50.

FURTHCOMING, in law, the name of an action competent to any perſon who has uſed arreſtment in the hands of his debtor's creditor, for having the ſubject arreſted declared his property.

FURUNCULE, or BOIL, in ſurgery, a ſmall ſuppurating tumour, with inflammation, redneſs, and great pain, ariſing in the adipoſe membrane, under the ſkin. See SURGERY.

FURZE, in botany. See ULEX.

FUSANUS, in botany; a genus of the monœcia order, belonging to the polygamia claſs of plants. The hermaphrodite calyx is quinquefid; there is no corolla; there are four ſtamina; the germen beneath; there are four ſtigmata; the fruit a plum.

FUS ROLE, in architecture, a moulding or ornament placed immediately under the echinus, in the Doric, Ionic, and Compoſite capitals.

FUSE, or FUZE, in artillery. See FUSEE.

FUSEE, in clock-work, is that conical part drawn by the ſpring, and about which the chain or ſtring is wound; for the uſe of which, ſee the articles CLOCK and WATCH.

FUSEE, or *Firelock*. See MUSQUET.

FUSEE, *Fuze*, or *Fuſe*, of a bomb or grenado, is that which makes the whole powder or compoſition in the ſhell take fire, to do the deſigned execution. Fuzes are chiefly made of very dry beech-wood, and ſometimes of hornbeam, taken near the root. They are turned rough and bored at firſt, and then kept for ſeveral years in a dry place; the diameter of the hole is about $\frac{1}{4}$th of an inch; the hole does not come quite through, leaving about $\frac{1}{4}$th of an inch at the bottom; and the head is made hollow, in the form of a bowl. The compoſition for fuzes is ſaltpetre 3, ſulphur 1, and mealed powder 3, 4, and ſometimes 5 parts. This compoſition is drove in with an iron-driver (whoſe ends are capped with copper to prevent the compoſition from taking fire), and preſſed as hard as poſſible; the laſt ſhovel-full being all mealed powder, and two ſtands of quick-match laid acroſs each other being driven in with it, the ends of which are folded up into the hollow top, and a cap of parchment tied over it till uſed. When theſe fuzes are driven into the loaded ſhell, the lower end is cut off in a ſlope, ſo that the compoſition may inflame the powder in the ſhell: the fuze muſt have ſuch a length as to continue burning all the time the ſhell is in its range, and to ſet fire to the powder as ſoon as it touches the ground, which inſtantly burſts into many pieces. When the diſtance of the battery from the object is known, the time of the ſhell's flight may be computed to a ſecond or two; which being known, the fuze may be cut accordingly, by burning two or three, and making uſe of a watch or a ſtring by way of a pendulum to vibrate ſeconds.

FUSIBILITY, in natural philoſophy, that quality of bodies which renders them fuſible. Gold is more fuſible than iron or copper; but leſs ſo than ſilver, tin, and lead. Borax is frequently mixed with metals, to render them more fuſible.

FUSIL, in heraldry, a bearing of a rhomboidal figure, longer than the lozenge, and having its upper and lower angles more acute and ſharp than the other two in the middle. It is called in Latin *fuſus*, "a ſpindle," from its ſhape.

FUSILEERS, FUSILIERS, or *Fuzileers*, in the military art, are ſoldiers armed as the reſt of the infantry, but wearing caps like the grenadiers, though ſomewhat ſhorter. There are three regiments in the Britiſh ſervice: the royal regiment of Scots fuzileers, raiſed in 1678; the royal regiment of Engliſh fuzileers, raiſed in 1685: and the royal regiment of Welch fuzileers raiſed in 1688-9.

FUSION, the ſtate of a body rendered fluid by fire. See FLUIDITY and CHEMISTRY.

FUST, or FAUSTUS, a citizen of Mentz, and one of the earlieſt printers. He had the cunning to conceal his art; and to this policy we are indebted for the tradition of "The Devil and Dr. Fauſtus," handed down to the preſent times. Fuſt, in partnerſhip with Peter Schoeffer, having in 1462 printed off a conſiderable number of copies of the Bible to imitate thoſe which were commonly ſold in MS. Fuſt undertook the ſale of them at Paris, where the art of printing was then unknown. At firſt he ſold his copies for ſo high a ſum as 500 or 600 crowns, the prices uſually demanded by the ſcribes. He afterwards lowered his price to 60 crowns, which created univerſal aſtoniſhment: but when he produced copies as faſt as they were wanted, and lowered the price to 30 crowns, all Paris was agitated. The uniformity of the copies increaſed the wonder; informations were given into the police againſt him as a magician; his lodgings were ſearched; and a great number of copies being found, they were ſeized: the red ink with which they were embelliſhed was ſaid to be his blood; it was ſeriouſly adjudged that he was in league with the devil; and if he had not fled, moſt probably he would have ſhared the fate of thoſe whom ignorant and ſuperſtitious judges condemned in thoſe days for witchcraft.

FUSTIAN, in commerce, a kind of cotton ſtuff, which ſeems as it were whaled on one ſide. Right fuſtians ſhould be altogether made of cotton-yarn, both woof and warp; but a great many are made, the warp of which is flax, or even hemp. There are fuſtians made of ſeveral kinds, wide, narrow, fine, coarſe; with ſhag or nap, and without it.

FUSTIAN, is alſo uſed in a ludicrous ſenſe, for a bombaſt ſtyle, or a high ſwelling kind of writing made up of heterogeneous parts.

FUSTIC, or FUSTOCK, a yellow wood, that grows in all the Caribbee iſlands, uſed in dying yellow. It pays no duty on importation. It is a ſpecies of MORUS.

FUSTIGATIO, in the Roman cuſtoms, a puniſhment inflicted by beating with a cudgel. This puniſhment was peculiar to freemen; for the ſlaves were ſcourged or laſhed with whips.

FUTTOCKS, in a ſhip, the timbers raiſed over the keel, or the encompaſſing timbers that make her breadth.

FUTURE, ſomething to come hereafter. We ſay a *future* ſtate, a *future* contingency; there is none but God to whom *future* things are preſent.

FUTURE, or FUTURE *Tenſe*, in grammar, denotes an inflexion of verbs, whereby they denote, that a thing will be in ſome time yet to come See GRAMMAR.

FUZES, or FUSEES, in artillery. See FUSEE.

FUZILEERS. See FUSILEERS.

FYTT (John), a celebrated painter of animals and flowers, &c. was born at Antwerp about the year 1625, and proved one of the beſt artiſts of his time. He frequently painted in conjunction with Rubens and Jordaens; and whatever ſubject he choſe to repreſent in the ſtyle which he adopted was always deſigned and finiſhed in a maſterly manner. His general ſubjects were live and dead game, wild boars, hares, dogs, fruits, flowers, and birds, particularly partridges, which he deſcribed with ſurpriſing truth, nature, and ſtrength. He likewiſe imitated ſucceſsfully the bas relieves on vaſes of marble or porphyry; and gave uncommon freſhneſs to his fruits and flowers; and in objects of the animal kind, he deſcribed even the hairs of the animals and the plumage of his fowls with wonderful ſpirit, exactneſs, and freedom of pencil.

G.

G THE ſeventh letter and fifth conſonant of our alphabet; though, in the alphabets of all the oriental languages, the Hebrew, Phenician, Chaldee, Syriac, Samaritan, Arabic, and even Greek, *G* is the third letter. The Hebrews call it *ghimel* or *gimel*, *q. d.* "camel;" by reaſon it reſembles the neck of that animal; and the ſame appellation it bears in the Samaritan, Phenician, and Chaldee: in the Syriac it is called *gamel*, in Arabic, *giim*, and in Greek *gamma*.

The gamma (Γ) of the Greeks is manifeſtly the gimel (ג) of the Hebrews or Samaritans. All the difference between the gamma and gimel conſiſts in this, that the one is turned to the right and the other to the left, according to the different manners of writing and reading which obtained among thoſe different nations; ſo that all the pains Salmaſius has taken on Solinus, to prove that the G was derived from the Greek kappa, are loſt.

From the Greeks the Latins borrowed their form of this letter; the Latin G being certainly a corruption of the Greek gamma Γ, as might eaſily be ſhown, had our printers all the characters and forms of this letter which we meet with in the Greek and Latin MSS. through which the letter paſſed from Γ to G. Diomed, lib. ii. cap. *De Litera*, calls G a new letter. His reaſon is, that the Romans had not introduced it before the firſt Punic war; as appears from the roſtral column erected by C. Duilius, on which we every where find a C in lieu of G. It was Sp. Carvilius who firſt diſtinguiſhed between thoſe two letters, and invented the figure of the G; as we are aſſured by Terentius Scaurus. The C ſerved very well for G; it being the third letter of the Latin alphabet, as the Γ or γ was of the Greek.

The G is found inſtead of C on ſeveral medals: *Vaillant*, *Num. Imperat.* tom. i. p. 39. M. Beger produces a medal of the *Familia Ogulnia*, where GAR is read inſtead of CAR, which is on thoſe of M. Patin. But the C is more frequently ſeen on medals in lieu of G; as, AUCUSTALIS CALLAECIA CARTACINENSIS, &c. for AUGUSTALIS, &c. Not that the pronunciation of thoſe words was altered, but only that the G was unartfully or negligently cut by the workmen: as is the caſe in ſome inſcriptions of the eaſtern empire, where AUC, AUCC, AUCCC, are frequently found for AUG, &c.

The northern people frequently change the G into V or W; as in *Gallus*, *Wallus*; *Gallia*, *Wallia*, *Vallia*, &c. For in this inſtance it muſt not be ſaid that the French have changed the W into G; becauſe they wrote *Gallus* long before *Wallus* or *Wallia* was known, as appears from all the ancient Roman and Greek writers. And yet it is equally true, that the French change the W of the northern nations, and V conſonant, into G; as, *Willielmus*, "William," into *Guillaume*; *Wulphilas* into *Gulphilas*; *Vaſco* into *Gaſcon*, &c.

The letter G is of the mute kind, and cannot be any way ſounded without the help of a vowel. It is formed by the reflexion of the air againſt the palate, made by the tongue as the air paſſes out of the throat; which Martianus Capella expreſſes thus, G *ſpiritus cum palato*; ſo that G is a palatal letter.

The modern G takes its form from that of the Latins. In Engliſh it has two ſounds, one from the Greek Γ, and the Latin, which is called that of the hard *G*, becauſe it is formed by a preſſure ſomewhat hard on the fore-part of the tongue againſt the upper gum; which ſound it retains before *a*, *o*, *u*, *l*, *r*; as *gate*, *go*, *gull*. At the end of a word it is always hard, as *ring*, *ſing*, &c. The other ſound, called that of the ſoft *G*, reſembles that of *j*; and is commonly, though not always, found before *e* and *i*, as in *geſture*, *giant*, &c. To this rule, however, there are many exceptions; *G* is often hard before *i*, as *give*, &c. and ſometimes before *e*, as *get*, &c. It is alſo hard in derivatives from words ending in *g*, as *ſinging*, *ſtronger*, &c. and generally before *er*, at the end of words, as *finger*. *G* is mute before *n*, as *gnaſh*, *ſign*. *Gh* has the ſound of the hard *G* in the beginning of a word, as *ghoſtly*; in the middle, and ſometimes at the end, it is quite ſilent, as *right*, *though*. At the end of a word *Gh* has often the ſound of *f*, as *laugh*, *rough*, *tough*.

As a *numeral*, G was anciently uſed to denote 400; and with a daſh over it thus Ḡ, 40,000.

As an *abbreviature*, G. ſtands for *Gaius*, *Gellius*, *gens*, *genius*, &c. G. G. for *gemina*, *geſſit*, *geſſerunt*, &c. G. C. for *genio civitatis* or *Cæſaris*. G. L. for *Gaius libertus*, or *genio loci*. G. V. S. for *genio urbis ſacrum*. G. B. for *genio bono*. And G. T. for *genio tutelari*.

In *muſic*, G is the character or mark of the treble cleff; and from its being placed at the head, or marking the firſt ſound in Guido's ſcale, the whole ſcale took the name *gamut*.

GABALE, in mythology, a deity worſhiped at Heliopolis under the figure of a lion, with a radiant head; and it is thus repreſented on many medals of Caracalla.

GABARDINE, from the Italian *gavardina*, has been ſometimes uſed to denote a coarſe frock, or mean dreſs. In this ſenſe it is uſed by Shakeſpeare in his Tempeſt and Merchant of Venice, and by Butler in his Hudibras, book i.

GABARA, or GABBARA, in antiquity, the dead bodies which the Egyptians embalmed, and kept in their houſes, eſpecially thoſe of ſuch of their friends as died with the reputation of great piety and holineſs, or as martyrs. See EMBALMING, and MUMMY.

GABEL, *Gabella*, *Gablum*, *Gablagium*, in French *Gabelle*, i. e. *Vectigal*, hath the ſame ſignification among the ancient Engliſh writers that *gabelle* till lately had in France. It is a tax; but hath been variouſly uſed, as for a rent, cuſtom, ſervice, &c. And where it was a payment of rent, thoſe who payed it were termed *gablatores*. When the word *gabel* was formerly mentioned without any addition to it, it ſignified the tax on ſalt, though afterwards it was applied to all other taxes.

In the French cuſtoms, the gabel or tax on ſalt, heretofore computed to make one-fourth of the whole revenue of the kingdom, it is ſaid had its riſe in 1286, under Philip the Fair. Philip the Long took a double per livre on ſalt, by an edict in 1318, which he promiſed to remit when he was delivered from his enemies: this was renewed by Philip de Valois in 1345; and the duty was raiſed to four deniers per livre: king John reſumed it in 1355, and it was granted to the dauphin in 1358 to ranſom king John. It was continued by Charles V. in 1366: after his deceaſe it was ſuppreſſed, but revived again by Charles VI. in 1381. Louis XI. raiſed it to 12 deniers per livre; and Francis I. in 1542 to 24 livres per muid, and it has been conſiderably augmented ſince that time; ſo that a minot of ſalt latterly paid a duty of 52 livres, 8 ſols, and 6 deniers. Philip de Valois firſt eſtabliſhed granaries and officers of the gabelles, and prohibited all other perſons from ſelling ſalt: from which time the whole commerce of ſalt for the inland conſumption continued wholly in the king's hands, every grain thereof being ſold and diſtributed by his farmers and officers created for the purpoſe. This very odious and oppreſſive tax was aboliſhed by the National Aſſembly.

GABINIAN LAWS, in Roman antiquities, laws inſtituted upon ſeveral occaſions by perſons of the name of *Gabinius*. The firſt was the *Gabinia lex de Comitiis*, by A. Gabinius the tribune, in the year of Rome 614. It required that, in the public aſſemblies for electing magiſtrates, the votes ſhould be given by tablets, and not *viva voce*. Another *de Comitiis*, which made it a capital puniſhment to convene any clandeſtine aſſembly, agreeable to the old law of the 12 tables. Another *de Militia*, by A. Gabinius the tribune, in the year of Rome 685. It granted Pompey the power of carrying on the war againſt the pirates during three years, and of obliging all kings, governors, and ſtates, to ſupply him with all the neceſſaries he wanted, over all the Mediterranean ſea, and in the maritime provinces as far as 400 *ſtadia* from the ſea. Another *de Uſura* by Aul. Gabinius the tribune, year of Rome 685. It ordained that no action ſhould be granted for the recovery of any money borrowed upon ſmall intereſt to be lent upon larger. This was a common practice at Rome, and obtained the name of *verſuram facere*. Another againſt fornication.

GABIONS, in fortification, baſkets made of ozier-twigs, of a cylindrical form, ſix feet high and four wide; which, being filled with earth, ſerve as a ſhelter from the enemy's fire.

GABLE, or GABLE-*End*, of a houſe (from *gaval*, Welch), is the upright triangular end from the cornice or eaves to the top of the houſe.

GABRES, or GAVRES, a religious ſect in Perſia and India, called alſo *Gebres*, *Guebres*, *Gevres*, *Gaurs*, &c. See MAGI. The Turks call the Chriſtians *Gabres*, *q. d.* infidels, or people of a falſe religion; or rather, as Leunclavius obſerves, heathens or gentiles: the word *Gabre* among the Turks having the ſame ſignification as *pagan* or *infidel* among the Chriſtians, and denoting any thing not Mahometan. In Perſia the word has a more peculiar ſignification; wherein it is applied to a ſect diſperſed through the country, and ſaid to be the remains of the ancient Perſians or followers of Zoroaſter, being worſhippers of fire. They have a ſuburb at Iſpahan, which is called *Gaurabad*, or "the town of the *Gours*," where they are employed in the meaneſt and vileſt drudgery: ſome of them are diſperſed through other parts of Perſia; but they principally abound in Kerman, the moſt barren province in the whole country, where the Mahometans allow them liberty and the exerciſe of their religion. Several of them fled many ages ago into India, and ſettled about Surat, where their poſterity remain to this day. There is alſo a colony of them at Bombay. They are a poor, ignorant, inoffenſive people, extremely ſuperſtitious and zealous for their rites, rigorous in their morals, and honeſt in their dealings. They profeſs to believe a reſurrection and a future judgment, and to worſhip only one God: and though they perform their worſhip before fire, and direct their devotion towards the riſing ſun, for which they have an extraordinary veneration, yet they ſtrenuouſly maintain that they worſhip neither; but that theſe are the moſt expreſſive ſymbols of the Deity, and that for this reaſon they turn towards them in their devotional ſervices. Some, however, have ſuppoſed, that theſe are Perſians converted to Chriſtianity, who, being afterwards left to themſelves, mingled their ancient ſuperſtitions with the truths and practices of Chriſtianity, and ſo formed for themſelves a religion apart: and they allege, that throughout the whole of their ſyſtem of doctrine and practice we may diſcern the marks and traces of Chriſtianity, though grievouſly defaced; the annunciation, the magi, the maſſacre of the infants, our Saviour's miracles, his perſecutions, aſcenſion, &c.

GABRIEL, the name of one of the principal angels in heaven. It ſignifies *the ſtrength of God*. There are a few events, in which this exalted being was concerned, recorded in ſcripture. He was ſent to the prophet Daniel, to explain to him the viſion of the ram and goat, and the myſtery of the ſeventy weeks, which had been revealed to him. He was ſent to Zecharias, to declare to him the future birth of John the Baptiſt. Six months after, he was ſent to Nazareth to the Virgin Mary, to warn her of the birth of Jeſus Chriſt. The Orientaliſts add ſeveral particulars to what the ſcriptures inform us concerning the angel Gabriel. The Mahometans call him the *faithful ſpirit*; and the Perſians, by way of metaphor, the *peacock of heaven*. We read in the ſecond chapter of the Koran, that *whoſoever is an enemy to Gabriel ſhall be confounded*. It was Gabriel, they believe, who brought to Mahomet, their falſe prophet, the revelations which he publiſhed; and it was he who conducted him to heaven mounted upon the animal Borak.

GABRIELITES, in eccleſiaſtical hiſtory, a ſect of anabaptiſts that appeared in Pomerania in 1530. They derive their name from Gabriel Sherling; who, after having been for ſome time tolerated in that country, was obliged to remove, and died in Poland.

GAD, among miners, a ſmall punch of iron, with a long wooden handle, uſed to break up the ore. One of the miners holds this in his hand, directing the point to a proper place, while the other drives it into the vein, by ſtriking it with a ſledge-hammer.

GAD-*Bee*, or *Gad-Fly*. See OESTRUS.

GADUS, in ichthyology, a genus of fiſhes belonging to the order of jugulares. The head is ſmooth; there are ſeven cylindrical rays in the branchioſtege membrane; the body is oblong, with deciduous ſcales; the whole fins are covered with the common ſkin of the fiſh; the rays of the back-fins are blunt, and thoſe of the breaſt are ſharp. There are 17 ſpecies, principally diſtinguiſhed by their cirri and the number of back-fins. The moſt remarkable are,

1. The *morhua*, or COMMON COD, is cinereous on the back and ſides, and commonly ſpotted with yellow: the belly is white; but they vary much, not only in colour, but in ſhape, particularly that of the head. The ſide-line is white and broad, and ſtraight till it reaches oppoſite the vent, when it bends towards the tail. Codlings are often taken of a yellow, orange, and even red colour, while they remain among the rocks; but on changing their place aſſume the colour of other cod-fiſh. The jaws are of an equal length, and at the end of the lower is a ſmall beard; the teeth are diſpoſed in the palate as well as in the jaws.

The cod is found only in the northern parts of the world; it is, as Rondeletius calls it, an ocean fiſh, and never met with in the Mediterranean Sea. It frequents cold climates, and ſeems confined between the latitudes 66° and 50°; what are caught north and ſouth of thoſe degrees being either few in quantity or bad in quality. The Greenland fiſh are ſmall, and emaciated through want of food; being very voracious, and having in thoſe ſeas a ſcarcity of proviſion. This locality of ſituation is common to many other ſpecies of this genus, moſt of them being inhabitants of the cold ſeas, or ſuch as lie within regions that can juſt claim the title of *temperate*. There are nevertheleſs certain ſpecies found near the Canary Iſlands, called *cherny*, of which we know no more than the name; but which, according to Captain Glaſs, are better taſted than the Newfoundland kind.

The great rendezvous of the cod fiſh is on the banks of Newfoundland, and the other ſand-banks that lie off the coaſts of Cape Breton, Nova Scotia, and New England. They prefer thoſe ſituations, by reaſon of the quantity of worms produced in thoſe ſandy bottoms, which tempt them to reſort there for food; but another cauſe of the particular attachment the fiſh have to theſe ſpots is their vicinity to the polar ſeas, where they return to ſpawn: there they depoſit their roes in full ſecurity; but want of food forces them, as ſoon as the firſt more ſouthern ſeas are open, to repair thither for ſubſiſtence. Few are taken north

of Iceland, but on the south and west coasts they abound: they are again found to swarm on the coasts of Norway, in the Baltic, off the Orkney and the Western Isles; after which their numbers decrease, in proportion as they advance towards the south, when they seem quite to cease before we reach the mouth of the Straits of Gibraltar.

Before the discovery of Newfoundland, the greater fisheries of cod were on the seas of Iceland, and off the Western Isles, which were the grand resort of ships from all the commercial nations; but it seems that the greatest plenty was met with near Iceland. The English resorted thither before the year 1415: for we find that Henry V. was disposed to give the king of Denmark satisfaction for certain irregularities committed on those seas by his subjects. In the reign of Edward IV. the English were excluded from the fishery by treaty, and forbidden to resort there under pain of forfeiture of life and goods. Notwithstanding this, that monarch afterwards gave licence to a ship of Hull to sail to Iceland, and there re-lade fish and other goods, without regard to any restrictions to the contrary. The right of the English in latter times was far from being confirmed: for we find queen Elizabeth condescending to ask permission to fish in those seas from Christian IV. of Denmark; yet afterwards she so far repented her request, as to instruct her ambassadors at that court to insist on the right of a free and universal fishery. In the reign of her successor, however, they had not fewer than 150 ships employed in the Iceland fishery; which indulgence might arise from the marriage of James with a princess of Denmark. But the Spanish, the French, and the Bretons, had much the advantage of the English in all fisheries at the beginning, as appears by the state of that in the seas of Newfoundland in the year 1578, when the number of ships belonging to each nation stood thus:

Spaniards, 100, besides 20 or 30 that came from Biscay to take whales for train, being about five or six thousand tons.
Portuguese 50, or three thousand tons.
French and Bretons 150, or seven thousand tons.
English, from 30 to 50.

The number of shipping that resort to those fertile banks is now unspeakable. Britain now enjoys the greatest share; which ought to be esteemed our chiefest treasure, as it brings wealth to individuals, and strength to the state. See FISHERY.

All this immense fishery is carried on by the hook and line only. We have been informed that they fish from the depth of 16 to 60 fathoms, according to the inequality of the bank, which is represented as a vast mountain, under water, above 500 miles long and near 300 broad; and that seamen know when they approach it, by the great swell of the seas and the thick mists that impend over it. The bait is herring, a small fish called a *capelin*, a shell-fish called *clams*, and bits of sea-fowl; and with these are caught fish sufficient to find employ for near 15,000 British seamen, and to afford subsistence to a much more numerous body of people at home, who are engaged in the various manufactures which so vast a fishery demands.

The food of the cod is either small fish, worms, testaceous or crustaceous animals, such as crabs, large whelks, &c.; and their digestion is so powerful as to dissolve the greatest part of the shells they swallow. They are very voracious, and catch at any small body they perceive moved by the water, even stones and pebbles, which are often found in their stomachs.

Fishermen are well acquainted with the use of the air-bladder or sound of the cod, and are very dexterous in perforating this part of a live fish with a needle, in order to disengage the inclosed air; for without this operation it could not be kept under water in the well-boats, and brought fresh to market. The sounds of the cod salted is a delicacy often brought from Newfoundland. Isinglass is also made of this part by the Iceland fishermen: a process which deserves the attention of the natives of the north of Scotland, where these fish are plentiful. See farther the article ICHTHYOCOLLA.

Providence has kindly ordained, that this fish, so useful to mankind, should be so prolific as to supply more than the deficiencies of the multitudes annually taken. Leuwenhoeck counted 9,384,000 eggs in a cod-fish of a middling size; a number that will surely baffle all the efforts of man, or the voracity of the inhabitants of the ocean, to exterminate, and which will secure to all ages an inexhaustible supply of grateful provision.

In our seas they begin to spawn in January, and deposit their eggs in rough ground among rocks. Some continue in roe till the beginning of April. The cod-fish in general recover quicker after spawning than any other fish; therefore it is common to take some good ones all the summer. When they are out of season, they are thin-tailed and lousy; and the lice chiefly fix themselves on the inside of their mouths.

The fish of a middling size are most esteemed for the table; and are chosen by their plumpness and roundness, especially near the tail, by the depth of the sulcus or pit behind the head, and by the regular undulated appearance of the sides, as if they were ribbed. The glutinous parts about the head lose their delicate flavour after it has been 24 hours out of the water, even in winter when these and other fish of this genus are in highest season.

One, mentioned by Mr. Pennant as the largest that he ever heard of taken on our coasts, weighed 78 pounds: the length was five feet eight inches, and the girth round the shoulders five feet. It was taken at Scarborough in 1755, and was sold for one shilling. But the general weight of these fish in the Yorkshire seas, he says, is from 14 to 40 pounds. This species is short in proportion to its bulk, the belly being very large and prominent.

2. The *eglefinus*, or HADDOCK, has a long body; the upper part of a dusky brown colour, and the belly and lower part of the sides silvery: on the back are three fins resembling those of the common cod-fish; the lateral line is black; and the tail is forked: the head slopes down to the nose; on the chin is a short beard; and on each side beyond the gills is a large black spot. Superstition assigns this mark to the impression St. Peter left with his finger and thumb when he took the tribute out of the mouth of a fish of this species, which has been continued to the whole race of haddocks ever since that miracle. Large haddocks begin to be in roe in the middle of November, and continue so till the end of January; from that time till May they are very thin-tailed, and much out of season. In May they begin to recover; and some of the middling sized fish are then very good, and continue improving till the time of their greatest perfection. The small ones are extremely good from May till February, and some even in February, March, and April, viz. those which are not old enough to breed.

The fishermen assert, that in rough weather haddocks sink down into the sand and ooze in the bottom of the sea, and shelter themselves there till the storm is over; because in stormy weather they take none, and those that are taken immediately after a storm are covered with mud on their backs. In summer they live on young herrings and other small fish; in winter on the stone-coated worms, a species of SERPULA, which the fishermen call *haddock-meat*.

The grand shoal of haddocks comes periodically on the Yorkshire coasts. It is remarkable that they appeared in 1766 on the 10th of December, and exactly on the same day in 1767: these shoals extended from the shore near three miles in breadth, and in length from Flamborough head to Tinmouth-castle, and perhaps much farther northwards. An idea may be formed of their numbers by the following fact: Three fishermen, within the distance of a mile from Scarborough harbour, frequently

loaded their coble or boat with them twice a-day, taking each time about a ton of fifh: when they put down their lines beyond the diftance of three miles from the fhore, they caught nothing but dog-fifh, which fhows how exactly thefe fifh keep their limits. The beft haddocks were fold from eight-pence to a fhilling *per* fcore; and the poor had the fmaller fort at a penny and fometimes a halfpenny *per* fcore.

The large haddocks quit the coaft as foon as they go out of feafon, and leave behind great plenty of fmall ones. It is faid that the large ones vifit the coafts of Hamburgh and Jutland in the fummer. It is no lefs remarkable than providential, that all kinds of fifh (except mackrel) which frequent the Yorkfhire coaft, approach the fhore, and as it were offer themfelves to us, generally remaining there as long as they are in high feafon, and retire from us when they become unfit for ufe. It is the commoneft fpecies in the London markets. They do not grow to a great bulk, one of 14 pounds being of an uncommon fize, but thofe are extremely coarfe; the beft for the table weighing from two to three pounds.

3. The *barbatus*, or POUT, never grows to a large fize, feldom exceeding a foot in length. It is diftinguifhed from all others by its great depth; one of the fize above mentioned being near four inches deep in the broadeft part. The back is very much arched and carinated; the colour of the fins and tail is black: at the bottom of the pectoral fins is a black fpot. The lateral line is white, broad, and crooked. The tail is even at the end, and of a dufky colour. The colour of the body is white, but more obfcure on the back than the belly, and tinged with yellow. It is called at Scarborough a *kleg*, and is a very delicate fifh.

4. The *minutus*, or POOR, is the fmalleft fpecies yet difcovered, being little more than fix inches long. On the chin is a fmall beard: the eyes are covered with a loofe membrane: on the gill-covers and the jaws there are on each fide nine punctures. The colour on the back is a light brown; on the belly a dirty white. It is taken near Marfeilles, and fometimes in fuch quantities as to become a nuifance; for no other kinds of fifh are taken during their feafon. It is efteemed good, but incapable of being falted or dried. Belon fays that, when it is dried in the fun, it grows as hard as horn. We owe the difcovery of this kind in our feas to the Reverend Mr. Jago.

5. The *carbonarius*, or COAL-FISH, is of a more elegant form than the cod-fifh: they generally grow to the length of two feet and an half, and weigh about 28 or 30 pounds at moft. The head is fmall; the under jaw a little longer than the upper: the tail is broad and forked. They vary in colour: fome have their back, nofe, dorfal fins, and tail, of a deep black; the gill-covers, filver and black; the ventral and anal fins, and the belly, white: others are dufky, others brown; but, in all, the lateral line is ftraight and white, and the lower part of the ventral and anal fins white. This fifh takes its name from the black colour that it fometimes affumes. Belon calls it the *colfifch*, imagining that it was fo named by the Englifh, from its producing the Ichthyocolla; but Gefner gives the true etymology. Thefe fifh are common on moft of our rocky and deep coafts, but particularly thofe of the north of Great Britain. They fwarm about the Orkneys, where the fry are the great fupport of the poor. The young begin to appear on the Yorkfhire coaft the beginning of July in vaft fhoals, and are at that time about an inch and an half long. In Auguft they are from three to five inches in length, and are taken in great numbers with the angling rod: they are then efteemed a very delicate fifh; but grow fo coarfe when they are a year old, that few people will eat them. Fifh of that age are from 8 to 15 inches long, and begin to have a little blacknefs near the gills and on the back; and the blacknefs increafes as they grow older. The fry is known by different names in different places: they are called at Scarborough *parrs*; and, when a year old, *billets*. About 20 years ago fuch a glut of parrs vifited that part, that for feveral weeks it was impoffible to dip a pail into the fea without taking fome. Though this fifh is fo little efteemed when frefh, yet it is falted and dried for fale.

6. The *pollachius*, or POLLACK, has the under jaw longer than the upper: the head and body rife pretty high, as far as the firft dorfal fin. The fide line is incurvated, rifing towards the middle of the back, then finking and running ftraight to the tail; it is broad, and of a brown colour. The colour of the back is dufky, fometimes inclining to green: the fides beneath the lateral line are marked with lines of yellow; and the belly is white. This fifh is common on many of our rocky coafts: during fummer they are feen in great fhoals frolicking on the furface of the water, and flinging themfelves into a thoufand forms. They are at that time fo wanton as to bite at any thing that appears on the top of the waves, and are often taken with a goofe-feather fixed to the hook. They are very ftrong, being obferved to keep their ftation at the feet of the rocks in the moft turbulent and rapid fea. They are a good eating fifh. They do not grow to a very large fize; at leaft the biggeft feldom exceed fix or feven pounds: but fome have been taken in the fea near Scarborough, which they frequent during winter, that weighed near twenty-eight pounds. They are there called *leets*.

7. The *merlangus*, or WHITING, is a fifh of an elegant make: the upper jaw is the longeft; the eyes are large, the nofe is fharp; the teeth of the upper jaw are long, and appear above the lower when clofed. The colour of the head and back is a pale brown; the lateral line white and crooked; the belly and fides are filvery, the laft ftreaked lengthwife with yellow. Thefe fifh appear in vaft fhoals in our feas in the fpring, keeping at the diftance of about half a mile to that of three from the fhore. They are caught in vaft numbers by the line, and afford excellent diverfion. They are the moft delicate, as well as the moft wholefome, of any of the genus: but they do not grow to a large fize, the biggeft not exceeding 20 inches; and even that is very uncommon, the ufual length being 10 or 12; though it is faid that whitings from 4 to 8 pounds in weight have been taken in the deep water at the edge of the Dogger-Bank.

8. The *merlucius*, or HAKE, is found in vaft abundance on many of our coafts, and of thofe of Ireland. There was formerly a vaft ftationary fifhery of hake on the Nymph Bank off the coaft of Waterford, immenfe quantities appearing there twice a-year; the firft fhoal coming in June, during the mackrel-feafon; the other in September, at the beginning of the herring-feafon, probably in purfuit of thofe fifh: it was no unufual thing for fix men with hooks and lines to take a thoufand hake in one night, befides a confiderable quantity of other fifh. Thefe were falted and fent to Spain, particularly to Bilboa. We are at this time uninformed of the ftate of this fifhery; but find that Mr. Smith, who wrote the hiftory of the county of Waterford, complains, even in his time (1746), of its decline. Many of the gregarious fifh are fubject to change their fituations, and defert their haunts for numbers of years, and then return again. Mr. Smith inftances the lofs of the haddock on the Waterford fhores, where they ufed to fwarm; and we can bring the capricioufnefs of the herrings, which fo frequently quit their ftations, as another example. Sometimes the irregular migration of fifh is owing to their being followed and haraffed by an unufual number of fifh of prey, fuch as the fhark kind; fometimes to deficiency of the fmaller fifh, which ferved them as food; and laftly, in many places to the cuftom of trawling, which not only demolifhes a quantity of their fpawn, which is depofited in the fand, but alfo deftroys or drives into deeper waters numberlefs worms and infects, the repaft of many

fish. The hake is in England esteemed a very coarse fish, and is seldom admitted to table either fresh or salted. When cured, it is known by the name of *Poor John*. These fish are from a foot and an half to near twice that length: they are of a slender make, of a pale ash-colour on their backs, and of a dirty white on their bellies.

10. The *molva*, or LING, is usually from three to four feet long, but has been heard of seven feet long. The body is very slender; the head flat; the upper jaw is the longest; the teeth in that jaw are small and very numerous; in the lower, few, slender, and sharp: on the chin is a small beard. They vary in colour, some being of an olive hue on the sides and back, others cinereous; the belly white. The ventral fins are white: the dorsal and anal edged with white. The tail is marked near the end with a transverse black bar, and tipt with white. The ling takes its English name from its length, being corrupted from the word *long*. It abounds about the Scilly Isles, on the coast of Scarborough, and those of Scotland and Ireland, and forms a considerable article of commerce. This branch of trade was considerable so long ago as the reign of Edward III.; an act for regulating the price of lob, *ling*, and cod, being made in his 31st year. In the Yorkshire seas they are in perfection from the beginning of February to the beginning of May, and some till the end of that month. In June they spawn, depositing their eggs in the soft oozy ground of the mouth of the Tees: at that time the males separate from the females, and resort to some rocky ground near Flamborough-head, where the fishermen take great numbers, without ever finding any of the female or roe'd fish among them. While a ling is in season its liver is very white, and abounds with a fine-flavoured oil; but, as soon as the fish goes out of season, the liver becomes red as that of a bullock, and affords no oil. The same happens to the cod and other fish in a certain degree, but not so remarkably as in the ling. When the fish is in perfection, a very large quantity of oil may be melted out of the liver by a slow fire; but if a violent sudden heat be used for that purpose, they yield very little. The oil, which nature hoards up in the cellular membranes of the fishes, returns into their blood, and supports them in the engendering season, when they pursue the business of generation with so much eagerness as to neglect their food. Vast quantities of ling are salted for exportation as well as for home-consumption. When it is cut or split for curing, it must measure 26 inches or upwards from the shoulder to the tail: if less than that, it is not reckoned a sizeable fish, and consequently not intitled to the bounty on exportation; such are called *drizzles*, and are in season all summer.

11. The *lota*, or BURBOT, in its body has some resemblance to that of an eel, only shorter and thicker; and its motions also resemble those of that fish: they are besides very smooth, slippery, and slimy. The head is very ugly, being flat and shaped like that of a toad: the teeth are very small, but numerous. On the end of the nose are two small beards; on the chin another. The colour varies: some are dusky; others are of a dirty green, spotted with black, and oftentimes with yellow; and the belly in some is white; but the real colours are frequently concealed by the slime. This fish abounds in the lake of Geneva, where it is called *lota*; and it is also met with in the Lago Magiore and Lugano. In Britain it is found in the Trent, but in greater plenty in the river Witham, and in the great east fen in Lincolnshire. It is a very delicate fish for the table, though of a disgusting appearance when alive. It is very voracious, and preys on the fry and lesser fish. It does not often take a bait, but is generally caught in weels. The largest taken in our waters weigh between two and three pounds, but abroad they are sometimes found of double that weight.

12. The *mustela*, or FIVE-BEARDED COD, very much resembles the former. The beards on the upper jaw are four, *viz.* two at the very end of the nose, and two a little above them: on the end of the lower jaw is a single one. The fish are of a deep olive brown, their belly whitish. They grow to the same size as the former. The Cornish fishermen are said to whistle, and make use of the words *bod, bod, vean*, when they are desirous of taking this fish, as if by that they facilitated the capture. In the same manner the Sicilian fishermen repeat their *mamassu di pajanu*, &c. when they are in pursuit of the sword-fish.

13. The TORSK, or, as it is called in the Shetlands, *tusk* and *brismack*, is a northern fish; and as yet undiscovered lower than about the Orkneys, and even there it is rather scarce. In the seas about Shetland it swarms, and forms (barrelled or dried) a considerable article of commerce. The length is about 20 inches, the greatest depth four and a half. The head is small; the upper jaw a little longer than the lower; both jaws furnished with multitudes of small teeth: on the chin is a small single beard; from the head to the dorsal fin is a deep furrow. The colour of the head is dusky; the back and sides yellow; belly white; edges of the dorsal, anal, and caudal fins white; the other parts dusky; the pectoral-fins brown.

GAELIC LANGUAGE. See HIGHLANDS.

GAFF, a sort of boom or pole, frequently used in small ships to extend the upper edge of the mizen; and always employed for the same purpose on those sails whose foremost edges are joined to the mast by hoops or lacings, and which are usually extended by a boom below. Such are the main-sails of all sloops, brigs, and schooners.

GAFFAREL (James), a French divine, and very learned writer, born about 1601. He acquired great skill in the oriental and several other languages, and was particularly versant in the cabbalistic and occult sciences, which he learned, exposed, and refuted. Cardinal Richelieu made choice of him for his library-keeper, and sent him into Italy to collect the best manuscripts and books. He published a book, entitled *Curiositez Inouies*, i. e. Unheard-of Curiosities. It is said that the cardinal designed to employ him in his grand project for the reunion of religions. He died in 1681, aged 80. He had been labouring for many years, and had almost finished a history of the subterranean world; containing an account of the caves, grottos, vaults, catacombs, and mines, he had met with in the course of years travelling.

GAGATES, or JET. See JET.

GAGE, in our ancient customs, signifies a pledge or pawn, given by way of security. The word is only properly used in speaking of moveables; for immoveables, *hypotheca* is used. If the gage perish, the person who received it is not to answer for it, but only for extreme negligence, &c.

GAGE is also used for a challenge to combat: See CARTEL. In that sense, it was a pledge which the accuser or challenger cast on the ground, and the other took up as accepting the challenge: it was usually a glove, gauntlet, chaperoon, or the like. See COMBAT and DUEL.

GAGE is only now retained as a substantive. As a verb, the G is changed into *W*, and of *gage* is formed *wage*: as, to wage law, to wage deliverance, *q. d.* to give security that a thing shall be delivered. See WAGE. If a person who has distrained be sued for not having delivered what he had taken by distress, he should wage, or gage, or gager deliverance; that is, put in surety that he will deliver them.

Mort-GAGE, is that which is left in the hands of the proprietor, so that he reaps the fruits thereof: in opposition to the *vif-gage*, where the fruits or revenues are reaped by the creditor, and reckoned on the foot of the debt, which diminishes in proportion thereto. The second acquits or discharges itself; the first does not.

GAGE, in the sea-language. When one ship is to windward of another, she is said to have the weather-gage of her. They

likewise call the number of feet that a vessel sinks in the water, the ship's *gage*: this they find by driving a nail into a pike near the end, and putting it down beside the rudder till the nail catch hold under it; then as many feet as the pike is under water is the ship's gage.

Gage, among letter-founders, a piece of box or other hard wood, variously notched, the use of which is to adjust the dimensions, slopes, &c. of the different sorts of letters. See Foundery.

Gage, in joinery, is an instrument made to strike a line truly parallel to the straight side of any board or piece of stuff. Its chief use is for gaging of tenons true, to fit into mortises; and for gaging stuff of an equal thickness. It is made of an oval piece of wood, fitted upon a square stick, to slide up and down stiffly thereon, and with a tooth at the end of a staff to score, to strike a line upon the stuff at any distance, according to the distance of the oval from it.

Sliding-Gage, a tool used by mathematical-instrument-makers for measuring and setting off distances.

Sea-Gage, an instrument invented by Dr. Hales and Dr. Desaguliers for finding the depth of the sea; the description whereof is this. AB, in plate 36, figure 1, shows the gage-bottle, in which is cemented the gage-tube F*f* in the brass cap at G. The upper end of tube F is hermetically sealed, and the open lower end *f* is immersed in mercury, marked C, on which swims a small thickness or surface of treacle. On the top of the bottle is screwed a tube of brass HG, pierced with several holes to admit the water into the bottle AB. The body K is a weight hanging by its shank L in a socket N, with a notch on one side at *m*, in which is fixed the catch *l* of the spring S, and, passing through the hole L in the shank of the weight K, prevents its falling out when once hung on. On the top, in the upper part of the brass tube at H, is fixed a large empty ball or full-blown bladder I, which must not be so large but that the weight K may be able to sink the whole under water.

The instrument thus constructed is used in the following manner. The weight K being hung on, the gage is let fall into deep water, and sinks to the bottom: the socket N is somewhat longer than the shank L; and therefore, after the weight K comes to the bottom, the gage will continue to descend till the lower part of the socket strikes against the weight: this gives liberty to the catch to fly out of the hole L, and let go the weight K: when this is done, the ball or bladder I instantly buoys up the gage to the top of the water. While the gage is under water, the water, having free access to the treacle and mercury in the bottle, will by its pressure force it up into the tube F*f*, and the height to which it has been forced by the greatest pressure, viz. that at the bottom, will be shown by the mark in the tube which the treacle leaves behind it, and which is the only use of the treacle. This shows into what space the whole air in the tube F*f* is compressed; and consequently the height or depth of the water which by its weight produced that compression, which is the thing required.

If the gage-tube F*f* were of glass, a scale might be drawn on it with the point of a diamond, showing, by inspection, what height the water stands above the bottom. But the length of 10 inches is not sufficient for fathoming depths at sea, seeing that, when all the air in such a length of tube is compressed into half an inch, the depth of water is no more than 634 feet, which is not half a quarter of a mile.

If, to remedy this, we make use of a tube 50 inches long, which for strength may be a musket-barrel, and suppose the air compressed into an hundredth part of half an inch; then by saying, as 1 : 99 :: 400 : 39600 inches, or 3300 feet; even this is but little more than half a mile, or 2640 feet. But since it is reasonable to suppose the cavities of the sea bear some proportion to the mountainous parts of the land, some of which are more than three miles above the earth's surface, therefore, to explore such great depths, the author contrived a new form for his sea-gage, or rather for the gage-tube in it, as follows. BCDF (see the plate) is a hollow metalline globe communicating on the top with a long tube AB, whose capacity is a ninth part of that globe. On the lower part at D it has also a short tube DE, to stand in the mercury and treacle. The air contained in the compound gage-tube is compressed by the water as before; but the degree of compression, or height to which the treacle has been forced, cannot there be seen through the tube; therefore, to answer that end, a slender rod of metal or wood, with a knob on the top of the tube AB, will receive the mark of the treacle, and show it when taken out.

If the tube AB be 50 inches long, and of such a bore that every inch in length should be a cubit inch of air, and the contents of the globe and tube together 500 cubic inches; then, when the air is compressed within an hundredth part of the whole, it is evident the treacle will not approach nearer than five inches of the top of the tube, which will agree to the depth of 3300 feet of water as above. Twice this depth will compress the air into half that space nearly, viz. $2\frac{1}{2}$ inches, which correspond to 6600, which is a mile and a quarter. Again, half that space, or $1\frac{1}{4}$ inch, will show double the former depth, viz. 13200 feet, or $2\frac{1}{2}$ miles; which is probably very nearly the greatest depth of the sea.

Bucket Sea-Gage, an instrument contrived by Dr. Hales to find the different degrees of coolness and saltness of the sea at different depths. It consists of a common household pail or bucket made with two heads. These heads have each a round hole in the middle, about four inches in diameter, covered with square valves opening upward; and that they may both open and shut together, there is a small iron rod fixed to the upper part of the lower valve, and the other end to the lower side of the upper valve: So that, as the bucket descends with its sinking weight into the sea, both the valves may open by the force of the water, which by that means has a free passage through the bucket. But when the bucket is drawn up, then both the valves shut by the force of the water at the upper part of the bucket; so that the bucket is drawn up full of the lowest sea-water to which it has descended. When the bucket is drawn up, the mercurial thermometer fixed in it is examined; but great care must be taken to observe the degree at which the mercury stands, before the lower part of the thermometer is taken out of the water in the bucket, lest it be affected by the different temperature of the air. In order to keep the bucket in a right position, there are four cords fixed to it, reaching about three feet below it; to which the sinking weight is fixed. The result of several trials with this gage was, that, when it was let down to different depths from 360 feet to 5346 feet, in lat. 25. 13. N. and lon. 25. 12. W. it was discovered by the thermometer, that the cold increased gradually in proportion to the depths, till it descended to 3900 feet, *viz.* near $\frac{3}{4}$ths of a mile, whence the mercury in the thermometer came up at 53°; and though it was afterwards sunk to 5346 feet, *i. e.* a mile and 66 feet, it came up no lower: the warmth of the water upon the surface, and that of the air, was all that time 84°. When the water in the bucket was become of the same temperature with that on the surface of the sea, equal quantities of both were weighed and tried by the hydrometer; that from below was found to be the heaviest, and consequently the saltest.

Dr. Hales was probably led to the construction of this sea gage from an instrument invented by Dr. Hook, and designed for the same purpose. This consists of a square bucket C fig. 2, whose bottoms are so contrived that as the weight A sinks the iron B, to which the bucket C is fastened by two handles D, D, on the end of which are the moveable bottoms or valves E, E, and thereby draws down the bucket, the resistance of the

water keeps up the bucket in the poſture C, whereby the water, whilſt the bucket is deſcending, hath a free paſſage through it; whereas, as ſoon as the bucket is pulled upwards by the line F, the reſiſtance of the water to that motion beats the bucket downwards, and keeps it in the poſture G, whereby the included water is kept from getting out, and the ambient water prevented from getting in. See Phil. Tranſ. No. 9. p. 149. and No. 24. p. 447. or abr. vol. ii. p. 260.

Aqueo-Mercurial Gage, is the name of an apparatus contrived by Dr. Hales, and applied in various forms to the branches of trees, in order to determine the force with which they imbibe moiſture. Let *e r*, fig. 3. be a cylindric glaſs, *e. g.* of an inch diameter within, and eight inches long. Into this glaſs is introduced the branch of a young thriving apple-tree *b*, about three feet long, with lateral branches; the diameter of the tranſverſe cut *i* being $\frac{3}{4}$ of an inch. Having fitted the joint *r* to the tube at *r*, by folding a piece of ſheep's ſkin round the ſtem, it is cemented with a mixture of bees-wax and turpentine melted together, in ſuch a proportion as to make a very ſtiff clammy paſte when cold, and over the cement folds of wet bladders are bound firmly with packthread. To the lower end *e* of the large tube, a ſmaller tube *z e* is cemented, being about $\frac{1}{4}$ of an inch diameter, and 18 inches long, and in ſubſtance full $\frac{1}{8}$ of an inch thick. Theſe tubes are cemented together at *e* with common hard brick-duſt or powdered chalk cement, and the joint is farther ſecured with the cement of bees-wax and turpentine, over which a wet bladder is bound. The apparatus being thus prepared, the branch is turned downwards, and the glaſs-tube upwards, and then both tubes are filled with water; with the finger applied to the open end of the ſmall tube, it is inverted and immerſed in the glaſs ciſtern *x*, full of mercury and water. In this ſituation the lower end of the branch was immerſed ſix inches in water, *viz.* from *r* to *i*; the water was imbibed by the branch at its tranſverſe cut *i*; and, during its aſcent into the ſap-veſſels of the branch, the mercury roſe in the tube *e z* from the ciſtern *x*, ſo that in half an hour it was riſen $5\frac{3}{4}$ inches high, as far as *z*. The height of the mercury indicated, in ſome meaſure, the force with which the ſap was imbibed, though not the whole force; becauſe, while the water was imbibed by the branch, its tranſverſe cut was covered with innumerable little hemiſpheres of air, and many air-bubbles iſſued out of the ſap-veſſels, which partly filled the tube *e x*, as the water was drawn out of it: and, therefore, the height of the mercury could only be proportionable to the exceſs of the quantity of water drawn off above the quantity of air which iſſued out of the wood. If the quantity of air iſſuing from the wood had been equal to the quantity of water imbibed, it is plain that the mercury could not riſe at all, becauſe there would be no room for it in the tube: but if nine parts in twelve of the water be imbibed by the branch, and only three ſuch parts of air iſſue into the tube in the ſame time, the mercury muſt riſe near ſix inches, and ſo proportionably in other caſes. Dr. Hales obſerved, that the mercury roſe higheſt, in moſt caſes, when the ſun was clear and warm, and that it ſubſided three or four inches towards evening, but roſe again the next day as it grew warm, though ſeldom ſo high as at firſt. Dr. Hales adapted the ſize and ſhape of the glaſs apparatus to a great variety of branches of ſeveral ſizes and of different kinds of trees, and repeated the experiment above deſcribed, *mutatis mutandis*, in a variety of inſtances. See his Vegetable Statics, vol. i. chap. ii. p. 84 &c.

Tide-Gage, is the name of an inſtrument uſed for determining the height of the tides by Mr. Bayly, in the courſe of a voyage towards the ſouth pole, &c. in the Reſolution and Adventure, in 1772, 1773, 1774, and 1775. This inſtrument conſiſts of a glaſs tube, whoſe internal diameter was ſeven-tenths of an inch, laſhed faſt to a ten-feet fir rod, divided into feet, inches, and quarters: this rod was faſtened to a ſtrong poſt fixed upright and firm in the water. At the lower end of the tube was an exceeding ſmall aperture, through which the water was admitted. In conſequence of this conſtruction, the ſurface of the water in the tube was ſo little affected by the agitation of the ſea, that its height was not altered one-tenth of an inch, when the ſwell of the ſea was two feet; and Mr. Bayly was certain, that with this inſtrument he could diſcern a difference of one-tenth of an inch in the height of the tide.

Wind-Gage, an inſtrument for meaſuring the force of the wind upon any given ſurface. It was invented by Dr. Lind, who gives the following deſcription of it, Phil. Tranſ. vol. lxv. This inſtrument conſiſts of two glaſs tubes, AB, CD, fig. 4. of 5 or 6 inches in length. Their bores, which are ſo much the better for being equal, are about four-tenths of an inch in diameter. They are connected together like a ſiphon, by a ſmall bent glaſs-tube marked *a b*, the bore of which is about one-tenth of an inch in diameter. On the upper end of the leg AB there is a tube of latten braſs, which is kneed or bent perpendicularly outwards, and has its mouth open towards F. On the other leg CD is a cover with a round hole G in the upper part of it, two-tenths of an inch in diameter. This cover and the kneed tube are connected together by a ſlip of braſs *cd*, which not only gives ſtrength to the whole inſtrument, but alſo ſerves to hold the ſcale HI. The kneed tube and cover are fixed on with hard cement or ſealing-wax. To the ſame tube is ſoldered a piece of braſs *e*, with a round hole in it to receive the ſteel ſpindle KL; and at *f* there is juſt ſuch another piece of braſs ſoldered to the braſs-hoop *gh*, which ſurrounds both legs of the inſtrument. There is a ſmall ſhoulder on the ſpindle at *f*, upon which the inſtrument reſts, and a ſmall nut at *i*, to prevent it from being blown off the ſpindle by the wind. The whole inſtrument is eaſily turned round upon the ſpindle by the wind, ſo as always to preſent the mouth of the kneed tube towards it. The end of the ſpindle has a ſcrew on it, by which it may be ſcrewed into the top of a poſt or a ſtand made on purpoſe. It has alſo a hole at L, to admit a ſmall lever for ſcrewing it into wood with more readineſs and facility. A thin plate of braſs *k* is ſoldered to the kneed tube, about half an inch above the round hole G, ſo as to prevent rain from falling into it. There is likewiſe a crooked tube AB, fig. 5. to be put occaſionally upon the mouth of the kneed tube F, in order to prevent rain from being blown into the mouth of the wind-gage when it is left out all night or expoſed in the time of rain.

The force or momentum of the wind may be aſcertained by the aſſiſtance of this inſtrument, by filling the tubes half full of water, and puſhing the ſcale a little up or down, till the o of the ſcale, when the inſtrument is held up perpendicularly, be on a line with the ſurface of the water in both legs of the wind-gage. The inſtrument being thus adjuſted, hold it up perpendicularly, and, turning the mouth of the kneed tube towards the wind, obſerve how much the water is depreſſed by it in the one leg, and raiſed in the other. The ſum of the two is the height of a column of water which the wind is capable of ſuſtaining at that time; and every body that is oppoſed to that wind will be preſſed upon by a force equal to the weight of a column of water, having its baſe equal to the altitude of the column of water ſuſtained by the wind in the wind-gage. Hence the force of the wind upon any body where the ſurface oppoſed to it is known may be eaſily found; and a ready compariſon may be made betwixt the ſtrength of one gale of wind and that of another.

The force of the wind may be likewiſe meaſured with this inſtrument, by filling it until the water runs out at the hole G. For, if we then hold it up to the wind as before, a quantity of water will be blown out; and if both legs of the inſtrument are of the ſame bore, the height of the column ſuſtained will be

equal to double the column of water in either leg, or the ſum of what is wanting in both legs. But if the legs are of unequal bores, neither of theſe will give the true height of the column of water which the wind ſuſtained. But the true height may be obtained by the following formulæ.

Suppoſe that after a gale of wind which had blown the water from A to B, fig. 6. forcing it at the ſame time through the other tube out at E, the ſurface of the water ſhould be found ſtanding at ſome level as D G, and it were required to know what was the height of the column E F or A B, which the wind ſuſtained. In order to obtain this, it is only neceſſary to find the height of the columns D B or G F, which are conſtantly equal to one another; for either of theſe, added to one of the equal columns A D, E G, will give the true height of the column of water which the wind ſuſtained. 1. Let the diameters A C, E H, of the tubes be reſpectively repreſented by $c\,d$; and let $a =$ A D. or E G, and $x =$ D B or G F: then it is evident, that the column D B is to the column E G, as c^2x to d^2a. But theſe columns are equal. Therefore $c^2x = d^2a$; and conſequently $x = \frac{d^2a}{c^2}$. 2. But if, at any inſtant of time whilſt the wind was blowing, it was obſerved, that when the water ſtood at E, the top of the tube out of which it is forced, it was depreſſed in the other to ſome given level B F, the altitude at which it would have ſtood in each had it immediately ſubſided, may be found in the following manner. Let $b =$ A B or E F. Then it is evident that the column D B is equal to the difference of columns E F, G F. But the difference of theſe columns is as $d^2b - d^2x$; and conſequently $x = \frac{d^2b}{c^2 + d^2}$.

For the caſes when the wind blows in at the narrow leg of the inſtrument: Let A B = E F = b, E G or A D = a, G F = D B = x, and the diameters E H, G A, reſpectively = d, c, as before. Then it is evident that the column A D is to the column G F as ac^2 to d^2x. But theſe columns are equal; therefore $d^2x = ac^2$; and conſequently $x = \frac{ac^2}{d^2}$. It is alſo evident, that the column A D is equal to the difference of the columns A B, D B; but the difference of theſe columns is as $bc^2 - c^2x$. Therefore $d^2x = bc^2 - c^2x$. Whence we get $x = \frac{bc^2}{d^2 + c^2}$.

The uſe of the ſmall tube of communication *a b*, fig. 4, is to check the undulation of the water, ſo that the height of it may be read off from the ſcale with eaſe and certainty. But it is particularly deſigned to prevent the water from being thrown up to a much greater or leſs altitude, than the true height of the column which the wind is able at that time to ſuſtain, from its receiving a ſudden impulſe whilſt it is vibrating either in its aſcent or deſcent. As in ſome caſes freſh water in this inſtrument might be liable to freeze, and thus break the tubes, Dr. Lind recommends a ſaturated ſolution of ſea-ſalt to be uſed inſtead of it, which does not freeze till Fahrenheit's thermometer falls to 0.

GAHNIA, in botany; a genus of the monogynia order, belonging to the hexandria claſs of plants. The calyx is an involucrum with two or five flowers; the corolla is two-valved; the ſtamina ſix, capillary and very ſhort filaments; the antheræ linear, ſharp-pointed at the apex, and as long as the corolla; there is no pericarpium: the ſeed is ſingle and oblong.

GAIETA, an ancient, handſome, and ſtrong town of Italy, in the kingdom of Naples, and in the Terra di Lavoro, with a fort, citadel, harbour, and biſhop's ſee. It was taken by the Auſtrians in 1707, and by the Spaniards in 1734. It is ſeated at the foot of a mountain near the ſea, in E. long. 13. 37. N. lat. 41. 30.

GAILLAC, a town of France, in the department of Tarn and late province of Languedoc, remarkable for its trade in wines. It is ſeated on the river Tarn, 10 miles S. W. of Alby. E. lon. 2. 5. N. lat. 43. 54.

GAILLON, a town of France, in the department of Eure and late province of Normandy, remarkable for the magnificent palace, lately belonging to the archbiſhop of Rouen, and for its late handſome Chartreuſe, which is about three quarters of a mile from it. It is a mile and a half from the river Seine, five from Andely, and 22 from Rouen.

GAIN, the profit or lucre a perſon reaps from his trade, employment, or induſtry. Some derive the word from the German *gewinn*; whereof the Italians had made *guadagno*; the French and Engliſh *gain*. There are legal and reputable gains, as well as ſordid and infamous ones. What is gained beyond a certain ſum by gaming is all liable to be reſtored again, if the loſer will take the benefit of the law.

Gain, in architecture, is the workmen's term for the bevelling ſhoulder of a joiſt or other timber. It is uſed alſo for the lapping of the end of the joiſt, &c. upon a trimmer or girder; and then the thickneſs of the ſhoulder is cut into the trimmer, alſo bevelling upwards, that it may juſt receive the gain; and ſo the joiſt and trimmer lie even and level with the ſurface. This way of working is uſed in floors and hearths.

To Gain *the wind*, in ſea-language, is to arrive on the weather-ſide or to windward of ſome other veſſel in ſight, when both are plying to windward, or ſailing as near the wind as poſſible.

GAINAGE, Gainagium, in our ancient writers, ſignifies the draught-oxen, horſes, wain, plough, and furniture, for carrying on the work of tillage by the baſer ſort of ſokemen and villains. Gainage is the ſame with what is otherwiſe called *wainage*. Bracton, lib. i. cap. 9. ſpeaking of lords and ſervants, ſays, *Ut ſi eos deſtruant, quod ſalvum non poſſit eis eſſe wainagium ſuum.* And again, lib. iii. tract. 2. cap. 1. *Villanus non amerciabitur, niſi ſalvo wainagio ſuo.* For anciently, as it appears both by Magna Charta and other books, the villain, when amerced, had his gainage or wainage free; to the end his plough might not ſtand ſtill: and the law, for the ſame reaſon, does ſtill allow a like privilege to the huſbandman; that is, his draught-horſes are not in many caſes diſtrainable.

Gainage is alſo uſed for the land itſelf, or the profit raiſed by cultivating it.

GAINSBOROUGH, a town of Lincolnſhire in England, 150 miles from London, ſeated on the river Trent near the ſea. It is a large well built town, with a pretty good trade, and has the title of an earldom. W. lon. 0. 40. N. lat. 53. 26. The north marſh in its neighbourhood is noted for horſe-races. The Danes who invaded the kingdom brought their ſhips up to this place. It was here that Sweno the Dane was murdered by one of the Engliſh, who was never diſcovered.

GALACTITES, in the hiſtory of foſſils, a ſubſtance much reſembling the morochthus or French chalk in many reſpects, but different from it in colour. The ancients found it in the Nile and in ſome rivers in Greece, and uſed it in medicine as an aſtringent, and for defluxions and ulcers of the eyes. At preſent it is common in Germany, Italy, and ſome parts of France, and is wholly overlooked, being eſteemed a worſe kind of morochthus. See Morochthus.

GALACTOPHAGI, and Galactopotæ, in antiquity, perſons who lived wholly on milk, without corn or the uſe of any other food. The words are compounded of γαλα, γαλακτος, *milk*; φαγειν, *to eat*; and ποτης of πινω, *I drink*. Certain nations in Scythia Aſiatica, as the Getæ, Nomades, &c. are famous in ancient hiſtory, in quality of *galactophagi* or milk-eaters. Homer makes their eloge, Iliad, lib. iii. Ptolemy, in his geography, places the Galactophagi between the Ri-

phæan mountains on one ſide, and the Hyrcanian ſea on the other.

GALANGALS, in the materia medica. See KÆMPFERIA.

GALANTHUS, the SNOW-DROP, in botany; a genus of the monogynia order, belonging to the hexandria claſs of plants, and in the natural method ranking under the ninth order, *Spathaceæ.* There are three concave petals; and the nectarium conſiſts of three ſmall emarginated petals; the ſtigma is ſimple. There is but one ſpecies, viz. the nivalis; which is a bulbous-rooted flowery perennial, riſing but a few inches in height, and adorned at top with ſmall tripetalous flowers of a white colour. There are three varieties, viz. the common ſingle-flowered ſnow-drop, the ſemi-double ſnow-drop, and the double ſnow-drop. They are beautiful little plants, and are much valued on account of their early appearance, often adorning the gardens in January or February, when ſcarce any other flower is to be ſeen. They frequently burſt forth when the ground is covered with ſnow, and continue very often till the beginning of March, making a very ornamental appearance, eſpecially when diſpoſed in cluſters towards the fronts of the borders, &c. The ſingle kind comes firſt into bloom, then the ſemi-double, and after that the double. They will ſucceed any where, and multiply exceedingly by off-ſets from the roots.

GALATA, a great ſuburb belonging to Conſtantinople, oppoſite to the Seraglio, on the other ſide of the harbour. It is here the Greeks, Armenians, Franks, Chriſtians, and Jews inhabit, and are allowed the exerciſe of their reſpective worſhips.

GALATÆA and GALATHÆA, in fabulous hiſtory, a ſea-nymph, daughter of Nereus and Doris. She was paſſionately loved by the cyclops Polyphemus, whom ſhe treated with coldneſs and diſdain; while Acis, a ſhepherd of Sicily, enjoyed her unbounded affection. The happineſs of theſe two lovers was diſturbed by the jealouſy of the cyclops, who cruſhed his rival to pieces with a piece of a broken rock while he repoſed on the boſom of Galatæa. The nymph was inconſolable for the loſs of Acis; and, as ſhe could not reſtore him to life, ſhe changed him into a fountain.

GALATIA, the ancient name of a province of Aſia Minor, now called *Amaſia.* It was bounded on the eaſt by Cappadocia, on the weſt by Bithynia, on the ſouth by Pamphylia, and on the north by the Euxine ſea. It was the north part of Phrygia Magna; but, upon being occupied by the Gauls, was called *Galatia*; and becauſe ſituated amidſt Greek colonies, and itſelf mixed with Greeks, *Gallogræcia.* Strabo calls it *Galatia* and *Gallogræcia*: hence a two-fold name of the people, *Galatæ* and *Gallogræci.* The Greeks called it *Gallia Parva,* to diſtinguiſh it from the *Tranſalpina,* both which they called *Galatia.* It was reduced under the ſubjection of the Romans in the time of Auguſtus, and is now in the hands of the Turks. Here St. Paul founded a church, to which he directed that epiſtle which is ſtill known by the name of the *Epiſtle to the Galatians,* and was written to reclaim them from the obſervation of Jewiſh ordinances, into which they had been ſeduced by ſome falſe teachers.

GALAX, in botany; a genus of the monogynia order, belonging to the pentandria claſs of plants, and in the natural method ranking with thoſe of which the order is doubtful. The corolla is ſalver-ſhaped; the calyx decaphyllous; the capſule unilocular, bivalved, and elaſtic.

GALAXY, or *Milky-Way,* or *Via Lactea,* in aſtronomy, that long, whitiſh, luminous track which ſeems to encompaſs the heavens, like a ſwath, ſcarf, or girdle; and which is eaſily ſeen in a clear night, eſpecially when the moon is not up. It is of a conſiderable though unequal breadth; being alſo in ſome parts double, but in others ſingle.

The galaxy paſſes through many of the conſtellations in its circuit round the heavens, and keeps its exact place or poſition with reſpect to them. There have been various ſtrange and fabulous ſtories and opinions concerning the galaxy. The ancient poets, and even ſome of the philoſophers, ſpeak of it as the road or way by which the heroes went to heaven. But the Egyptians called it the Way of Straw, from the ſtory of its riſing from burning ſtraw, thrown behind the goddeſs Iſis in her flight from the giant Typhon. While the Greeks, who affect to derive every thing in the heavens from ſome of their own fables, have two origins for it: the one, that Juno, without perceiving it, accidentally gave ſuck to Mercury when an infant; but that as ſoon as ſhe turned her eyes upon him, ſhe threw him from her, and as the nipple was drawn from his mouth, the milk ran about for a moment: and the other, that the infant Hercules being laid by the ſide of Juno when aſleep, on waking ſhe gave him the breaſt; but ſoon perceiving who he was, ſhe threw him from her, and the heavens were marked by the waſted milk.

Some other philoſophers, however, gave it a different turn and different origin. Theſe eſteemed it to be a tract of liquid fire, ſpread in this manner along the ſkies: and others again, ſuppoſing a celeſtial region beyond all that was viſible, and imagining that fire, at ſome time let looſe from thence, was to conſume the world, made this a part of that celeſtial fire, and appealed to it as a preſage of what would ſurely happen. This diffuſed brightneſs they conſidered as a crack in the vault or wall of heaven, and fancied this a glimmering of the celeſtial fire through it, and that there required nothing more than the undoing of this crack by ſome accident in nature, or by the will of the gods, to make the whole frame ſtart, and let out the fire of deſtruction.

Ariſtotle makes the galaxy a kind of meteor, formed of a crowd of vapours drawn into that part by certain large ſtars diſpoſed in the region of the heavens anſwering to it. Others, finding that the galaxy was ſeen all over the globe, that it always correſponded to the ſame fixed ſtars, and that it was far above the higheſt planets, ſet Ariſtotle's opinion aſide, and placed the galaxy in the firmament or region of the fixed ſtars; and concluded that it was nothing elſe but an aſſemblage of an infinite number of minute ſtars. And, ſince the invention of teleſcopes, this opinion has been abundantly confirmed: for, by directing a good teleſcope to any part of the milky way, we perceive an innumerable quantity of very ſmall ſtars, where before we only obſerved a confuſed whiteneſs ariſing from the aſſemblage and union of their joint light; like as any thing powdered with fine white powder, at a diſtance we only obſerve the confuſed whiteneſs, but on examining it very near we perceive all the ſmall particles of the powder ſeparately; as Milton finely expreſſes it,

> A broad and ample road, whoſe duſt is gold,
> And pavement ſtars, as ſtars to thee appear,
> Seen in the galaxy, that milky way,
> Which nightly, as a circling zone thou ſeeſt
> Powder'd with ſtars.

There are other ſuch marks in the heavens; as the nebulæ or nebulous ſtars, and certain whitiſh parts about the ſouth pole called Magellanic clouds, which are all of the ſame nature, appearing to be vaſt cluſters of ſmall ſtars when viewed through a teleſcope, which are too faint to affect the eye ſingly.

M. le Monnier, however, not being able to diſcover more ſtars in this ſpace than in other parts of the heavens, diſputes the opinion above recited as to the reaſon of the whiteneſs, and ſuppoſes that this and the nebulous ſtars are occaſioned by ſome other kind of matter. Vide Inſt. Aſt. p. 60.

GALBANUM, in pharmacy, a gum iſſuing from the ſtem of an umbelliferous plant growing in Perſia and many parts of Africa. See BUBON. The juice, as brought to us, is ſemipel-

lucid, soft, tenacious; of a strong, and to some unpleasant, smell; and a bitterish warm taste: the better sort is in pale coloured masses, which, on being opened, appear composed of clear white tears. Geoffroy relates, that a dark greenish oil is to be obtained from this simple by distillation, which, upon repeated rectifications, becomes of an elegant sky-blue colour. The purer sorts of galbanum are said by some to dissolve entirely in wine, vinegar, or water; but these liquors are only partial menstrua with regard to this drug; nor do spirit of wine or oils prove more effectual in this respect: the best dissolvent is a mixture of two parts spirit of wine and one of water. Galbanum agrees in virtue with gum ammoniacum, but is generally accounted less efficacious in asthmas, and more so in hysterical complaints. It is an ingredient in the *Pillulæ e gummi*, the *Emplastrum lithargyri cum gummi*, and some other officinal compositions.

GALE, in the sea-language, a term of various import. When the wind blows not so hard but that a ship may carry her topsails a-trip (that is, hoisted up to the highest), then they say it is a loom-gale. When it blows very strong, they say it is a stiff, strong, or fresh gale. When two ships are near one another at sea, and, there being but little wind blowing, one of them finds more of it than the other, they say that the one ship gales away from the other.

Gale (Dr. John), an eminent and learned minister among the Baptists, was born at London in 1680. He studied at Leyden, where he distinguished himself very early, and afterwards at Amsterdam under Dr. Limborch. He was chosen minister of the Baptist congregation at Barbican; where his preaching, being chiefly practical, was greatly resorted to by people of all persuasions. Four volumes of his sermons were published after his death, which happened in 1721. His *Reflections on Dr. Wall's History of Infant-baptism* is the best defence of the Baptists ever published; and the reading of that performance induced the learned Mr. William Whiston and Dr. Foster to become Baptists.

Gale (Theophilus), an eminent nonconformist minister, born in 1628. He was invited to Winchester in 1657, and continued a stated preacher there until the re-establishment of the church by Charles II. when he rather chose to suffer the penalties of the act of conformity, than to submit to it contrary to his conscience. He was afterwards engaged by Philip lord Wharton as tutor to his sons, whom he attended to an academy at Caen in Normandy; and, when this duty was fulfilled, he became pastor over a congregation of private conventiclers in Holborn. He died in 1678; and is principally known by an elaborate work intitled the *Court of the Gentiles*, calculated to show that the Pagan philosophers derived their most sublime sentiments from the Scriptures.

Gale (Dr. Thomas), a learned divine, born at Scruton in Yorkshire in the year 1636, was educated at Cambridge, and at length became professor of the Greek language in that university. He was afterwards chosen head master of St. Paul's school, London; and was employed by the city in writing those elegant inscriptions on the Monument erected in memory of the conflagration in 1666. In 1676 he was collated to a prebend in the cathedral of St. Paul's, and was likewise elected a fellow of the Royal Society, to which he presented a Roman urn with its ashes. About the year 1697 he gave to the new library of Trinity College in Cambridge a great number of Arabic manuscripts; and in 1697 was admitted dean of York. He died in that city in 1702, and was interred in the cathedral, where a monument, with a Latin inscription, was erected to his memory. He was a learned divine, a great historian, one of the best Greek scholars of his age, and maintained a correspondence with the most learned men abroad as well as at home. He published, 1. *Historiæ Poeticæ Antiqui Scriptores*, octavo. 2. *Opuscula Mythologica, Ethica, & Physica*, in Greek and Latin, octavo. 3. *Herodoti Historia*, folio. 4. *Historiæ Anglicanæ Scriptores quinque*, in folio. 5. *Historiæ Britannicæ, Saxonicæ, Anglo-Danicæ, Scriptores quindecim*, in folio. 6. *Rhetores Selecti*, &c.

GALEA, in antiquity, a light casque, head piece, or morrion, coming down to the shoulders, and commonly of brass; though Camillus, according to Plutarch, ordered those of his army to be of iron, as being the stronger metal. The lower part of it was called *buccula*, and on the top was a crest. The Velites wore a light galea, made of the skin of some wild beast to make it more terrible.

GALEASSE, a large low-built vessel, using both sails and oars, and the biggest of all the vessels that make use of the latter. It may carry twenty guns, and has a stern capable of lodging a great number of marines. It has three masts, which are never to be lowered or taken down. It has also thirty-two benches of rowers, and to each bench six or seven slaves, who sit under cover. This vessel is at present used only by the Venetians.

GALEGA, in botany; a genus of the decandria order, belonging to the diadelphia class of plants, and in the natural method ranking under the 32d order, *Papilionaceæ*. The calyx is composed of subulated nearly equal dents or segments; the legumen has oblique striæ, and seeds lying between them.

GALEN (Claudius), in Latin *Galenus*, prince of the Greek physicians after Hippocrates, was born at Pergamus in the Lesser Asia about the year 131. His father was possessed of a considerable fortune; was well versed in polite literature, philosophy, astronomy, and geometry; and was also well skilled in architecture. He himself instructed his son in the first rudiments of learning, and afterwards procured him the greatest masters of the age in philosophy and eloquence. Galen, having finished his studies under their care, chose physic for his profession, and chiefly studied the works of Hippocrates. Having at length exhausted all the sources of literature that were to be found at home, he resolved to travel, in order to converse with the most able physicians in all parts, intending at the same time to take every opportunity of inspecting on the spot the plants and drugs of the countries through which he passed. With this view he went to Alexandria, and staid some years in that metropolis of Egypt: from thence he travelled through Cilicia; passed through Palestine; visited the isles of Crete and Cyprus; and made two voyages to Lemnos, in order to examine the Lemnian earth, which was then esteemed an admirable medicine. With the same view he went into the Lower Tyria, in order to obtain a thorough insight into the nature of the opobalsamum, or balm of Gilead; and, having completed his design, returned home by the way of Alexandria.

Galen had been four years at Pergamus, where his practice was attended with extraordinary applause, when some seditious commotions induced him to go to Rome, where he resolved to settle: but the proofs he gave of his superior skill, added to the respect shown him by several persons of very high rank, created him so many enemies among his brethren of the faculty, that he was obliged to quit the city, after having resided there four or five years. But he had not long returned to Pergamos, when he was recalled by the emperors Aurelius and Verus. After their death, he retired to his native country, where he died about the year 200. He wrote in Greek, and is said to have composed two hundred volumes, which were unhappily burnt in the temple of Peace. The best editions of those that remain are, that printed at Basil in 1538 in five volumes, and that of Venice in 1625 in seven volumes. Galen was of a weak and delicate constitution, as he himself asserts: but he nevertheless, by his temperance and skill in physic, arrived to a great age;

for it was his maxim, always to riſe from table with ſome degree of appetite. He is juſtly conſidered as the greateſt phyſician of antiquity, next to Hippocrates; and he performed ſuch ſurpriſing cures, that he was accuſed of magic.

GALENA, a name given by mineraliſts to a ſpecies of poor lead-ore. It was alſo the original name given by Andromachus to his *theriaca*, from its effect in bringing on a pleaſing calm over the ſpirits on taking it.

GALENIA, in botany; a genus of the digynia order, belonging to the octandria claſs of plants, and in the natural method ranking under the 13th order, *Succulentæ*. The calyx is trifid; there is no corolla; the capſule is roundiſh and diſpermous.

GALENIC, in medicine, is that manner of conſidering and treating diſeaſes founded on the principles of, or introduced by, GALEN. This author, collecting and digeſting what the phyſicians before him had done, and explaining every thing according to the ſtricteſt doctrine of the Peripatetics, put phyſic on a new footing: he introduced the doctrine of the four elements; the cardinal qualities and their degrees; and the four humours or temperaments.

GALENIC is more frequently uſed as contradiſtinguiſhed from *chemical*. The diſtinction of *galenical* and *chemical* was occaſioned by a diviſion of the practitioners of medicine into two ſects, which happened on the introduction of chemiſtry into medicine. Then the chemiſts, arrogating to themſelves every kind of merit and ability, ſtirred up an oppoſition to their adverſaries, founded on the invariable adherence of the other party to the ancient practice. And though this diviſion into the two ſects of galeniſts and chemiſts has long ceaſed, yet the diſtinction of medicines which reſulted from it is ſtill retained. Galenical medicines are thoſe which are formed by the eaſier preparations of herbs, roots, &c. by infuſion, decoction, &c. and by combining and multiplying ingredients; while thoſe of chemiſtry draw their more intimate and remote virtues by means of fire and elaborate preparations, as calcination, digeſtion, fermentation, &c.

GALENISTS, a denomination given to ſuch phyſicians as practiſe, preſcribe, or write, on the galenical principles, and ſtand oppoſed to the *chemiſts*. See GALENICAL. At preſent the galeniſts and chemiſts are pretty well accommodated; and moſt of our phyſicians uſe the preparations and remedies of both.

GALENISTS, or *Galenites*, in church-hiſtory, a branch of Mennonites or Anabaptiſts, who take in ſeveral of the opinions of the Socinians, or rather Arians, touching the divinity of our Saviour. In 1664 the Waterlandians were divided into two parties, of which the one were called *Galeniſts*, and the other *Apoſtolians*. They are thus called from their leader Abr. Galenus, a learned and eloquent phyſician of Amſterdam, who conſidered the Chriſtian religion as a ſyſtem that laid much leſs ſtreſs on faith than practice, and who was for taking into the communion of the Mennonites all thoſe who acknowledged the divine origin of the books of the Old and New Teſtament, and led holy and virtuous lives.

GALEON. See GALLEON.

GALEOPSIS, in botany; a genus of the angioſpermia order, belonging to the didynamia claſs of plants, and in the natural method ranking under the 42d order, *Verticillatæ*. The upper lip of the corolla is a little crenated or arched; the under lip more than bidentate.

GALERICULUM, was a cap worn both by men and women amongſt the ancient Romans. It conſiſted of ſkin, which was ſo neatly dreſſed with human hair, that the artificial covering could ſcarcely be diſtinguiſhed from the natural. It was uſed by thoſe whoſe hair was thin; and by wreſtlers, to keep their own hair from receiving any injury from the naſty oils with which they were rubbed all over before they exerciſed. It ſeems to have reſembled our wigs.

GALIC, or GAELIC, *Language*. See HIGHLANDS.

GALICIA, a large country in the S. of Poland, which was forcibly ſeized by the Auſtrians in 1772. It conſiſts of that part of Little Poland which is on the S. ſide of the river Viſtula, almoſt the whole of Red Ruſſia, and a ſlip of Podolia; and it is incorporated into the Auſtrian dominions, under the appellation of the kingdoms of Galicia and Lodomeria; which kingdoms, as the court of Vienna alleged, ſome ancient diplomas repreſent as ſituated in Poland, and ſubject to the kings of Hungary; but their moſt powerful and convincing argument was the "*ultima ratio regum*," derived from an army of 200,000 men. The population of Galicia and Lodomeria, according to the numeration made in 1776, amounted to 2,580,796. The mountainous parts produce fine paſture; the plains are moſtly ſandy, but abound in foreſts, and are fertile in corn. The principal articles of traffic are cattle, hides, wax, and honey; and theſe countries contain mines of copper, lead, iron, and ſalt, of which the latter are the moſt valuable. Lemburg, or Leopold, is the capital of the whole country, which extends 380 miles from E. to W. its greateſt breadth being 190. It is bounded on the N. by that part of Little Poland which is on the N. ſide of the Viſtula, and the palatinates of Lublin and Chelm; on the N. E. by Volhinia; on the E. by Podolia; on the S. by Hungary and Moldavia, and on the W. by Sileſia.

GALICIA, a province of Spain, bounded on the N. and W. by the ocean, on the S. by Portugal, and on the E. by the Aſturias and Leon. The air is temperate along the coaſt, but in other places it is cold and moiſt. It is thin of people. The produce is wine, flax, and citron. Here alſo are good paſtures, copper, and lead; and the foreſts yield wood for building of ſhips. St. Jago de Compoſtella is the capital.

GALICIA, now called alſo *Guadala Jara*, a country of N. America, in New Spain, bounded on the E. by Old Mexico, on the N. by New Mexico, and on the W. by the South Sea. The air is temperate, and there is abundance of corn and pulſe. Here are alſo mines of ſilver and copper.

GALILEE, anciently a province of Judea, but now of Turkey in Aſia. The bounds are not now certainly known.

GALILEANS, a ſect of the Jews. Their founder was one Judas, a native of Galilee, from which place they derived their name. Their chief, eſteeming it an indignity for the Jews to pay tribute to ſtrangers, raiſed up his countrymen againſt the edict of the emperor Auguſtus, which had ordered a taxation or enrolment of all the ſubjects of the Roman empire. They pretended that God alone ſhould be owned as Maſter and Lord, and in other reſpects were of the opinion of the Phariſees: but, as they judged it unlawful to pray for infidel princes, they ſeparated themſelves from the reſt of the Jews, and performed their ſacrifices apart. As our Saviour and his apoſtles were of Galilee, they were ſuſpected to be of the ſect of Galileans; and it was on this principle, as St. Jerome obſerves, that the Phariſees laid a ſnare for him; aſking, Whether it was lawful to give tribute to Cæſar; that, in caſe he denied it, they might have an occaſion of accuſing him.

GALILEO (Galilei), the famous mathematician and aſtronomer, was the ſon of a Florentine nobleman, and born in the year 1564. He had from his infancy a ſtrong inclination to philoſophy and the mathematics, and made prodigious progreſs in theſe ſciences. In 1592 he was choſen profeſſor of mathematics at Padua, and during his abode there he *invented*, it is ſaid, the teleſcope; or, according to others, improved that inſtrument, ſo as to make it fit for aſtronomical obſervations: (See ASTRONOMY, p. 355, col. 1.). In 1611 Coſmo II. grand duke of Tuſcany, ſent for him to Piſa, where he made him profeſſor of mathematics, with a handſome ſalary; and ſoon after, inviting

him to Florence, gave him the office and title of *principal philosopher and mathematician to his highness.*

He had been but a few years at Florence before he was convinced by sad experience, that Aristotle's doctrine, however ill-grounded, was held too sacred to be called in question. Having observed some solar spots in 1612, he printed that discovery the following year at Rome; in which, and in some other pieces, he ventured to assert the truth of the Copernican system, and brought several new arguments to confirm it. For these he was cited before the Inquisition; and, after some months imprisonment, was released upon a simple promise, that he would renounce his heretical opinions, and not defend them by word or writing. But having afterwards, in 1632, published at Florence his "Dialogues of the two greatest Systems of the World, the Ptolemaic and Copernican," he was again cited before the Inquisition, and committed to the prison of that ecclesiastical court at Rome. In June, in the same year, the congregation convened, and in his presence pronounced sentence against him and his books, obliging him to abjure his errors in the most solemn manner; committed him to the prison of their office during pleasure; and enjoined him, as a saving penance, for three years to come, to repeat once a-week the seven penitential psalms: reserving to themselves, however, the power of moderating, changing, or taking away altogether or in part, the abovementioned punishment and penance. On this sentence, he was detained a prisoner till 1634; and his "Dialogues of the System of the World" were burnt at Rome.

He lived ten years after this, seven of which were employed in making still further discoveries with his telescope: but by the continual application to that instrument, added to the damage he received in his sight from the nocturnal air, his eyes grew gradually weaker, till he became totally blind in 1639. He bore this calamity with patience and resignation, worthy of a great philosopher. The loss neither broke his spirit, nor hindered the course of his studies. He supplied the defect by constant meditation; whereby he prepared a large quantity of materials, and began to dictate his own conceptions, when, by a disease of three months continuance, wasting away by degrees, he expired at Arcetti near Florence in January 1642, N. S. in the 78th year of his age.

Among various useful inventions of which Galileo was the author, is that of the simple pendulum, which he had made use of in his astronomical experiments. He had thoughts of applying it to clocks, but did not execute it: the glory of that invention was reserved for Vicenzio, his son, who made the experiment at Venice in 1649; and Mr. Huygens afterwards carried this invention to perfection. He wrote a great number of treatises, several of which were published in a collection by Signor Mendessi, under the title of *L'opera di Galileo Galilei Lynceo.* Some of these, with others of his pieces, were translated into English and published by Thomas Salisbury, Esq. in his mathematical collections, &c. in two volumes folio. A volume also of his letters to several learned men, and solutions of several problems, were printed at Bologna in quarto. Besides these, he wrote many others, which were unfortunately lost through his wife's devotion; who, solicited by her confessor, gave him leave to peruse her husband's manuscripts; of which he tore and took away as many as he said were not fit to be published.

GALINACEUS LAPIS. See GALLINACEUS.

GALIUM, in botany; a genus of the monogynia order, belonging to the tetrandria class of plants, and in the natural method ranking under the 47th order, *Stellatæ.* The corolla is monopetalous and plain; and there are two roundish seeds. There are a great many species, of which the most remarkable are, the *verum* or yellow lady's bed-straw, and the *aperine,* clivers or goose-grass. The former has a firm, erect, brown, square, stem; the leaves generally eight in each whorl, linear, pointed, brittle, and often reflex; branches short, generally two from each joint, terminating in spikes of small yellow flowers. It grows commonly in dry ground and on road-sides. The flowers will coagulate boiling milk; and the best Cheshire cheese is said to be prepared with them. The French prescribe them in hysteric and epileptic cases. Boiled in alum-water, they tinge wool yellow. The roots dye a red not inferior to madder; for which purpose they are used in the island of Jura. In the Edinburgh Medical Commentaries we have accounts of some violent scorbutic complaints being cured by the juice of this plant. Sheep and goats eat the plant; horses and swine refuse it; cows are not fond of it. The aperine or clivers has a square, very rough, jointed, very weak stem, two, three, or four feet long, and adhesive: the branches are opposite; the joints hairy at the base: the leaves, consisting of eight or ten at each joint, are narrow, pointed, above rough, beneath smooth, and carinated: the seeds are rough; flowers white, small, few, on slender foot-stalks on the tops of the branches. It is frequent in fields by the sides of hedges, &c. The expressed juice of this plant taken internally, and the bruised leaves applied by way of poultice, are said to have been used with success as a cure for the cancer. The effects are, however, uncertain: the course, it is said, often requires to be continued for nine or ten months.

GALL, in the animal economy. See BILE. Gall was generally given, amongst the Jews, to persons suffering death under the execution of the law, to make them less sensible of their pain: but gall and myrrh are supposed to have been the same thing; because at our Saviour's crucifixion, St. Matthew says, they gave him vinegar to drink mingled with gall; whereas St. Mark calls it wine mingled with myrrh: the truth of the matter perhaps is, that they distinguished every thing bitter by the name of gall. The Greeks and Romans also gave such a mixture to persons suffering a death of torture.

A great number of experiments have been made upon the gall in different animals; but few conclusions can be drawn from them with any certainty. Dr. Percival, however, has shown that putrid bile may be corrected by the vegetable acids, vinegar, and juice of lemons. These, he observes, have this effect much more completely than the mineral ones: and hence, he thinks, arises the great usefulness of the vegetable acids in autumnal diseases; which are always attended with a putrescent disposition of the bile, owing to the heat of the preceding summer. On this occasion he takes notice of a common mistake among physicians, who frequently prescribe elixir of vitriol in those diseases, where vinegar or lemon juice would be much more effectual.

From this effect of acids on the gall, he also thinks we may see why the immoderate use of acids is so pernicious to digestion. It is necessary to health that the gall should be in some degree acrid and alkalescent: but, as acids have the property of rendering it perfectly mild and sweet, they must be proportionably pernicious to the due preparation and assimilation of the food; which without an acrid bile cannot be accomplished. Hence the body is deprived of its proper nourishment and support, the blood becomes vapid and watery, and a fatal cachexy unavoidably ensues. This hath been the case with many unfortunate persons, who, in order to reduce their excessive corpulency, have indulged themselves in the too free use of vinegar. From the mild state of the gall in young children, Dr. Percival also thinks it is, that they are so much troubled with acidities.

GALL-*Bladder.* See ANATOMY, page 190.

GALL, in natural history, denotes any protuberance or tumor produced by the puncture of insects on plants and trees of different kinds. These galls are of various forms and sizes, and

no lefs different with regard to their internal ftructure. Some have only one cavity, and others a number of fmall cells communicating with each other. Some of them are as hard as the wood of the tree they grow on, whilft others are foft and fpongy; the firft being termed *gall-nuts*, and the latter *berry-galls* or *apple-galls*.

The natural hiftory of the gall is this: An infect of the fly kind (fee CYNIPS) is inftructed by nature to take care for the fafety of her young, by lodging her eggs in a woody fubftance, where they will be defended from all injuries: fhe, for this purpofe, wounds the leaves or tender branches of a tree; and the lacerated veffels, difcharging their contents, foon form tumors about the holes thus made. The external coat of this excrefcence is dried by the air, and grows into a figure which bears fome refemblance to the bow of an arch, or the roundnefs of a kernel. This little ball receives its nutriment, growth, and vegetation, as the other parts of the tree, by flow degrees, and is what we call the *gall-nut*. The worm that is hatched under this fpacious vault finds in the fubftance of the ball, which is as yet very tender, a fubfiftence fuitable to its nature; gnaws and digefts it till the time comes for its transformation to a nymph, and from that ftate of exiftence changes into a fly. After this, the infect, perceiving itfelf duly provided with all things requifite, difengages itfelf foon from its confinement, and takes its flight into the open air. The cafe, however, is not fimilar with refpect to the gall-nut that grows in autumn. The cold weather frequently comes on before the worm is transformed into a fly, or before the fly can pierce through its inclofure. The nut falls with the leaves; and although you may imagine that the fly which lies within is loft, yet in reality it is not fo: on the contrary, its being covered up fo clofe is the means of its prefervation. Thus it fpends the winter in a warm houfe, where every crack and cranny of the nut is well ftopped up, and lies buried as it were under a heap of leaves, which preferves it from the injuries of the weather. This apartment, however, though fo commodious a retreat in the winter, is a perfect prifon in the fpring. The fly, roufed out of its lethargy by the firft heats, gnaws its way through, and ranges where it pleafes. A very fmall aperture is fufficient, fince at this time the fly is but a diminutive creature. Befides, the ringlets whereof its body is compofed dilate and become pliant in the paffage.

Oak galls put, in a very fmall quantity, into a folution of vitriolated iron in water, though but a very weak one, give it a purple or violet colour, which, as it grows ftronger, becomes black; and on this property depends the art of making our writing-ink, as alfo the arts of dyeing and dreffing leather, and other manufactures. See INK.

The beft galls come from Aleppo: thefe are not quite round and fmooth like the other forts, but have feveral tubercles on the furface. Galls have a very auftere ftyptic tafte, without any fmell: they are very ftrong aftringents; and, as fuch, have been fometimes made ufe of both internally and externally, but are not now much taken notice of by medical practitioners. Some recommend an ointment of powdered galls and hog's-lard as very effectual in certain painful ftates of the piles; and it is alleged, that the internal ufe of galls has cured intermittents, after the Peruvian bark has failed. A mixture of galls with a bitter and aromatic has been propofed as a fubftitute for the bark.

GALL, (ST.) or ST. GALLEN, a confiderable town in Swifferland, and in the Upper Thurgau, with a rich and celebrated abbey, whofe abbot is titular prince of the German empire, and is chofen by the 72 Benedictines who compofe the chapter. He formerly poffeffed the fovereignty of the town; but the inhabitants fhook off his authority, and became independent; and the various difputes which fince that period have arifen between the two rival parties have been compromifed by the interpofition of their allies, the Swifs cantons. The town is entirely Proteftant, and its government arifto-democratical. The fubjects of the abbot, whofe territory is diftinct, are moftly Catholics. The abbey, in which this prince refides, is fituated clofe to the town, and in the midft of its territory; as the latter is alfo entirely furrounded by the poffeffions of the prince. The town owes its flourifhing ftate to the uncommon induftry of the inhabitants, and to a very extenfive commerce, arifing chiefly from its manufactures of linen, muflin, and embroidery. To the library belonging to the abbey, which is very numerous and well-arranged, and which contains feveral MSS. of the claffic writers, we are indebted for Petronius Arbiter, Silius Italicus, Valerius Flaccus, and Quintilian, copies of which were found here in 1413. St. Gallen is feated in a narrow barren valley, between two mountains, and on two fmall ftreams, 37 miles N. E. of Zurich. E. lon. 9. 22. N. lat. 47. 26.

GALL-*Fly*. See CYNIPS.

GALLA, an Abyffinian nation, originally dwelling, as Mr. Bruce fuppofes, under the line, and exercifing the profeffion of fhepherds, which they ftill continue to do. For a number of years, our author tells us, they have been conftantly migrating northwards, though the caufe of this migration is not known. At firft they had no horfes; the reafon of which was, that the country they came from did not allow thefe animals to breed: but, as they proceeded northward and conquered fome of the Abyffinian provinces, they foon furnifhed themfelves with fuch numbers, that they are now almoft entirely cavalry, making little account of infantry in their armies. On advancing to the frontiers of Abyffinia, the multitude divided; and part directed their courfe towards the Indian Ocean; after which, having made a fettlement in the eaftern part of the continent, they turned fouthward into the countries of Bali and Dawaw, which they entirely conquered, and fettled there in the year 1537. Another divifion, having taken a wefterly courfe, fpread themfelves in a femicircle along the banks of the Nile; furrounding the country of Gojam, and paffing eaftward behind the country of the Agows, extended their poffeffions as far as the territories of the Gongas and Gafats. Since that time, the Nile has been the boundary of their poffeffions; though they have very frequently plundered, and fometimes conquered, the Abyffinian provinces on the other fide of the river, but have never made any permanent fettlement in thefe parts. A third divifion has fettled to the fouthward of the low country of Shoa, which the governor of that province has permitted, in order to form a barrier betwixt him and the territories of the emperor, on whom he fcarcely acknowledges any dependence.

The Galla are of a brown complexion, and have long black hair; but fome of them who live in the valleys are entirely black. At firft their common food was milk and butter; but, fince their intercourfe with the Abyffinians, they have learned to plough and fow their land, and to make bread. They feem to have a predilection for the number feven, and each of the three divifions already mentioned are fubdivided into feven tribes. In their behaviour they are extremely barbarous, and live in continual war with the Abyffinians, whom they murder without mercy as often as they fall into their hands. They cut off the privities of the men, and hang them up in their houfes by way of trophies; and are fo cruel as to rip up women with child, in hopes of thus deftroying a male. Yet, notwithftanding their exceffive cruelty abroad, they live under the ftricteft difcipline at home; and every broil or quarrel is inftantly punifhed according to the nature of the offence. Each of the three divifions of the Galla above mentioned has a king of its own; and they have alfo a kind of nobility, from among whom the fovereign can only be chofen: however, the commonalty are not excluded from rifing to the rank of nobles, if they diftinguifh

themſelves very much in battle. None of the nobility can be elected till upwards of 40 years of age, unleſs he has with his own hand killed ſuch a number of enemies as, added to his own age, makes up 40. There is a council of each of the ſeven tribes, which meets ſeparately in its own diſtrict, to ſettle how many are to be left behind for the governing and cultivating of the territory, and other matters of importance. Theſe nations have all a great veneration for a tree which grows plentifully in their country, called *wanzey*, and which theſe ſuperſtitious people are even ſaid to adore as a god. Their aſſemblies for the choice of a king are all held under one of theſe trees; and when the ſovereign is choſen, they put a bludgeon of this wood in his hand by way of ſceptre, and a garland of the flowers upon his head.

The Galla are reported to be very good ſoldiers, eſpecially in caſes of ſurpriſe; but, like moſt other barbarians, have no conſtancy nor perſeverance after the firſt attack. They will, however, perform extraordinary marches, ſwimming rivers holding by the horſe's tail, and thus being enabled to do very great miſchief by reaſon of the rapidity of their movements. They are excellent light-horſe for a regular army in an hoſtile country; but are very indifferently armed on account of the ſcarcity of iron among them. Their principal arms are lances made of wood ſharpened at the end and hardened in the fire; and their ſhields are compoſed only of one ſingle fold of bull's hide; ſo that they are extremely apt to warp by heat, or become too ſoft in wet weather. They are exceedingly cruel, and make a ſhrill horrid noiſe at the beginning of every engagement, which greatly terrifies the horſes, and very often the barbarous riders which oppoſe them.

The Galla, according to Mr. Bruce's account, are ſomewhat below the middle ſize, but extremely light and nimble. The women are fruitful, and ſuffer ſo little in child-bearing, that they do not even confine themſelves for a ſingle day after delivery. They plough, ſow, and reap the corn, which is trodden out by the cattle; but the men have all the charge of the cattle in the fields. In their cuſtoms they are filthy to the laſt degree; plaiting their hair with the guts of oxen, which they likewiſe twiſt round their middle, and which by the quick putrefaction occaſion an abominable ſtench. They anoint their heads and whole bodies with butter or greaſe; in which, as well as in other reſpects, they greatly reſemble the Hottentots. It has been ſuppoſed that they have no religion whatever; but Mr. Bruce is of opinion that this is a miſtake. The wanzey, he ſays, is undoubtedly worſhipped by all the nations as a god; and they have likewiſe certain ſtones which are worſhipped as gods: beſides theſe, they worſhip the moon, and ſome ſtars, when in certain poſitions, and at ſome particular ſeaſons of the year. They all believe in a reſurrection, and have ſome faint notions of a ſtate of happineſs, but no idea of future puniſhment. Some of them to the ſouthward profeſs the Mahometan religion; but thoſe to the eaſt and weſt are generally pagans. All of them intermarry with each other, but will not allow ſtrangers to live among them, though the Moors have at laſt found out a method of trading ſafely with them. The commodities they deal in are blue Surat cloths, myrrh, and ſalt; the laſt being the moſt valuable article.

The marriages among the Galla are celebrated with ſome of the diſguſting cuſtoms of the Hottentots; and, after theſe ceremonies, the bridegroom promiſes to give the bride meat and drink while ſhe lives, and to bury her when dead. Polygamy is allowed among them; but it is ſingular, that among theſe people the women ſolicit their huſbands to take others to their embraces. The reaſon of this cuſtom is, that the men may have numerous families of children, who may be capable of defending them againſt their enemies; as the Galla, according to our author, always fight in families, whether againſt foreign enemies or with one another.

Galla, a fort of Ceylon, belonging to the Dutch, who drove the Portugueſe thence in 1640. Some call it Punta de Gallo. Lon. 80. 20. E. Lat. 6. 20. N.

GALLAND (Anthony), a learned antiquarian, member of the Academy of Inſcriptions, and profeſſor of Arabic in the Royal College of Paris, was born of poor parents at Rollo, a village in Picardy. Having ſtudied at the Sorbonne and other univerſities, he travelled into the eaſt, where he acquired great ſkill in the Arabic tongue and in the manners of the Mahometans. He wrote ſeveral works; the principal of which are, 1. An Account of the Death of the Sultan Oſman, and the Coronation of the Sultan Muſtapha. 2. A Collection of Maxims, drawn from the works of the Orientals. 3. A Treatiſe on the Origin of Coffee. 4. The Arabian Nights Entertainments, &c.

GALLANT, or Galant, a French term adopted into our language, and ſignifying polite, civil, and well-bred, with a diſpoſition to pleaſe, particularly the ladies. It alſo ſignifies brave or courageous.

GALLE, the name of ſeveral engravers, of whom the principal was Cornelius, who flouriſhed about the year 1600. He learned the art of engraving from his father, and imitated his ſtiff ſtyle till he went to Rome, where he reſided a conſiderable time, and there acquired that freedom, taſte, and correctneſs of drawing, which are found in his beſt works. He ſettled at Antwerp upon his return from Italy, where he carried on a conſiderable commerce in prints. His beſt prints are thoſe done after Rubens.

GALLEON, in naval affairs, a ſort of ſhips employed in the commerce of the Weſt Indies. The Spaniards ſend annually two fleets; the one for Mexico, which they call the *flota;* and the other for Peru, which they call the *galleons*. See Flota. By a general regulation made in Spain, it has been eſtabliſhed, that there ſhould be twelve men of war and five tenders annually fitted out for the armada or galleons; eight ſhips of 600 tons burden each, and three tenders, one of 100 tons, for the iſland Margarita, and two of 80 each, to follow the armada; for the New Spain fleet, two ſhips of 600 tons each, and two tenders of 80 each; and for the Honduras fleet, two ſhips of 500 tons each: and in caſe no fleet happened to ſail any years, three galleons and a tender ſhould be ſent to New Spain for the plate. They are appointed to ſail from Cadiz in January, that they may arrive at Porto Bello about the middle of April; where, the fair being over, they may take aboard the plate, and be at Havannah with it about the middle of June; where they are joined by the flota, that they may return to Spain with the greater ſafety.

GALLEOT, a ſmall galley deſigned only for chace, carrying but one maſt and two pattereroes. It can both ſail and row, and has 16 or 20 oars. All the ſeamen on board are ſoldiers, and each has a muſket by him on quitting his oar.

GALLERY, in architecture, a covered place in a houſe, much longer than broad, and uſually in the wings of a building; its uſe being chiefly to walk in.

Gallery, in fortification, a covered walk acroſs the ditch of a town, made of ſtrong beams covered over with planks, and loaded with earth: ſometimes it is covered with raw hides, to defend it from the artificial fires of the beſieged.

Gallery *of a Mine*, is a narrow paſſage or branch of a mine carried on under ground to a work deſigned to be blown up. See Mine.

Gallery, in a ſhip, that beautiful frame which is made in the form of a balcony at the ſtern of a ſhip without board, into which there is a paſſage out of the admiral's or captain's cabin, and is deſigned as an ornament of the ſhip.

GALLEY, a kind of low flat-built veſſel, furniſhed with one deck, and navigated with ſails and oars, particularly in the Mediterranean. By the Greek authors under the eaſtern empire this kind of veſſel was called γαλαια and γαλεια, and by the Latin authors of the ſame time, *galea*; whence, according to ſome, the modern denomination. Some ſay it was called *galea*, on account of a caſque or helmet which it carried on its prow, as Ovid atteſts, *de Triſtibus*. The French call it *galere*; by reaſon, they ſay, that the top of the maſt is uſually cut in the form of a hat, which the Italians call *galero*. Others derive both *galea* and *galere* from a fiſh by the Greeks called γαλεωτης or ξιφιας, and by us the *ſword-fiſh*, which this veſſel reſembles. Laſtly, others derive the *galley*, *galea*, *galere*, *galeaſſe*, &c. from the Syriac and Chaldee *gaul* and *gallin*, a man expoſed on the water in a veſſel of wood.

The largeſt ſort of theſe veſſels is employed only by the Venetians. They are commonly 162 feet long above, and 133 feet by the keel, 32 feet wide, with 23 feet length of ſtern-poſt. They are furniſhed with three maſts, and 32 banks of oars; every bank containing two oars, and every oar being managed by ſix or ſeven ſlaves, who are uſually chained thereto. In the fore-part they have three little batteries of cannon, of which the loweſt is of two 36 pounders, the ſecond of two 24 pounders, and the uppermoſt of two 2 pounders: three 18 pounders are alſo planted on each quarter. The complement of men for one of theſe galleys is 1000 or 1200. They are eſteemed extremely convenient for bombarding or making a deſcent upon an enemy's coaſt, as drawing but little water; and having by their oars frequently the advantage of a ſhip of war, in light winds or calms, by cannonading the latter near the ſurface of the water; by ſcouring her whole length with their ſhot, and at the ſame time keeping on her quarter or bow, ſo as to be out of the direction of her cannon.

The galleys next in ſize to theſe, which are alſo called *half-galleys*, are from 120 to 130 feet long, 18 feet broad, and 9 or 10 feet deep. They have two maſts, which may be ſtruck at pleaſure; and are furniſhed with two large lateen ſails and five pieces of cannon. They have commonly 25 banks of oars, as deſcribed above. A ſize ſtill leſs than theſe are called *quarter-galleys*, carrying from 12 to 16 banks of oars. There are very few galleys now beſides theſe in the Mediterranean, which are found by experience to be of little utility except in fine weather; a circumſtance which renders their ſervice extremely precarious. They generally keep cloſe under the ſhore, but ſometimes venture out to ſea to perform a ſummer cruiſe.

GALLEY-*Worm*, in zoology. See IULUS.

GALLI, in antiquity, a name given to the prieſts of Cybele, from the river Gallus in Phrygia; but of the etymology of the name we have no certain account. All that we learn with certainty about them is, that they were eunuchs and Phrygians, and that in their ſolemn proceſſions they danced, bawled, drummed, cut and ſlaſhed themſelves, playing upon timbrels, pipes, cymbals, &c. and driving about an aſs loaded with the ſacred rites and trumpery of their goddeſs. When a young man was to be initiated, he was to throw off his clothes, run crying aloud into the midſt of their troop, and there draw a ſword and caſtrate himſelf; after this he was to run into the ſtreet with the parts cut off in his hand, throw them into ſome houſe, and in the ſame houſe put on a woman's dreſs. Theſe prieſts had the names alſo of *Curetes*, *Corybantes*, and *Dactyli*. The chief prieſt was called *Archi-Gallus*. This order of prieſthood is found both amongſt Greeks and Romans. See an account of them in *Lucret.* lib. ii. and *Juv.* ſat. vi.

GALLI, the *Gauls*. See GALLIA and GAULS.

GALLI, five ſmall deſolate iſlands on the coaſt of the Principato Citra of Naples. They are ſuppoſed to be the Syrenuſæ, or iſlands once inhabited by the Sirens, which Ulyſſes paſſed with ſo much caution and hazard. Great revolutions, however, have been occaſioned in their ſhape, ſize, and number, by the effects of ſubterranean fire; and ſome learned perſons go ſo far as to aſſert, that theſe rocks have riſen from the bottom of the ſea ſince Homer ſang his rhapſodies; conſequently, that thoſe monſters dwelt on ſome other ſpot, probably Sicily or Capri. The tradition of Sirens reſiding hereabouts is very ancient and univerſally admitted; but what they really were, diveſted of their fabulous and poetical diſguiſe, it is not eaſy to diſcover. See SIREN. Theſe iſlands are uncultivated and uninhabited ſince the old hermit of St. Antonio died. Myrtle covers moſt of the ſurface.

GALLIA, a large country of Europe, called *Galatia* by the Greeks. The inhabitants were called *Galli*, *Celtæ*, *Celtiberi*, and *Celtoſcythæ*. Ancient Gaul was divided into four different parts by the Romans, called *Gallia Belgica*, *Narbonenſis*, *Aquitania*, and *Celtica*. Gallia Belgica was the largeſt province, bounded by Germany, Gallia Narbonenſis, and the German ocean; and contained the modern country of Alſace, Lorraine, Picardy, with part of the Low Countries, and of Champagne, and of the iſle of France. Gallia Narbonenſis, which contained the provinces lately called *Languedoc*, *Provence*, *Dauphiné*, *Savoy*, was bounded by the Alps and Pyrenean mountains, by Aquitania, Belgium, and the Mediterranean. Aquitania Gallica, afterwards the *provinces of Poitou*, *Santonge*, *Guienne*, *Berry*, *Limoſin*, *Gaſcogny*, *Auvergne*, &c. was ſituated between the Garumna, the Pyrenean mountains, and the ocean. Gallia Celtica, or Lugdunenſis, was bounded by Belgium, Gallia Narbonenſis, the Alps, and the ocean. It contained the country heretofore known by the name of *Lyonnois*, *Touraine*, *Franche Comté*, *Senenois*, *Switzerland*, and part of *Normandy*. Beſides theſe grand diviſions, there is often mention made of Gallia Ciſalpina or Citerior, Tranſalpina or Ulterior, which refers to that part of Italy which was conquered by ſome of the Gauls who croſſed the Alps. By Gallia Ciſalpina, the Romans underſtood that part of Gaul which lies in Italy, and by Tranſalpina, that which lies beyond the Alps in regard only to the inhabitants of Rome. Gallia Ciſpadana and Tranſpadana is applied to a part of Italy conquered by ſome of the Gauls; and then it means the country on this ſide of the Po, or beyond the Po with reſpect to Rome. By Gallia Togata, the Romans underſtood Ciſalpine Gaul, where the Roman gowns *togæ* were uſually worn. Gallia Narbonenſis was called *Braccata*, on account of the peculiar covering of the inhabitants for their thighs. The epithet of *Comata* is applied to Gallia Celtica, becauſe the people ſuffered their hair to grow to an uncommon length. The inhabitants were great warriors, and their valour overcame the Roman armies, took the city of Rome, and invaded Greece in different ages. They ſpread themſelves over the greateſt part of the world. They were very ſuperſtitious in their religious ceremonies, and revered the ſacerdotal order as if they had been gods. They long maintained a bloody war againſt the Romans, and Cæſar reſided 10 years in their country before he could totally ſubdue them. See GAUL.

GALLIARD, or GAGLIARDA, a ſort of dance anciently in great requeſt, conſiſting of very different motions and actions, ſometimes proceeding *terra à terra* or ſmoothly along, ſometimes capering, ſometimes along the room, and ſometimes acroſs. The word is French, *galliarde*, or rather Italian, and literally ſignifies "gay, merry, ſprightly." This dance was alſo called *Romaneſque*, becauſe brought from Rome. Thoinet Arbeau, in his Orcheſography, deſcribes it as conſiſting of five ſteps and five poſitions of the feet, which the dancers performed before each other, and whereof he gives us the ſcore or tablature, which is of ſix minims and two triple times.

GALLIARDA, in the Italian muſic, the name of a tune

that belongs to a dance called a *galliard*. The air of it is lively in triple time.

GALLICAN, any thing belonging to France: thus the now exploded term *Gallican church* denoted the eftablifhed religion of France, or the affembly of the clergy of that kingdom.

GALLICISM, a mode of fpeech peculiar to the French language, and contrary to the rules of grammar in other languages. With us it is ufed to denote fuch phrafes or modes of fpeech in Englifh as are formed after the French idiom.

GALLINACEUS LAPIS, a gloffy fubftance produced by volcanic fires, the fame with the *lapis obfidianus* of the ancients. A kind of it is brought from Paris, of a beautiful black, refembling the colour of a large crow in that country named *gallinazo*.

GALLINÆ, in ornithology, an order of birds. See ORNITHOLOGY.

GALLINACIOUS, an appellation given to the birds of the order of the gallinæ.

GALLING, or EXCORIATION, in medicine. See EXCORIATION.

GALLING *of a Horfe's Back*, a diforder occafioned by heat and the chafing or pinching of the faddle. In order to prevent it, fome take a hind's fkin well garnifhed with hair, and fit it neatly under the pannel of the faddle, fo that the hairy fide may be next the horfe. When a horfe's back is galled upon a journey, remove the preffure entirely by taking out a little of the ftuffing of the pannel over the fwelling, and fewing a piece of foft white leather on the infide in its ftead. Wafh the part with lead water, and, if the fkin be loft, apply a plafter of frefh butter.

GALLINULE. See FULICA.

GALLIPAGO ISLANDS, in the South Sea, lying under the equator, difcovered by the Spaniards, to whom they belong. They are not inhabited; for the Spaniards only call there for frefh water and provifions, when they fail from America to Afia. Here are a great number of birds and excellent tortoifes.

GALLIPOLI, a feaport of the kingdom of Naples, with a bifhop's fee and a fort. It is feated on a rock, furrounded by the fea, and joined to the main-land by a bridge. It is 23 miles W. of Otranto. Lon. 18. 5. E. Lat. 40. 20. N.

GALLIPOLI, a feaport of Turkey in Europe, in Romania, feated at the entrance of the fea of Marmora, with a good harbour and a bifhop's fee. It contains about 10,000 Turks, 3500 Greeks, befide a great number of Jews. It is an open place, and has no other defence than a forry fquare caftle. The houfes of the Greeks and Jews have doors not above three feet and a half high, to prevent the Turks riding into their houfes. It is 100 miles S. W. of Conftantinople. Lon. 26. 59. E. Lat. 40. 26. N.

GALLIUM, in botany. See GALIUM.

GALLO, an ifland of the South Sea, near the fea coaft of Peru in South America, which was the firft place poffeffed by the Spaniards when they attempted the conqueft of Peru; it is alfo the place where the buccaniers ufed to come for wood and water, and to refit their veffels when they were in thefe parts. W. lon. 88. 0. N lat. 2. 30.

GALLOIS (John), born at Paris in 1632, was an univerfal fcholar, but chiefly noted for having been, in conjunction with M. de Sallo who formed the plan, the firft publifher of the *Journal des Sçavans*. The firft journal was publifhed January 5th, 1665; but thefe gentlemen criticifed new works fo rigoroufly, that the whole tribe of authors united and cried it down. De Sallo declined entirely after the publication of the third number: but Gallois ventured to fend out a fourth, on January 4th, 1666, though not without a moft humble advertifement at the beginning, wherein it was declared, that the author "would not prefume to criticife, but fimply give an account of the books." This, with the protection of M. Colbert, who was greatly taken with the work, gradually reconciled the public to it: and thus began literary journals, which have been continued from that time to this, under various titles and by various writers. Gallois continued his journal to the year 1674, when more important occupations obliged him to turn it over to other hands. M. Colbert had taken him into his houfe to teach him Latin; and when he loft his patron in 1683, he was firft made librarian to the king, and then Greek profeffor in the royal college. He died in 1707.

GALLON, a meafure of capacity both for dry and liquid things, containing four quarts. But thefe quarts, and confequently the gallon itfelf, are different, according to the quality of the thing meafured: for inftance, the wine-gallon contains 231 cubic inches, and holds eight pounds avoirdupois of pure water; the beer and ale-gallon contains 281 folid inches, and holds ten pounds three ounces and a quarter avoirdupois of water; and the gallon for corn, meal, &c. 272½ cubic inches, and holds nine pounds thirteen ounces of pure water.

GALLOP, in the manege, is the fwifteft natural pace of a horfe, performed by reaches or leaps, the two fore-feet being raifed almoft at the fame time; and when thefe are in the air, and juft ready to touch the ground again, the two hind-feet are lifted almoft at once. The word is borrowed from the barbarous Latin *calupare* or *calpare*, "to run." Some derive it from *caballicare*; others from the Greek καλπαζειν or καλπαν, "to fpur a horfe."

GALLOWAY, a county of Scotland, which gives the title of earl to a branch of the noble family of Stuart. It is divided into two diftricts; the weftern, called *Upper Galloway*, being the fame with Wigtonfhire; and the eaftern, or ftewartry of Kirkcudbright, called *Lower Galloway*. See KIRKCUDBRIGHT and WIGTONSHIRE.

GALLOWAY is the name of a peculiar fort of horfes, fo called from the county of Galloway in Scotland, where they are bred. Tradition reports, that this kind of horfes fprung from fome Spanifh ftallions, which fwam on fhore from fome of the fhips of the famous Spanifh armada, wrecked on the coaft; and, coupling with the mares of the country, furnifhed the kingdom with their pofterity. They are of a middling fize, ftrong, active, nervous, and hardy.

Mull of GALLOWAY, one of the Weftern Iflands of Scotland, about 24 Scotch miles long, and as much in breadth. It is in general rocky and barren, not producing a fufficient quantity of corn for the inhabitants; but about 1800 head of cattle are annually exported. The ifland was originally part of the dominions of the Lords of the Ifles; but in after-times it became part of the poffeffions of the ancient and valiant family of Macleans, who ftill retain one-half. The other is the litigated property of the duke of Argyle, whofe anceftor poffeffed himfelf of it in 1674 on account of a debt; but after the courts of law had made an adjudication in his favour, he was obliged to fupport their decree by force of arms.

GALLOWS, an inftrument of punifhment, whereon perfons convicted capitally of felony, &c. are executed by hanging. Among our anceftors it was called *furca*, "fork;" a name by which it is ftill denominated abroad, particularly in France and Italy. In this latter country, the reafon of the name ftill fubfifts; the gallows being a real fork driven into the ground, acrofs the legs whereof is laid a beam, to which the rope is tied. See FURCA.

GALLUS (Cornelius), an ancient Roman poet, born at Forum Julium, now called *Frejus*, in France. He was a particular favourite with Auguftus Cæfar, who made him governor of Egypt: but his mal-adminiftration there occafioned his banifhment and the lofs of his eftate; for grief of which he

put an end to his own life. He wrote four books of love-elegies; and Virgil has complimented him in many places.

Gallus, or Cock, in ornithology. See Phasianus.

GALLY, in printing, a frame into which the compofitor empties the lines out of his compofing-ftick, and in which he ties up the page when it is completed. The gally is formed of an oblong fquare board, with a ledge on three fides, and a groove to admit a falfe bottom called a *gally-flice*.

GALWAY, a county of Ireland, in the province of Connaught, 82 miles in length, and 42 in breadth, bounded by the counties of Clare, Tipperary, King's County, Rofcommon, and the fea. The river Shannon wafhes the frontiers of the E. and S. E. and forms a lake feveral miles in length. It contains 136 parifhes, and fends eight members to parliament. The capital bears the fame name.

Galway, a town of Ireland, in the county of the fame name, of which it is the capital. It is furrrounded by ftrong walls; the ftreets are large and ftraight, and the houfes are generally well built of ftone. It has a good trade into foreign parts, on account of its harbour, which is defended by a fort It is feated on a bay of the fame name on the Atlantic Ocean, 40 miles W. S. W. of Athlone, and 100 W. of Dublin. Lon. 9. 0. W. Lat. 53. 18. N.

GAMA (Vafco de), a Portuguefe admiral, celebrated for his difcovery of the Eaft Indies by the Cape of Good Hope, was born at Synes, and in 1497 was fent to the Indies by king Emanuel: he returned in 1502, and failed thither again with 13 veffels richly laden. He was made viceroy of the Indies by king John III.; and died at Cochin on the 24th of December 1525. Don Stephen and Don Chriftopher de Gama, his fons, were alfo viceroys of the Indies, and celebrated in hiftory.

GAMBIA, a large river of Negroland in Africa, generally fuppofed to be a branch of the Niger. See Nile, Niger, and Senegal.

GAMBOGE, is a concreted vegetable juice, partly of a gummy and partly of a refinous nature. See Gambogia. It is chiefly brought to us in large cakes or rolls from Cambaja in the Eaft Indies. The beft fort is of a deep yellow or orange colour; breaks fhining and free from drofs: it has no fmell, and very little tafte, unlefs kept in the mouth for fome time, when it impreffes a flight fenfe of acrimony. It immediately communicates to fpirit of wine a bright golden colour, and almoft entirely diffolves in it; Geoffroy fays, except the fixth part. Alkaline falts enable water to act upon this fubftance powerfully as a menftruum: the folution made by their means is fomewhat tranfparent, of a deep blood-red colour, and paffes the filter: the dulcified fpirit of fal ammoniac readily and entirely diffolves it, and takes up a confiderable quantity; and, what is pretty remarkable, this folution mixes either with water or fpirit without growing turbid. As a *pigment*, it makes a beautiful yellow, which is much ufed by the painters. Dr. Lewis fays, that it makes a beautiful and durable citron-yellow ftain upon marble, whether rubbed in fubftance on the hot-ftone, or applied, as dragon's blood fometimes is, in form of a fpirituous tincture. When it is applied on cold marble, the ftone is afterwards to be heated, to make the colour penetrate. As a *medicine*, gamboge evacuates powerfully both upwards and downwards; and fome condemn it as acting with too great violence. Geoffroy feems particularly fond of it, however, and informs us, that he has frequently given from two to four grains without its proving at all emetic; but this account is not to be depended on. It has been ufed in dropfy with cream of tartar, to correct its operation. It is alfo recommended by fome, joined with an equal quantity of vegetable alkali, in cafes of the tape-worm. This is faid to be the remedy alluded to by Van Swieten, which was employed by Dr. Herenfchward, and with him proved fo fuccefsful in the removal of the tænia lata.

GAME, in general, fignifies any diverfion or fport that is performed with regularity and reftrained to certain rules. See Gaming. Games are ufually diftinguifhed into thofe of exercife and addrefs, and thofe of hazard. To the firft belong chefs, tennis, billiards, &c. and to the latter thofe performed with cards or dice, as back-gammon, ombre, picquet, whift, &c. See Back-*Gammon*, &c.

In the fifth volume of the Tranfactions of the Royal Irifh Academy is given a very curious account of the origin of the game of chefs by Mr. Eyles Irwin, who obtained, through the affiftance of a young Mandarin then purfuing his ftudies in the college of Canton in China, what he conceives to be fatisfactory evidence that we owe folely to that country the invention of the game of chefs.

"I requefted the favour of him (fays the author) to confult fuch ancient books as might give fome infight into the period of the introduction of chefs into China; to confirm, if poffible, the idea that ftruck me of its having originated here. The acknowledged antiquity of this empire, the unchangeable ftate of her cuftoms and manners beyond that of any other nation in the world, and more efpecially the fimplicity of the game itfelf when compared to its compafs and variety in other parts, appeared to give a colour to my belief. That I was not difappointed in the event, I have no doubt will be allowed, on the perufal of the tranflation of a manufcript extract, which my friend Tinqua brought me in compliance with my defire; and which is accompanied by the Chinefe manufcript.

"In the purfuit of one curiofity (continues Mr. Irwin), I flatter myfelf that I have ftumbled by accident on another, and have gone fome length to reftore to the Chinefe the invention of gunpowder, fo long difputed with them by the Europeans; but which the evidence on their chefs-board, in the action of the rocket, feems to eftablifh beyond a doubt. The inftitution of the game is likewife difcovered to form the principal æra in the Chinefe hiftory; fince, by the conqueft of Shenfi, the kingdom was firft connected in its prefent form, and the monarch affumed the title of emperor; as may be feen in the extract which I have obtained from their annals.

"From thefe premifes I have, therefore, ventured to make the following inferences: That the game of chefs is probably of Chinefe origin:—That the confined fituation and powers of the king, refembling thofe of a monarch in the earlier parts of the world, countenance the fuppofition; and that, as it travelled weftward and defcended to later times, the fovereign prerogative extended itfelf until it became unlimited, as in our ftate of the game:—That the agency of the princes, in lieu of the queen, befpeaks forcibly the nature of the Chinefe cuftoms, which exclude females from all power or influence whatever; which princes, in its paffage through Perfia, were changed into a fingle vizier or minifter of ftate, with the enlarged portion of delegated authority that exifts there; inftead of whom, the European nations, with their ufual gallantry, adopted a queen on their board:—That the river between the parties is expreffive of the general face of this country, where a battle could hardly be fought without encountering an interruption of this kind, which the foldier was here taught to overcome; but that, on the introduction of the game into Perfia, the board changed with the dry nature of the region, and the conteft was decided on terra firma:—And laftly, that in no account of the origin of chefs that I have read has the tale been fo characteriftic or confiftent as that which I have the honour to offer to the Irifh Academy. With the Indians, it was defigned by a Bramin to cure the melancholy of the daughter of a Rajah. With the Perfians, my memory does not affift me to trace the fable; though, if it were more to the purpofe, I think I fhould have retained it. But, with the Chinefe, it was invented by an experienced foldier on the principles of war: not to difpel love-

fick vapours, or inftruct a female in a fcience that could neither benefit nor inform her; but to quiet the murmurs of a difcontented foldiery, to employ their vacant hours in leffons on the military art, and to cherifh the fpirit of conqueft in the bofom of winter quarters. Its age is traced by them on record near two centuries before the Chriftian æra: and among the numerous claims for this noble invention, that of the Chinefe, who call it, by way of diftinction, *Chong Kè* or the *Royal Game*, appears alone to be indifputable."

To this account fucceeds a *tranflation of the Extract* procured from the *Concum*, or Chinefe annals, by Tinqua, a foldier Mandarin of the province of Fokien. It runs thus: "Three hundred and feventy-nine years after the time of Confucius, or one thoufand nine hundred and fixty-five years ago, Hung Cochu, king of Kiangnan, fent an expedition into the Shenfi country, under the command of a mandarin called Hanfing, to conquer it. After one fuccefsful campaign, the foldiers were put into winter quarters; where, finding the weather much colder than what they had been accuftomed to, and being alfo deprived of their wives and families, the army, in general, became impatient of their fituation, and clamorous to return home. Hanfing, upon this, revolved in his mind the bad confequences of complying with their wifhes. The neceffity of foothing his troops, and reconciling them to their pofition, appeared urgent, in order to finifh his operations in the enfuing year. He was a man of genius as well as a good foldier; and, having contemplated fome time on the fubject, he invented the game of chefs, as well for an amufement to his men in their vacant hours, as to inflame their military ardour, the game being wholly founded on the principles of war. The ftratagem fucceeded to his wifh. The foldiery were delighted with the game, and forgot, in their daily contefts for victory, the inconveniencies of their poft. In the fpring the general took the field again, and in a few months added the rich country of Shenfi to the kingdom of Kiangnan, by the defeat and capture of its king, Choupayuen, a famous warrior among the Chinefe. On this conqueft, Hung Cochu affumed the title of emperor, and Choupayuen put an end to his own life in defpair."

An explanation of the pofition, powers, and moves, of the pieces on the Chinefe chefs-board, *Chong Kè* (Royal Game), is given as follows: "As there are nine pieces inftead of eight to occupy the rear rank, they ftand on the *lines between* and not *within* the fquares. The game is confequently played on the lines.

"The King, or *Chong*, ftands in the middle line of this row. His moves refemble thofe of our king, but are confined to the fortrefs marked out for him.

"The two Princes, or *Sou*, ftand on each fide of him, and have equal powers and limits.

"The Mandarins, or *Tchong*, anfwer to our bifhops, and have the fame moves, except that they cannot crofs the water or white fpace in the middle of the board, to annoy the enemy, but ftand on the defenfive.

"The Knights, or rather Horfes, called *Māā*, ftand and move like ours in every refpect.

"The War-Chariots, or *Tchè*, refemble our Rooks or Caftles.

"The Rocket-boys, or *Paö*, are pieces whofe motions and powers were unknown to us. They act with the direction of a rocket, and can take none of their adverfary's men that have not a piece or pawn intervening. To defend your men from this attack, it is neceffary to open the line between, either to take off the check on the king, or to fave a man from being captured by the *Paö*. Their operation is, otherwife, like that of the Rook. Their ftations are marked between the pieces and pawns.

"The five Pawns, or *Ping*, make up the number of the men equal to that of our board. Inftead of taking fideways like ours, they have the Rook's motion, except that it is limited to one ftep, and is not retrograde. Another important point in which the Ping differs from ours is, that they continue *in ftatu quo* after reaching their adverfary's head-quarters. It will appear, however, that the Chinefe pieces far exceed the proportion of ours; which occafions the whole force of the conteft to fall upon them, and thereby precludes the beauty and variety of our game when reduced to a ftruggle between the pawns, who are capable of the higheft promotion and often change the fortune of the day. The pofts of the Ping are marked in front." See a reprefentation of the Chinefe chefs-board in plate 37.

Games, in antiquity, were public diverfions exhibited on folemn occafions. Such, among the Greeks, were the Olympic, Pythian, Ifthmian, Nemean, &c. games; and, among the Romans, the Apollinarian, Circenfian, Capitoline, &c. games. See Olympic, Pythian, Funeral, &c.

Game, in law, fignifies birds or prey taken or killed by fowling or hunting. The property of fuch animals *feræ naturæ* as are known under the denomination of *game*, with the right of purfuing, taking, and deftroying them, is vefted in the king alone, and from him derived to fuch of his fubjects as have received the grants of a chace, a park, or a free warren.

By the law of nature, indeed, every man, from the prince to the peafant, has an equal right of purfuing and taking to his own ufe all fuch creatures as are *feræ naturæ*, and therefore the property of nobody, but liable to be feized by the firft occupant. But, as Blackftone obferves, it follows from the very end and conftitution of fociety, that this natural right, as well as many others belonging to man as an individual, may be reftrained by pofitive laws enacted for reafons of ftate, or for the fuppofed benefit of the community. This reftriction may be either with refpect to the *place* in which this right may or may not be exercifed; with refpect to the *animals* that are the fubjects of this right; or with refpect to the *perfons* allowed or forbidden to exercife it. And, in confequence of this authority, we find that the municipal laws of many nations have exerted fuch power of reftraint; have in general forbidden the entering on another man's grounds, for any caufe, without the owner's leave; have extended their protection to fuch particular animals as are ufually the objects of purfuit; and have invefted the prerogative of hunting and taking fuch animals in the fovereign of the ftate only, and fuch as he fhall authorize. Many reafons have concurred for making thefe conftitutions: as, 1. For the encouragement of agriculture and improvement of lands, by giving every man an exclufive dominion over his own foil. 2. For the prefervation of the feveral fpecies of thefe animals, which would foon be extirpated by a general liberty. 3. For prevention of idlenefs and diffipation in hufbandmen, artificers, and others of lower rank; which would be the unavoidable confequence of univerfal licence. 4. For prevention of popular infurrections and refiftance to the government, by difarming the bulk of the people: which laft is a reafon oftener meant than avowed, by the makers of foreft or game laws. Nor, certainly, in thefe prohibitions is there any *natural* injuftice, as fome have weakly enough fuppofed: fince, as Puffendorf obferves, the law does not hereby take from any man his prefent property, or what was already his own; but barely abridges him of one means of acquiring a future property, that of occupancy; which indeed the law of nature would allow him, but of which the laws of fociety have in moft inftances very juftly and reafonably deprived him.

Yet, however defenfible thefe provifions in general may be on the footing of reafon, or juftice, or civil policy, we muft notwithftanding acknowledge, that, in their prefent fhape, they owe their immediate original to flavery. It is not till after the irruption of the northern nations into the Roman empire, that we read of any other prohibitions than that natural one

of not ſporting on any private grounds without the owner's leave.

With regard to the riſe and origin of our preſent civil prohibitions it will be found, that all foreſt and game laws were introduced into Europe at the ſame time, and by the ſame policy, as gave birth to the feodal ſyſtem; when thoſe ſwarms of barbarians iſſued from their northern hive, and laid the foundation of moſt of the preſent kingdoms of Europe on the ruins of the weſtern empire. For, when a conquering general came to ſettle the economy of a vanquiſhed country, and to part it out among his ſoldiers or feudatories, who were to render him military ſervice for ſuch donations, it behoved him, in order to ſecure his new acquiſitions, to keep the *ruſtici* or natives of the country, and all who were not his military tenants, in as low a condition as poſſible, and eſpecially to prohibit them the uſe of arms. Nothing could do this more effectually than a prohibition of hunting and ſporting: and therefore it was the policy of the conqueror to reſerve this right to himſelf, and ſuch on whom he ſhould beſtow it; which were only his capital feudatories, or greater barons. And accordingly we find, in the feudal conſtitutions, one and the ſame law prohibiting the *ruſtici* in general from carrying arms, and alſo proſcribing the uſe of nets, ſnares, or other engines for deſtroying the game. This excluſive privilege well ſuited the martial genius of the conquering troops, who delighted in a ſport which in its purſuit and ſlaughter bore ſome reſemblance to war. *Vita omnis* (ſays Cæſar, ſpeaking of the ancient Germans) *in venationibus atque in ſtudiis rei militaris conſiſtit.* And Tacitus in like manner obſerves, that *quoties bella non ineunt, multum venatibus, plus per otium tranſigunt.* And indeed, like ſome of their modern ſucceſſors, they had no other amuſement to entertain their vacant hours; they deſpiſing all arts as effeminate, and having no other learning than was couched in ſuch rude ditties as were ſung at the ſolemn carouſals which ſucceeded theſe ancient huntings. And it is remarkable, that, in thoſe nations where the feodal policy remains the moſt uncorrupted, the foreſt or game laws continue in their higheſt rigour. In France, all game was properly the king's; and in ſome parts of Germany it is death for a peaſant to be found hunting in the woods of the nobility.

With us in Britain alſo, hunting has ever been eſteemed a moſt princely diverſion and exerciſe. The whole iſland was repleniſhed with all ſorts of game in the times of the Britons, who lived in a wild and paſtoral manner, without incloſing or improving their grounds, and derived much of their ſubſiſtence from the chace, which they all enjoyed in common. But, when huſbandry took place under the Saxon government, and lands began to be cultivated, improved, and incloſed, the beaſts naturally fled into the woody and deſert tracts, which were called the *foreſts*; and, having never been diſpoſed of in the firſt diſtribution of lands, were therefore held to belong to the crown. Theſe were filled with great plenty of game, which our royal ſportſmen reſerved for their own diverſion, on pain of a pecuniary forfeiture for ſuch as interfered with their ſovereign. But every freeholder had the full liberty of ſporting upon his territories, provided he abſtained from the king's foreſts.

However, upon the Norman conqueſt, a new doctrine took place; and the right of purſuing and taking all beaſts of chaſe or *venary*, and ſuch other animals as were accounted *game*, was then held to belong to the king, or to ſuch only as were authorized under him. This obtains as well upon the principles of the feodal law, that the king is the ultimate proprietor of all the lands in the kingdom, they being all held of him as the chief lord, or lord paramount of the fee; and that therefore he has the right of the univerſal ſoil, to enter thereon, and to chaſe and take ſuch creatures at his pleaſure: as alſo upon another maxim of the common law, that theſe animals are *bona vacantia*, and, having no other owner, belong to the king by his prerogative. As, therefore, the former reaſon was held to veſt in the king a *right* to purſue and take them any where, the latter was ſuppoſed to give the king, and ſuch as he ſhould authorize, a *ſole* and *excluſive* right.

This right, thus newly veſted in the crown, was exerted with the utmoſt rigour, at and after the time of the Norman eſtabliſhment, not only in the ancient foreſts, but in the new ones which the conqueror made, by laying together vaſt tracts of country, depopulated for that purpoſe, and reſerved ſolely for the king's royal diverſion; in which were exerciſed the moſt horrid tyrannies and oppreſſions under colour of foreſt-law, for the ſake of preſerving the beaſts of chaſe; to kill any of which within the limits of the foreſt was as penal as the death of a man. And, in purſuance of the ſame principle, king John laid a total interdict upon the *winged* as well as the *fourfooted* creation: *capturam avium per totam Angliam interdixit.* The cruel and inſupportable hardſhips which theſe foreſt-laws created to the ſubject occaſioned our anceſtors to be as zealous for their reformation, as for the relaxation of the feodal rigours and the other exactions introduced by the Norman family; and accordingly we find the immunities of *charta de foreſta* as warmly contended for, and extorted from the king with as much difficulty, as thoſe of *magna charta* itſelf. By this charter, confirmed in parliament 9 Hen. III. many foreſts were diſafforeſted, or ſtripped of their oppreſſive privileges, and regulations were made in the regimen of ſuch as remained; particularly, killing the king's deer was made no longer a capital offence, but only puniſhed by a fine, impriſonment, or abjuration of the realm. And by a variety of ſubſequent ſtatutes, together with the long acquieſcence of the crown without exerting the foreſt-laws, this prerogative is now become no longer a grievance to the ſubject.

But as the king reſerved to himſelf the *foreſts* for his own excluſive diverſion, ſo he granted out from time to time other tracts of lands to his ſubjects under the names of *chaſes* or *parks*; or gave them licence to make ſuch in their own grounds; which indeed are ſmaller foreſts in the hands of a ſubject, but not governed by the foreſt-laws; and by the common law no perſon is at liberty to take or kill any beaſts of chaſe, but ſuch as hath an ancient chaſe or park; unleſs they be alſo beaſts of prey.

As to all inferior ſpecies of game, called *beaſts and fowls of warren*, the liberty of taking or killing them is another franchiſe or royalty derived likewiſe from the crown, and called *free-warren*; a word which ſignifies preſervation or cuſtody: as the excluſive liberty of taking and killing fiſh in a public ſtream or river is called a *free-fiſhery*; of which, however, no new franchiſe can at preſent be granted, by the expreſs proviſion of *magna charta*, c. 16. The principal intention of granting a man theſe franchiſes or liberties was in order to protect the game, by giving him a ſole and excluſive power of killing it himſelf, provided he prevented other perſons. And no man but he who has a chaſe or free-warren, by grant from the crown, or preſcription, which ſuppoſes one, can juſtify hunting or ſporting upon another man's ſoil; nor indeed, in thorough ſtrictneſs of common law, either hunting or ſporting at all.

However novel this doctrine may ſeem, it is a regular conſequence from what has been before delivered, that the ſole right of taking and deſtroying game belongs excluſively to the king. This appears, as well from the hiſtorical deduction here made, as becauſe he may grant to his ſubjects an excluſive right of taking them; which he could not do, unleſs ſuch a right was firſt inherent in himſelf. And hence it will follow, that no perſon whatever, but he who has ſuch derivative right from the crown, is by common law intitled to take or kill any beaſts of chaſe, or other game whatſoever. It is true that, by the acquieſcence of the crown, the frequent grants of free-warren in an-

cient times, and the introduction of new penalties of late by certain ſtatutes for preſerving the game, this excluſive prerogative of the king is little known or conſidered ; every man that is exempted from theſe modern penalties, looking upon himſelf as at liberty to do what he pleaſes with the game : whereas the contrary is ſtrictly true, that no man, however well *qualified* he may vulgarly be eſteemed, has a right to encroach on the royal prerogative by the killing of game, unleſs he can ſhow a particular grant of free-warren ; or a preſcription, which preſumes a grant ; or ſome authority under an act of parliament. As for the latter, there are but two inſtances wherein an expreſs permiſſion to kill game was ever given by ſtatute ; the one by 1 Jac. I. c. 27. altered by 7 Jac. I. c. 11. and virtually repealed by 22 and 23 Car. II. c. 25. which gave authority, ſo long as they remained in force, to the owners of free-warren, to lords of manors, and to all freeholders having 40l. *per annum* in lands of inheritance, or 80l. for life or lives, or 400l. perſonal eſtate (and their ſervants), to take partridges and pheaſants upon their own, or their maſter's free-warren, inheritance, or freehold : the other by 5 Ann. c. 14. which empowers lords and ladies of manors to appoint game-keepers, to kill game for the uſe of ſuch lord or lady ; which with ſome alteration ſtill ſubſiſts, and plainly ſuppoſes ſuch power not to have been in them before. The truth of the matter is, that theſe game-laws do indeed *qualify* nobody, except in the inſtance of a game-keeper, to kill game : but only to ſave the trouble and formal proceſs of an action by the perſon injured, who perhaps too might remit the offence, theſe ſtatutes inflict *additional* penalties, to be recovered either in a regular or ſummary way, by any of the king's ſubjects, from certain perſons of inferior rank who may be found offending in this particular. But it does not follow that perſons excuſed from theſe additional penalties are therefore *authoriſed* to kill game. The circumſtance of having 100l. *per annum*, and the reſt, are not properly qualifications, but exemptions. And theſe perſons, ſo exempted from the penalties of the game-ſtatutes, are not only liable to actions of treſpaſs by the owners of the land ; but alſo, if they kill game within the limits of any royal franchiſe, they are liable to the actions of ſuch who may have the right of chaſe or free-warren therein.

Upon the whole it appears, that the king, by his prerogative, and ſuch perſons as have, under his authority, the ROYAL FRANCHISE OF CHASE, PARK, or *Free*-WARREN, are the *only* perſons who may acquire any property, however fugitive and tranſitory, in theſe animals *feræ naturæ*, while living ; which is ſaid to be veſted in them *propter privilegium*. And it muſt alſo be obſerved, that ſuch perſons as may thus lawfully hunt, fiſh, or fowl, *ratione privilegii*, have only a qualified property in theſe animals : it not being abſolute or permanent, but laſting only ſo long as the creatures remain within the limits of ſuch reſpective franchiſe or liberty, and ceaſing the inſtant they voluntarily paſs out of it. It is held indeed, that if a man ſtarts any game within his own grounds, and follows it into another's, and kills it there, the property remains in himſelf. And this is grounded on reaſon and natural juſtice : for the property conſiſts in the poſſeſſion ; which poſſeſſion commences by the finding it in his own liberty, and is continued by the immediate purſuit. And ſo, if a ſtranger ſtarts game in one man's chaſe or free-warren, and hunts it into another liberty, the property continues in the owner of the chaſe or warren ; this property ariſing from privilege, and not being changed by the act of a mere ſtranger. Or, if a man ſtarts game on another's private grounds, and kills it there, the property belongs to him in whoſe ground it was killed, becauſe it was alſo ſtarted there ; this property ariſing *ratione ſoli*. Whereas if, after being ſtarted there, it is killed in the grounds of a third perſon, the property belongs not to the owner of the firſt ground, becauſe the property is local ; nor yet to the owner of the ſecond, becauſe it was not ſtarted in his ſoil ; but it veſts in the perſon who ſtarted and killed it, though guilty of a treſpaſs againſt both the owners. See the article *Game*-LAWS.

GAME-*Cock*, a fighting cock, or one kept for ſport ; a barbarous practice, which is a diſgrace to any civilized nation. See COCK-*Fighting*.

GAMELIA, in Grecian antiquity, a nuptial feaſt, or rather ſacrifice, held in the ancient Greek families on the day before a marriage ; thus called from a cuſtom they had of ſhaving themſelves on this occaſion, and preſenting their hair to ſome deity to whom they had particular obligations.

GAMELION, in the ancient chronology, was the eighth month of the Athenian year, containing 29 days, and anſwering to the latter part of our January and beginning of February. It was thus called, as being, in the opinion of the Athenians, the moſt proper ſeaſon of the year for marriage.

GAMING, the art of playing or practiſing any kind of game, particularly thoſe of chance, as cards, dice, tables, &c. Gaming has at all times been looked upon as a thing of pernicious conſequence to the commonwealth, and is therefore ſeverely prohibited by law. Its tendency is to promote public idleneſs, theft, and debauchery among thoſe of a lower claſs ; and, among perſons of a ſuperior rank, it has frequently occaſioned the ſudden ruin and deſolation of ancient and opulent families, an abandoned proſtitution of every principle of honour and virtue, and too often hath ended in ſuicide. To reſtrain this pernicious vice among the inferior ſort of people, the ſtatute 33 Hen. VIII. c. 9. was made ; which prohibits, to all but gentlemen, the games of tennis, tables, cards, dice, bowls, and other unlawful diverſions there ſpecified, unleſs in the time of Chriſtmas, under pecuniary pains and impriſonment. And the ſame law, and alſo the ſtatute 23 Geo. II. c. 24. inflict pecuniary penalties, as well upon the maſter of any public houſe wherein ſervants are permitted to game, as upon the ſervants themſelves who are found to be gaming there. But this is not the principal ground of modern complaint : it is the gaming in high life that demands the attention of the magiſtrate. By ſtat. 16 Car. II. c. 7. if any perſon by playing or betting ſhall loſe more than 100l. at one time, he ſhall not be compellable to pay the ſame ; and the winner ſhall forfeit treble the value, one moiety to the king, the other to the informer. The ſtatute 9 Ann. c. 14. enacts, that all bonds and other ſecurities given for money won at play, or money lent at the time to play withal, ſhall be utterly void : that all mortgages and incumbrances of lands made upon the ſame conſideration ſhall be and enure to the heir of the mortgager : that, if any perſon at one time loſes 10l. at play, he may ſue the winner, and recover it back by action of debt at law ; and, in caſe the loſer does not, any other perſon may ſue the winner for treble the ſum ſo loſt ; and the plaintiff in either caſe may examine the defendant himſelf upon oath : and that in any of theſe ſuits no privilege of parliament ſhall be allowed. The ſtatute farther enacts, that if any perſon cheats at play, and at one time wins more than 10l. or any valuable thing, he may be indicted thereupon, and ſhall forfeit five times the value, ſhall be deemed infamous, and ſuffer ſuch corporal puniſhment as in caſe of wilful perjury. By ſeveral ſtatutes of the reign of king George II. all private lotteries by tickets, cards, or dice (and particularly the games of faro, baſſet, ace of hearts, hazard, paſſage, rolly polly, and all other games with dice, except backgammon), are prohibited under a penalty of 200l. for him that ſhall erect ſuch lotteries, and 50l. a-time for the players. Public lotteries, unleſs by authority of parliament, and all manner of ingenious devices under the denomination of *ſales* or otherwiſe, which in the end are equivalent to lotteries, were before prohibited by a great variety of ſtatutes under heavy pecuniary penalties. But particular-

descriptions will ever be lame and deficient, unlefs all games of mere chance are at once prohibited; the invention of fharpers being fwifter than the punifhment of the law, which only hunts them from one device to another. The ftat. 13 Geo. II. *c.* 19. to prevent the multiplicity of horfe races, another fund of gaming, directs, that no plates or matches under 50l. value fhall be run, upon penalty of 200l. to be paid by the owner of each horfe running, and 100l. by fuch as advertife the plate. By ftatute 18 Geo. II. *c.* 34. the ftatute 9 Ann. is farther enforced, and fome deficiencies fupplied: the forfeitures of that act may now be recovered in a court of equity; and, moreover, if any man be convicted, upon information or indictment, of winning or lofing at any fitting 10l. or 20l. within 24 hours, he fhall forfeit five times the fum. Thus careful has the legiflature been to prevent this deftructive vice: which may fhow that our laws againft gaming are not fo deficient as ourfelves and our magiftrates in putting thofe laws in execution.

Chance, in GAMING. Chance is a matter of mathematical confideration, becaufe it admits of more and lefs. Gamefters either fet out upon an equality of chance, or are fuppofed to do fo. This equality may be altered in the courfe of the game, by the greater good-fortune or addrefs of one of the gamefters, whereby he comes to have a better chance, fo that his fhare in the ftakes is proportionably better than at firft. This more and lefs runs through all the ratios between equality and infinite difference, or from an infinitely little difference till it come to an infinitely great one, whereby the game is determined. The whole game, therefore, with regard to the iffue of it, is a chance of the proportion the two fhares bear to each other.

The probability of an event is greater or lefs, according to the number of chances by which it may happen, compared with the number of all the chances by which it may either happen or fail. M. de Moivre, in a treatife *de Menfura Sortis*, has computed the variety of chances in feveral cafes that occur in gaming, the laws of which may be underftood by what follows. Suppofe p the number of cafes in which an event may happen, and q the number of cafes wherein it may not happen, both fides have the degree of probability which is to each other as p to q. If two gamefters, A and B, engage on this footing—that, if the cafes p happen, A fhall win; but if q happen, B fhall win, and the ftake be a—the chance of A will be $\frac{pa}{q+p}$, and that of B $\frac{qa}{p+q}$; confequently, if they fell the expectancies, they fhould have that for them refpectively.

If A and B play with a fingle die, on this condition, that, if A throw two or more aces at eight throws, he fhall win: otherwife B fhall win:—What is the ratio of their chances? Since there is but one cafe wherein an ace may turn up, and five wherein it may not, let $a=1$ and $b=5$:—and again, fince there are eight throws of the die, let $n=8$; and you will have $\overline{a+b}|^n - b^n - nab^n - 1$, to $b^n + nab^n - 1$: that is, the chance of A will be to that of B as 663991 to 1015625, or nearly as 2 to 3.

A and B are engaged at fingle quoits, and, after playing fome time, A wants 4 of being up, and B 6; but B is fo much the better gamefter, that his chance againft A upon a fingle throw would be as 3 to 2:—What is the ratio of their chances? Since A wants 4 and B 6, the game will be ended at nine throws; therefore, raife $a+b$ to the ninth power, and it will be $a^9 + 9a^8b + 36a^7bb + 84a^6b^3 + 126a^5b^4 + 126a^4b^5$, to $84a^3b + 36aab^7 + 6ab^3 + b^9$: call a 3, and b 2, and you will have the ratio of chances in numbers, viz. 1759077 to 194048.

A and B play at fingle quoits, and A is the beft gamefter, fo that he can give B 2 in 3:—What is the ratio of their chances at a fingle throw? Suppofe the chances as z to 1, and raife $z+1$ to its cube, which will be z^3+3z^2+3z+1. Now fince A could give B 2 out of 3, A might undertake to win three throws running; and confequently the chances in this cafe will be as z^3 to $3z^2+3z+1$. Hence $z^3=3z^2+3z+1$: or $2z^3 = z^3+3z^2-3z+1$. And therefore $z\sqrt[3]{2}=z+1$; and, confequently, $z=\frac{1}{\sqrt[3]{2}-1}$. The chances, therefore, are $\frac{1}{\sqrt[3]{2}-1}$, and 1, refpectively.

Again, fuppofe I have two wagers depending, in the firft of which I have 3 to 2 the beft of the lay, and in the fecond 7 to 4:—What is the probability I win both wagers? 1. The probability of winning the firft is $\frac{3}{5}$, that is the number of chances I have to win, divided by the number of all the chances: the probability of winning the fecond is $\frac{7}{11}$: therefore, multiplying thefe two fractions together, the product will be $\frac{21}{55}$, which is the probability of winning both wagers. Now this fraction being fubtracted from 1, the remainder is $\frac{34}{55}$, which is the probability I do not win both wagers: therefore the odds againft me are 34 to 21. 2. If I would know what the probability is of winning the firft and lofing the fecond, I argue thus: the probability of winning the firft is $\frac{3}{5}$, the probability of lofing the fecond is $\frac{4}{11}$: therefore multiplying $\frac{3}{5}$ by $\frac{4}{11}$, the product $\frac{12}{55}$ will be the probability of my winning the firft and lofing the fecond; which being fubtracted from 1, there will remain $\frac{43}{55}$, which is the probability I do not win the firft, and at the fame time lofe the fecond. 3. If I would know what the probability is of winning the fecond, and at the fame time lofing the firft, I fay thus: the probability of winning the fecond is $\frac{7}{11}$; the probability of lofing the firft is $\frac{2}{5}$: therefore, multiplying thefe two fractions together, the product $\frac{14}{55}$ is the probability I win the fecond, and alfo lofe the firft. 4. If I would know what the probability is of lofing both wagers, I fay: the probability of lofing the firft is $\frac{2}{5}$, and the probability of lofing the fecond $\frac{4}{11}$: therefore the probability of lofing them both is $\frac{3}{51}$: which being fubtracted from 1, there remains $\frac{47}{55}$: therefore, the odds of lofing both wagers is 47 to 8.

This way of reafoning is applicable to the happening or failing of any events that may fall under confideration. Thus if I would know what the probability is of miffing an ace four times together with a die, this I confider as the failing of four different events. Now the probability of miffing the firft is $\frac{5}{6}$, the fecond is alfo $\frac{5}{6}$, the third $\frac{5}{6}$, and the fourth $\frac{5}{6}$; therefore the probability of miffing it four times together is $\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}=\frac{625}{1296}$; which being fubtracted from 1, there will remain $\frac{671}{1296}$ for the probability of throwing it once or oftener in four times: therefore the odds of throwing an ace in four times is 671 to 625.

But, if the flinging of an ace was undertaken in three times, the probability of miffing it three times would be $\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}=\frac{125}{296}$; which being fubtracted from 1, there will remain $\frac{91}{216}$ for the probability of throwing it once or oftener in three times: therefore the odds againft throwing it in three times are 125 to 91. Again, fuppofe we would know the probability of throwing an ace once in four times, and no more: fince the probability of throwing it the firft time is $\frac{1}{6}$, and of miffing it the other three times is $\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}$, it follows that the probability of throwing it the firft time, and miffing it the other three fucceffive times, is $\frac{1}{6}\times\frac{5}{6}\times\frac{5}{6}\times\frac{5}{6}=\frac{125}{2296}$; but, becaufe it is poffible to hit every throw as well as the firft, it follows, that the probability of throwing it once in four throws, and miffing it the other three, is $\frac{4\times125}{1296}=\frac{500}{1296}$; which being fubtracted from 1, there will remain $\frac{796}{1296}$ for the probability of throwing it once, and no more, in four times. Therefore, if one undertake to throw an ace once, and no more, in four times, he has 500 to 796 the worft of the lay, or very near 5 to 8.

Suppofe two events are fuch, that one of them has twice as many chances to come up as the other; what is the probability

that the event which has the greater number of chances to come up does not happen twice before the other happens once, which is the cafe of flinging 7 with two dice before 4 once? Since the number of chances is as 2 to 1, the probability of the firft happening before the fecond is $\frac{2}{3}$, but the probability of its happening twice before it is but $\frac{2}{3} \times \frac{2}{3}$ or $\frac{4}{9}$: therefore it is 5 to 4 feven does not come up twice before four once.

But, if it were demanded what muft be the proportion of the facilities of the coming up of two events, to make that which has the moft chances come up twice before the other comes up once? The anfwer is, 12 to 5 very nearly: whence it follows, that the probability of throwing the firft before the fecond is $\frac{12}{17}$, and the probability of throwing it twice is $\frac{12}{17} \times \frac{12}{17}$, or $\frac{144}{289}$; therefore the probability of not doing it is $\frac{145}{289}$: therefore the odds againft it are as 145 to 144, which comes very near an equality.

Suppofe there is a heap of thirteen cards of one colour, and another heap of thirteen cards of another colour:—What is the probability, that, taking one card at a venture out of each heap, I fhall take out the two aces? The probability of taking the ace out of the firft heap is $\frac{1}{13}$, the probability of taking the ace out of the fecond heap is $\frac{1}{13}$; therefore the probability of taking out both aces is $\frac{1}{13} \times \frac{1}{13} = \frac{1}{169}$, which being fubtracted from 1, there will remain $\frac{168}{169}$: therefore the odds againft me are 168 to 1.

In cafes where the events depend on one another, the manner of arguing is fomewhat altered. Thus, fuppofe that, out of one fingle heap of thirteen cards of one colour, I fhould undertake to take out firft the ace; and, fecondly, the two: though the probability of taking out the ace be $\frac{1}{13}$, and the probability of taking out the two be likewife $\frac{1}{13}$, yet, the ace being fuppofed as taken out already, there will remain only twelve cards in the heap; which will make the probability of taking out the two to be $\frac{1}{12}$; therefore the probability of taking out the ace, and then the two, will be $\frac{1}{13} \times \frac{1}{12}$.

In this laft queftion the two events have a dependence on each other; which confifts in this, that, one of the events being fuppofed as having happened, the probability of the other's happening is thereby altered. But the cafe is not fo in the two heaps of cards.

If the events in queftion be n in number, and be fuch as have the fame number a of chances by which they may happen, and likewife the fame number b of chances by which they may fail, raife $a+b$ to the power n. And if A and B play together, on condition that if either one or more of the events in queftion happen, A fhall win, and B lofe, the probability of A's winning will be $\frac{\overline{a+b}|^{n} - b^{n}}{\overline{a+b}|^{n}}$: and that of B's winning will be $\frac{b^{n}}{\overline{a+b}|^{n}}$: for when $a+b$ is actually raifed to the power n, the only term in which a does not occur is the laft b^{n}: therefore all the terms but the laft are favourable to A.

Thus if $n=3$, raifing $a+b$ to the cube $a^{3}+3a^{2}b+3ab^{2}+b^{3}$, all the terms but b^{3} will be favourable to A; and therefore the probability of A's winning will be $\frac{a^{3}+3a^{2}b+3ab^{2}}{\overline{a+b}|^{3}}$, or $\frac{\overline{a+b}|^{3}-b^{3}}{\overline{a+b}|^{3}}$; and the probability of B's winning will be $\frac{b^{3}}{\overline{a+b}|^{3}}$. But if A and B play on condition, that if either two or more of the events in queftion happen, A fhall win; but in cafe one only happen, or none, B fhall win; the probability of A's winning will be $\frac{\overline{a+b}|^{n} - nab^{n-1} - b^{n}}{\overline{a+b}|^{n}}$; for the only two terms in which aa does not occur, are the two laft, viz. nab^{n-1} and b^{n}.

GAMMONING, among feamen, denotes feveral turns of a rope taken round the bowfprit, and reeved through holes in knees of the head, for the greater fecurity of the bowfprit.

GAMMUT, Gamut, Gam-*ut*, in mufic, a fcale whereon we may learn to found the mufical notes, *ut*, *re*, *mi*, *fa*, *fol*, *la*, in their feveral orders and difpofitions. See Music. The invention of this fcale is owing to Guido Aretin, monk of Arezzo in Tufcany, about the year 1009; though it is not fo properly an invention, as an improvement on the diagram or fcale of the ancients. Several alterations, in fact, have been made in the gammut. M. le Maire, particularly, has added a feventh note, viz. *fi*; and the Englifh ufually throw out both *ut* and *fi*, and make the other five ferve for all.

GANDER, in ornithology, the male of the goofe-kind; one of which, it is faid, will ferve five geefe. See Anas.

GANG-way, is the feveral paffages or ways from one part of the fhip to the other; and whatfoever is laid in any of thofe paffages is faid to lie in the gang-way.

GANGES, a large and celebrated river of India. It has its fource in the mountains which border on Little Thibet, in 96 degrees of longitude and 35. 45. of latitude. It croffes feveral kingdoms, running from north to fouth, and falls into the bay of Bengal by feveral mouths. The waters are loweft in April and May, and higheft before the end of September. It overflows yearly like the Nile, and renders the kingdom of Bengal as fruitful as that of the Delta in Egypt. The people in thefe parts hold the water of this river in high veneration; and it is vifited annually by a prodigious number of pilgrims from all parts of India. The Englifh have feveral fettlements on this river, which will be taken notice of in their proper places. The greateft happinefs that many of the Indians wifh for is to die in this river.

GANGLION, in anatomy, denotes a knot frequently found in the courfe of the nerves, and which is not morbid; for wherever any nerve fends out a branch, or receives one from another, or where two nerves join together, there is generally a ganglion or plexus, as may be feen at the beginning of all the nerves of the medulla fpinalis, and in many other parts of the body.

Ganglion, in furgery, a hard tubercle, generally moveable, in the external or internal part of the carpus, upon the tendons or ligaments in that part; ufually without any pain to the patient.

GANGRENE, a very great and dangerous degree of inflammation, wherein the parts affected begin to corrupt, and put on a ftate of putrefaction. See Surgery.

GANNET, or Soland *Goofe*, in ornithology. See Pelicanus.

GANTLET, or Gauntlet, a large kind of glove made of iron, and the fingers covered with fmall plates. It was formerly worn by the cavaliers, when armed at all points. The word is derived of the French *gantelet*, and that from *gand* or *gant*, "glove." The cafque and gauntlets were always borne in the ancient marches in ceremony. Gauntlets were not introduced till about the 13th century. The gauntlet was frequently thrown, like the glove, by way of challenge.

GANTLOPE. See Gauntlope.

GANYMEDE, in mythology, a beautiful youth of Phrygia, fon of Tros and brother to Ilus; according to Lucian, he was the fon of Dardanus. Jupiter was charmed with him; and, carrying him away, made him his cup-bearer in the room of Hebe. Some fay that he caufed him to be carried away by an eagle, and others affirm he was himfelf the ravifher under the form of that bird. He deified this youth; and, to comfort his father, made a prefent to him of fome of thofe very fwift horfes that the gods rode upon.

GAOL (*Geol*, Welch—*Geole*, Fr.), is ufed metaphorically for a

prison. It is a strong place or house for keeping of debtors, &c. and wherein a man is restrained of his liberty to answer an offence done against the laws: and every county hath two gaols; one for debtors, which may be any house where the sheriff pleases; the other for the peace and matters of the crown, which is the county gaol. If a gaol be out of repair or insufficient, &c. justices of peace, in their quarter sessions, may contract with workmen for the rebuilding or repairing it; and by their warrant order the sum agreed on for that purpose to be levied on the several hundreds and other divisions in the county by a just rate, 11 & 12 Will. III. c. 19. See Prison.

Gaol-*Delivery*. The administration of justice being originally in the crown, in former times our kings in person rode through the realm once in seven years, to judge of and determine crimes and offences; afterwards justices in eyre were appointed; and since, justices of assise and gaol-delivery, &c. A commission of gaol-delivery is a patent in nature of a letter from the king to certain persons, appointing them his justices, or two or three of them, and authorising them to deliver his gaol at such a place of the prisoners in it: for which purpose it commands them to meet at such a place, at the time they themselves shall appoint; and informs them, that, for the same purpose, the king hath commanded his sheriff of the same county to bring all the prisoners of the gaol and their attachments before them at the day appointed. The justices of gaol-delivery are empowered by the common law to proceed upon indictments of felony, trespass, &c. and to order to execution or reprieve: they may likewise discharge such prisoners as on their trials are acquitted, and those against whom, on proclamation being made, no evidence has appeared: they have authority to try offenders for treason, and to punish many particular offences, by statute 2 *Hawk.* 24. 2 *Hale's Hist. Placit. Cor.* 35.

GAOLER, the keeper of a gaol or prison. Sheriffs are to make such gaolers for whom they will be answerable: but if there be any default in the gaoler, an action lies against him for an escape, &c. yet the sheriff is most usually charged.—2 Inst. 592. Where a gaoler kills a prisoner by hard usage, it is felony.—3 Inst. 52. No fee shall be taken by gaolers, but what is allowed by law and settled by the judges, who may determine petitions against their extortions, &c. 2 Geo. II. c. 22.

GAONS, a certain order of Jewish doctors, who appeared in the East after the closing of the talmud. The word *Gaons* signifies "excellent, sublime;" as in the divinity-schools we formerly had Irrefragable, Sublime, Resolute, Angelic, and Subtile doctors. The Gaons succeeded the Seburæans or Opiners about the beginning of the sixth century. Chanan Meischtia was the head and first of the excellents. He restored the academy of Pandebita, which had been shut up for 30 years.

GAR-fish, Horn-*fish*, or *Sea-needle*. See Esox.

GARAMOND (Claude), a very ingenious letter-founder, was born at Paris, where he began in the year 1510 to found his printing types free from all the remains of the Gothic, or (as it is generally called) the *black letter*, and brought them to such perfection, that he had the glory of surpassing all who went before him, and of being scarcely ever excelled by his successors in that useful art. His types were prodigiously multiplied, both by the great number of matrices he struck, and the types formed in resemblance of his in all parts of Europe. Thus in Italy, Germany, England, and Holland, the booksellers, by way of recommending their books, distinguished the type by his name; and, in particular, the small Roman was by way of excellence known among the printers of these nations by the name of *Garamond's small Roman*. By the special command of king Francis I. he founded three sizes of Greek types for the use of Robert Stephens, who with them printed all his beautiful editions of the New Testament and other Greek authors. He died at Paris in 1561.

GARASSE (Francis), a remarkable jesuitical writer, the first author of that irreconcilable enmity that still subsists between the Jesuits and Jansenists in the church of Rome, was born at Angoulesme in 1585, and entered the Jesuits' college in 1600. As he had a quick imagination, a strong voice, and a peculiar turn to wit, he became a popular preacher in the chief cities of France; but, not content with this honour, he distinguished himself still more by his writings, which were bold, licentious, and produced much controversy. The most considerable in its consequences was intitled *La somme theologique des veritez capitales de la religion Chretienne*; which was first attacked by the abbot of St. Cyran, who, observing in it a prodigious number of falsifications of the Scriptures and of the Fathers, besides many heretical and impious opinions, conceived the honour of the church required him to undertake a refutation. Accordingly he published a full answer to it, while Garasse's book was also under examination of the doctors of the Sorbonne, by whom it was afterwards condemned. Garasse replied to St. Cyran; but the two parties of Jesuits and Jansenists, of whom these were respectively the champions, grew to an implacable animosity against each other, that is not even now likely to subside. The Jesuits were forced to remove their brother to a distance from Paris; where, probably weary of his inactive obscurity, when the plague raged at Poictiers in 1631, he begged leave of his superior to attend the sick, in which charitable office he caught the disorder and died.

GARBE, in heraldry, a sheaf of any kind of grain, borne in several coats of arms, and said to represent summer, as a bunch of grapes does autumn.

GARBLE, a word used to signify the action of separating the dross and dust from spice, drugs, &c. *Garbling* is the cleansing and purifying the good from the bad, and may come from the Italian *garbo*, i. e. finery or neatness; and hence, probably, we say, when we see a man in a neat habit, that he is in a handsome *garb*.

GARCILASSO (de la Vega), a celebrated Spanish poet, born of a noble family at Toledo in 1500. He was educated near the emperor Charles V. who had a particular regard for him, and whom he attended in all his military expeditions; acquiring as much renown by his courage as by his poetry. In Provence he commanded a battalion, and was killed, in the 36th year of his age, by a stone thrown at his head by a countryman from a turret. He had strong natural talents for poetry, and not only extended the bounds, but introduced new beauties into that of the Spanish language. We must not confound this poet with another person of the same name, a native of Cusco, who wrote in Spanish a History of Florida, and of Peru and the Incas.

GARCINIA, in botany; a genus of the monogynia order, belonging to the dodecandria class of plants, and in the natural method ranking under the 18th order, *Bicornes*. The calyx is tetraphyllous inferior; there are four petals; the berry is octospermous, and crowned with a shield-like stigma. There is but one species, the mangostana, a tree of great elegance, and producing the most pleasant fruit of any yet known. See Plate 34.

This tree has been very accurately described by Dr. Garcin, in honour of whom, as its most accurate describer, Linnæus gave it the name *Garcinia*, in the 35th volume of the Philosophical Transactions. It grows, he informs us, to about 17 or 18 feet high, "with a straight taper stem like a fir," having a regular tuft in form of an oblong cone, composed of many branches and twigs, spreading out equally on all sides without leaving any hollow. Its leaves, he observes, are oblong, pointed at both ends, entire, smooth, of a shining green on the upper

ſide, and of an olive on the back. Its flower is compoſed of four petals almoſt round, or a little pointed; their colour reſembles that of a roſe, only deeper and leſs lively. The calyx of this flower is of one piece, expanded, and cut into four lobes. The two upper lobes are ſomething larger than the lower ones; they are greeniſh on the outſide, and of a fine deep red within: the red of the upper ones is more lively than that of the lower ones. This calyx incloſes all the parts of the flower; it is ſupported by a pedicle, which is green, and conſtantly comes out of the end of a twig above the laſt pair of leaves. The fruit is round, of the ſize of a ſmall orange, from an inch and an half to two inches diameter. The body of this fruit is a capſula of one cavity, compoſed of a thick rind a little like that of a pomegranate, but ſofter, thicker, and fuller of juice. Its thickneſs is commonly of a quarter of an inch. Its outer colour is of a dark brown purple, mixed with a little grey and dark green. The inſide of the peel is of a roſe colour, and its juice is purple. Laſt of all, this ſkin is of a ſtyptic or aſtringent taſte, like that of a pomegranate; nor does it ſtick to the fruit it contains. The inſide of this fruit is a furrowed globe, divided into ſegments, much like thoſe of an orange, but unequal in ſize, which do not adhere to each other. The number of theſe ſegments is always equal to that of the rays of the top which covers the fruit. The fewer there are of theſe ſegments, the bigger they are. There are often in the ſame fruit ſegments as big again as any of thoſe that are on the ſide of them. Theſe ſegments are white, a little tranſparent, fleſhy, membranous, full of juice like cherries or raſberries, of a taſte of ſtrawberries and grapes together. Each of the ſegments incloſes a ſeed of the figure and ſize of an almond ſtripped of its ſhell, having a protuberance on one of its ſides. Theſe ſeeds are covered with two ſmall ſkins, the outermoſt of which ſerves for a baſis to the filaments and membranes of which the pulp is compoſed. The ſubſtance of theſe ſeeds comes very near to that of cheſnuts, as to their conſiſtency, colour, and aſtringent quality.

"This tree (according to our author) originally grows in the Molucca iſlands, where it is called *mangoſtan*, but has been tranſplanted from thence to the iſlands of Java and Malacca, at which laſt place it thrives very well. Its tuft is ſo fine, ſo regular, ſo equal, and the appearance of its leaves ſo beautiful, that it is at preſent looked upon at Batavia as the moſt proper for adorning a garden and affording an agreeable ſhade. There are few ſeeds, however (he obſerves), to be met with in this fruit that are good for planting, moſt part of them being abortive." He concludes his deſcription by mentioning, that one may eat a great deal of this fruit without any inconvenience; and that it is the only one which ſick people may be allowed to eat without any ſcruple.

Other writers concur in their praiſes of this fruit. Rumphius obſerves, that the mangoſtan is univerſally acknowledged to be the beſt and wholeſomeſt fruit that grows in India; that its fleſh is juicy, white, almoſt tranſparent, and of as delicate and agreeable a flavour as the richeſt grapes; the taſte and ſmell being ſo grateful, that it is ſcarce poſſible to be cloyed with eating it. He adds, that when ſick people have no reliſh for any other food, they generally eat this with great delight; but, ſhould they refuſe it, their recovery is no longer expected. "It is remarkable (ſays he) that the mangoſtan is given with ſafety in almoſt every diſorder. The dried bark is uſed with ſucceſs in the dyſentery and teneſmus; and an infuſion of it is eſteemed a good gargle for a ſore mouth or ulcers in the throat. The Chineſe dyers uſe this bark for the ground or baſis of a black colour, in order to fix it the firmer."

According to Captain Cook, in his Voyage round the World, vol. iii. p. 737, the garcinia mangoſtana of Linnæus is peculiar to the Eaſt Indies. It is about the ſize of the crab-apple, and of a deep red-wine colour. On the top of it is the figure of five or ſix ſmall triangles joined in a circle; and at the bottom ſeveral hollow green leaves, which are remains of the bloſſom. When they are to be eaten, the ſkin or rather fleſh muſt be taken off; under which are found ſix or ſeven white kernels, placed in a circular order; and the pulp with which theſe are enveloped is the fruit, than which nothing can be more delicious. It is a happy mixture of the tart and the ſweet, which is no leſs wholeſome than pleaſant; and, as well as the ſweet orange, is allowed in any quantity to thoſe who are afflicted with fevers either of the putrid or inflammatory kind.

GARCON, or Garsoon, a French term, literally ſignifying a boy or male child any time before his marriage. It is alſo applied to certain inferior officers, among us called *grooms*, *garçiones*. Thus all the ſervants in the French king's chambers, wardrobe, &c. who held the leſſer offices thereof under the proper officers, were called *garçons de la chambre*, *de la garderobe*, &c.

GARDANT, or Guardant, in heraldry, denotes any beaſt full-faced and looking right forward.

GARDEN, a piece of ground properly laid out, cultivated, and ornamented with a variety of plants, flowers, fruits, &c. See the next article.

GARDENING,

THE art of planning and cultivating gardens. Conſidered in its utmoſt extent, whatever contributes to render the ſcenes of vegetable nature delightful, forms a part of gardening; but in its more limited ſenſe, it denotes the cultivation of gardens for the ſake of their produce; and in this view, as being by far the moſt important, we mean to treat of it.

Gardens are uſually diſtinguiſhed into *flower*-garden, *fruit*-garden, and *kitchen*-garden. The firſt of theſe, being deſigned for pleaſure and ornament, is to be placed in the moſt conſpicuous part, that is, next to the back-front of the houſe; and the two latter, being deſigned for uſe, ſhould be placed leſs in ſight. But though the fruit and kitchen gardens are here mentioned as two diſtinct gardens, yet they are now uſually in one; and that with good reaſon, ſince they both require a good ſoil and expoſure, and equally require to be placed out of the view of the houſe.

In the choice of a place proper for a garden, the moſt eſſential points to be conſidered are, the ſituation, the ſoil, the expoſure, water, and proſpect.

1ſt, As to the ſituation, it ought to be ſuch a one as is wholeſome, and in a place neither too high nor too low; for, if a garden be too high, it will be expoſed to the winds, which are very prejudicial to trees; and if it be too low, the dampneſs, the vermin, and the venomous creatures that breed in ponds and marſhy places, add much to their inſalubrity. The moſt happy ſituation is on the ſide of a hill, eſpecially if the ſlope be eaſy, and in a manner imperceptible; if a good deal of level ground be near the houſe; and if it abounds with ſprings of

water: for, being ſheltered from the fury of the winds, and the violent heat of the ſun, a temperate air will be there enjoyed; and the water that deſcends from the top of the hill, either from ſprings or rain, will not only ſupply fountains, canals, and caſcades for ornament, but, when it has performed its office, will water the adjacent valleys, and, if it be not ſuffered to ſtagnate, will render them fertile and wholeſome.

2dly, A good earth or ſoil is next to be conſidered; for it is ſcarce poſſible to make a fine garden in a bad ſoil. There are indeed ways to meliorate ground, but they are very expenſive; and ſometimes, when the expence has been beſtowed of laying good earth three feet deep over the whole ſurface, a whole garden has been ruined, when the roots of the trees have come to reach the natural bottom. To judge of the quality of the ſoil, obſerve whether there be any heath, thiſtles, or ſuch like weeds, growing ſpontaneouſly in it; for they are certain ſigns that the ground is poor. Or, if there be large trees growing thereabouts, obſerve whether they grow crooked, ill-ſhaped, and grubby, and whether they are of a faded green, and full of moſs, or infeſted with vermin: if this be the caſe, the place is to be rejected. But, on the contrary, if it be covered with good graſs fit for paſture, you may then be encouraged to try the depth of the ſoil. To know this, dig holes in ſeveral places, ſix feet wide and four deep; and if you find three feet of good earth it will do very well, but leſs than two will not be ſufficient. The quality of good ground is, neither to be ſtony nor too hard to work; neither too dry, too moiſt, nor too ſandy and light; nor too ſtrong and clayey, which is the worſt of all for gardens.

3dly, The next requiſite is water; the want of which is one of the greateſt inconveniencies that can attend a garden, and will bring a certain mortality upon whatever is planted in it, eſpecially in the greater droughts that often happen in a hot and dry ſituation in ſummer; beſides its uſefulneſs in fine gardens for making fountains, canals, caſcades, &c. which are the greateſt ornaments of a garden.

4thly, The laſt thing to be conſidered is the proſpect of a fine country; and though this is not ſo abſolutely neceſſary as water, yet it is one of the moſt agreeable beauties of a fine garden: beſides, if a garden be planted in a low place that has no kind of proſpect, it will not only be diſagreeable but unwholeſome.

In the laying out and planting of gardens, the beauties of nature ſhould always be ſtudied; for the nearer a garden approaches to nature, the longer it will pleaſe. According to Mr. Miller, the area of a handſome garden may take up 30 or 40 acres, but not more; and the following rules ſhould be obſerved in the diſpoſition of it. There ought always to be a deſcent of at leaſt three ſteps from the houſe to the garden; this will render the houſe more dry and wholeſome, and the proſpect on entering the garden more extenſive. The firſt thing that ought to preſent itſelf to view ſhould be an open lawn of graſs, which ought to be conſiderably broader than the front of the building; and, if the depth be one-half more than the width, it will have a better effect: if on the ſides of the lawn there are trees planted irregularly, by way of open groves, the regularity of the lawn will be broken, and the whole rendered more like nature. For the convenience of walking in damp weather, this lawn ſhould be ſurrounded with a gravel-walk, on the outſide of which ſhould be borders, three or four feet wide, for flowers: and from the back of theſe the proſpect will be agreeably terminated by a ſlope of ever-green ſhrubs; which, however, ſhould never be ſuffered to exclude agreeable proſpects or the view of handſome buildings. Theſe walks may lead through the different plantations, gently winding about in an eaſy natural manner; which will be more agreeable than either thoſe long ſtraight walks, too frequently ſeen in gardens, or thoſe ſerpentine windings that are twiſted about into ſo many ſhort turns as to render it difficult to walk in them; and as no garden can be pleaſing where there is a want of ſhade and ſhelter, theſe walks ſhould lead as ſoon as poſſible into plantations, where perſons may walk in private and be ſheltered from the wind.

Narrow rivulets, if they have a conſtant ſtream, and are judiciouſly led about a garden, have a better effect than many of the large ſtagnating ponds or canals ſo frequently made in large gardens. When wilderneſſes are intended, they ſhould not be cut into ſtars and other ridiculous figures, nor formed into mazes or labyrinths, which in a great deſign appear trifling.

In ſhort, the ſeveral parts of a garden ſhould be diverſified; but, in places where the eye takes in the whole at once, the two ſides ſhould be always the ſame. In the buſineſs of deſigns, the aim ſhould be always at what is natural, great, and noble. The general diſpoſition of a garden and of its parts ought to be accommodated to the different ſituations of the ground, to humour its inequalities, to proportion the number and ſorts of trees and ſhrubs to each part, and to ſhut out from the view of the garden no objects that may become ornamental. But theſe extended views of the ſubject are not to our preſent purpoſe.

A practical attention to a garden is by no means to be eſteemed a degrading employment. It is true, indeed, that paſtoral and agricultural manners, if we may form a judgment from the dignified deſcriptions of Virgil, are greatly degenerated. The employments of ſhepherds and huſbandmen are now become mean and ſordid. The work of the garden is uſually left to a peaſant. Nor is it unnatural to aſſign that labour, which wearies without amuſement, to thoſe who are ſufficiently amuſed by the proſpect of their wages. But the operations of graſting, of inoculating, of pruning, of tranſplanting, are curious experiments in natural philoſophy; and that they are pleaſing as well as curious, thoſe can teſtify who remember what they felt on ſeeing their attempts in the amuſement of practical gardening attended with ſucceſs. Among the employments ſuitable to old age, Cicero has enumerated the ſuperintendence of a garden. It requires no great exertion of mind or body; and its ſatisfactions are of that kind which pleaſe without violent agitation. Its beneficial influence on health is an additional reaſon for an attention to it at an age when infirmities abound.

In almoſt every deſcription of the ſeats of the bleſſed, ideas of a garden ſeem to have predominated. The word Paradiſe itſelf is ſynonymous with garden. The fields of Elyſium, that ſweet region of poeſy, are adorned with all that imagination can conceive to be delightful. Some of the moſt pleaſing paſſages of Milton are thoſe in which he repreſents the happy pair engaged in cultivating their bliſsful abode. Poets have always been delighted with the beauties of a garden. Lucan is repreſented by Juvenal as repoſing in his garden. Virgil's Georgics prove him to have been captivated with rural ſcenes; though, to the ſurpriſe of his readers, he has not aſſigned a book to the ſubject of a garden. Our Shenſtone made it his ſtudy; but, with all his taſte and fondneſs for it, he was not happy in it. The captivating ſcenes which he created at the Leaſowes afforded him, it is ſaid, little pleaſure in the abſence of ſpectators. The truth is, he made the embelliſhment of his grounds, which ſhould have been the amuſement of his life, the buſineſs of it; and involved himſelf in ſuch troubles by the expences it occaſioned, as neceſſarily excluded tranquil enjoyment.

It is the lot of few, in compariſon, to poſſeſs territories like his, extenſive, and ſufficiently well adapted to conſtitute an ornamented farm. Still fewer are capable of ſupporting the expence of preſerving it in good condition. But let not the rich ſuppoſe they have appropriated the pleaſures of a garden. The poſſeſſor of an acre, or a ſmaller portion, may receive a real pleaſure from obſerving the progreſs of vegetation, even in a

plantation of culinary plants. A very limited tract, properly attended to, will furniſh ample employment for an individual. Nor let it be thought a mean care; for the ſame hand that raiſed the cedar formed the hyſſop on the wall. Even the orchard, cultivated ſolely for advantage, exhibits beauties unequalled in the ſhrubbery; nor can the green-houſe produce an appearance to exceed the bloſſom of the apple and the almond.

We ſhall now proceed to point out what is to be undertaken in the different months of the year, in the kitchen garden, the flower-garden, orchard, &c. firſt obſerving, that the kitchen-garden ought to be ſituated on one ſide of the houſe, near the ſtables, from whence the dung may be eaſily conveyed into it; and after having built the wall, borders ſhould be made under them, which, according to Miller, ought to be eight or ten feet broad. Upon thoſe borders expoſed to the ſouth, many ſorts of early plants may be ſown; and upon thoſe expoſed to the north, you may have ſome late crops, taking care not to plant any ſort of deep-rooting plants, eſpecially beans and peaſe, too near the fruit-trees. You ſhould next proceed to divide the ground into quarters; the beſt figures for theſe are a ſquare or an oblong, if the ground will admit of it; otherwiſe they may be of that ſhape which will be moſt advantageous to the ground. The ſize of theſe quarters ſhould be proportioned to that of the garden; if they are too ſmall, your ground will be loſt in walks, and the quarters being incloſed by eſpaliers of fruit-trees, the plants will draw up ſlender, for want of a more open expoſure. The walks ſhould alſo be proportioned to the ſize of the ground: theſe in a ſmall garden ſhould be ſix feet broad, but in a large one ten; and on each ſide of the walk there ſhould be allowed a border three or four feet wide between it and the eſpalier; and in theſe borders may be ſown ſmall ſallads, or any other herbs that do not take deep root or continue long; but theſe quarters ſhould not be ſown or planted with the ſame thing two years together. In one of theſe quarters, ſituated neareſt to the ſtables, and beſt defended from the cold winds, ſhould be the hot-beds, for early cucumbers, melons, &c. and to theſe there ſhould be a paſſage from the ſtables, and a gate through which a ſmall cart may enter. The moſt important points of general culture conſiſt in well digging and manuring the ſoil, and giving a proper diſtance to each plant, according to their different growths: as alſo in keeping them clear from weeds; for which purpoſe, you ſhould always obſerve to keep your dung-hills free from them, otherwiſe their ſeeds will be conſtantly brought in and ſpread with the dung.

J A N U A R Y.

The Kitchen-Garden.

Aſparagus in this month being one of the greateſt rarities which the art of gardening affords ought to be planted every month, to have a regular ſucceſſion of it till April, as it is above three weeks before it will be fit to cut, and the fourth hotbed ſhould now be made.

Beans of the early Mazagan ſort muſt be planted for the ſecond crop.

Beets and cabbages of every ſort, intended to procure ſeed from, ſhould now be planted, if it were omitted in October.

Carrots to draw young, for the firſt crop, ſhould now be ſown; and thoſe intended for ſeed ſhould be planted.

Cauliflower plants under glaſſes and frames ſhould be covered with pea-ſtraw, or mats, to defend them from the froſt.

Celery ſhould be digged up as ſoon as the froſt begins, for daily uſe, and the other covered with ſtraw.

Creſs, muſtard, radiſh, and rape, ſhould be ſown every week on a hotbed.

Cucumbers for the firſt crop, to come in early in March, ſhould now be ſown. As ſoon as they are three or four days old, put each into a ſmall pot, and every week ſow more to have plenty of plants.

Dung ſhould be wheeled into the kitchen-garden in froſty weather, when other work cannot be done.

Endive ſhould be digged up like the celery as ſoon as the froſt begins, and the reſt covered with ſtraw.

Ground lying vacant ſhould be digged up, if omitted in October, and thrown up into ridges.

Hotbeds and loam ſhould be prepared for aſparagus, cucumbers, and melons.

Lettuces under glaſſes ſhould be examined, and, if they be killed, ſow more on a hotbed.

Mint ſhould be planted in pots, and if you have no hotbeds, it will grow in a warm room.

Muſhroom beds will require regular attendance, and froſt and rain muſt be kept out by dry ſtraw and mats.

Onions, to draw young, ſhould be ſown on a warm border.

Peas under the ſouth wall, for the firſt crop, ſhould have the earth drawn up to them in a dry day, and ſticks placed to them to defend them from the violence of the winds, and ſow the ſecond crop.

Plant aſparagus for the fourth crop.

Beans for the ſecond crop of mazagans.

Beets, cabbages, carrots, parſneps for ſeed.

Mint and potatoes on a hotbed.

Onions for eſcalions and ſeed.

Radiſhes for the ſecond crop, ſow in a warm ſituation, and the firſt crop on a hotbed.

Small ſallading, as creſs, muſtard, rape, radiſhes, ſow every week on a hotbed.

Sow carrots for the firſt crop, and the ſecond of peas.

Sow on hotbeds, carrots and cucumbers for the firſt crop.

Creſs, muſtard, radiſh, and rape for ſallads.

Radiſhes, turneps.

Produce of the Kitchen-Garden.

Beets	Cauliflowers	Rocambole
— red	Celery	Sage
— white	Coleworts	Salſafy
Boorcole or kale	Endive	Savoy cabbages
— purple	Eſchalots	Scorzoneras
— green	Garlic	Skirrets
Brocoli	Horſe-radiſh	Spinach
— purple	Jeruſalem arti-chokes	Sprouts of
— white		— Cabbages
— green	Leeks	— Savoys
Cabbages	Onions	Thyme
— red	Parſley	Turneps
— large white	Parſley-roots	Water-creſs
— ſugarloaf	Parſneps	Winter ſavory.
Carrots	Potatoes	

On the Hot-Beds.

Aſparagus	Green eſchalots	Muſtard
Creſſes	Lettuces	Muſhrooms.
Cucumbers	Mint	

Flower-Garden *and* Shrubbery.

Anemones which were planted in the autumn will require to be covered with pea-ſtraw, rotten tan, or mats.

Auricula and polyanthus ſeeds may now be ſown in boxes or pots in mild weather.

Auriculas ſhould be ſheltered from violent rains and froſt by mats; and at the end of the month freſh earthed.

Beds for bulbous roots ſhould be digged and thrown up into ridges, that they may be planted the firſt fine weather, if any

roots remain unplanted; but it is bad policy not to plant them in October or the beginning of November.

Bulbous-rooted flowers in boxes or glaſſes ſhould be removed in froſty weather, before night, from the windows; nor ſhould they be ſet on chimney-pieces until they are in flower, for ſhade draws all flowers up very weak. Boxes made five inches deep, eight wide, and ſixteen long, filled with light ſandy earth, without any dung in them, are better than glaſſes, and will not require ſo much trouble. It will be neceſſary frequently to ſtir up the earth with a table fork.

Carnations muſt be ſheltered from violent rains and froſt by mats.

Plant at the end of the month, or ſooner if the weather be mild, all ſorts of bulbous roots, as crocuſes, jonquils, narciſſuſes, polyanthus-narciſſuſes, ſnowdrops, tulips, &c.

Plant flowering-ſhrubs which are hardy, and flower early, as almonds, double-flowering cherries, honeyſuckles, lilacs, mezereons, roſes, &c.

Shrubs and trees of all ſorts may be planted at the end of the month.

Sow auricula and polyanthus ſeeds in pots or boxes.

Trenches ſhould be cut to carry off the water, if it ſtands any where, after heavy rains.

Trees and Shrubs in Flower.

Alaternus	Mezereons
Cornelian cherry	Pyracantha
Glaſtonbury thorn	Spurge-laurel
Lauruſtinus	Strawberry-tree in fruit and flower.
Manna aſh	

Flowers.

Aconite (yellow)	Navelwort (Perennial)
Alyſſon (Alpine)	Periwinkle
Anemones	Polyanthuſes
Crocuſes	Primroſes
Cyclamens	Snowdrops
Hellebore	Wallflowers.

Forced Flowers.

Hyacinths	Pinks
Jonquils	Polyanthus-Narciſſus
Lilacs	Roſes
Lily of the Valley	Tulips
Mignonette	Violets.

The Fruit-Garden *and* Orchard.

Apple-trees ſhould be pruned as ſoon as the violent froſts are over.

Eſpaliers ought always to be repaired before the buds of the trees begin to open.

Fruit-room, examine frequently, to pick out all fruit which begins to decay, and nail mats before the windows to keep out the froſt.

Ground for planting ſhould be prepared by digging the holes ready; and if it be wettiſh, a cart-load of good loam ſhould be brought for each ſtandard-tree, and formed into a little hill before the tree be planted.

Moſs, ſcrape off from all fruit-trees.

Orchards in general are much neglected, by not cutting out the dead wood and branches that croſs each other.

Pear-trees will require pruning, both ſtandards, eſpaliers, and againſt walls, as ſoon as the weather becomes mild.

Prune currants, gooſeberries, and raſpberries.

Strawberries in pots may be placed on hotbeds for forcing.

Vines ſhould not be pruned till towards the end of the month.

Fruits in Seaſon.

Almonds.	Nuts.
Apples	Pears
— Aromatic pippin	— Ambrette
— Aromatic ruſſet	— L'Echaſſerie
— Golden pippin	— Citron d'Hyver
— French pippin	— Colmar
— Golden ruſſet	— Beurree
— John apple	— Bonchretien
— Hervey apple	— Bezi de Chaumontelle
— Kentiſh pippin	— Bezi de Queſſois
— Kirton pippin	— Epine d'Hyver
— Monſtrous rennet	— Francreal
— Nonpareil	— Portail
— Pear ruſſet	— Rouville
— Pile's ruſſet	— Rouſſelet d'Hyver
— Pearmains	— Saint Auguſtine
— Wheeler's ruſſet	— Saint Germain.
— Winter ruſſet	Pears for baking
— Winter Julyflower	— Black Worceſter
— Rouen jelly apple.	— Cadillac
Cheſnuts.	— Engliſh warden.
Grapes.	Walnuts.

The Greenhouse.

Air may be given to the plants, if the weather be mild.

Fire muſt be made if it freezes, and particularly when it begins to thaw, or it is foggy weather, to dry the houſe; for dampneſs is as prejudicial as cold; and if there be no flue, light a few candles in froſty weather. To know for a certainty when it begins to freeze, ſet a pan of water near the windows.

Leaves, which are any ways decayed, ſhould be conſtantly picked off, particularly from the geraniums.

Succulent plants, ſuch as aloes, ficoides, &c. ſhould not have any water given them this month.

Water for all ſorts of plants ſhould be the ſofteſt you can get, and rain-water is the beſt; the chillneſs ſhould be taken off by ſtanding in the houſe ſome days before it is uſed; and this month it ſhould be given very ſparingly.

Windows in froſty weather ſhould be kept very cloſe, by paſting ſtrips of paper where the wind blows in, for that contributes to the froſt; and if you be obliged to cover the windows with mats, take them down in the day-time to admit the light and the ſun; for if plants be ſhut up in the dark, their leaves will ſoon fall off; and the outward door ſhould be opened as ſeldom as poſſible, but, to have it proper, there ſhould be another door leading through a ſhed.

FEBRUARY.

The Kitchen-Garden.

Aſparagus ſhould have the mats taken off the glaſſes, except when it ſnows; for without light it will not be green; and the fifth and laſt crop ſhould be planted on a hotbed.

Beans of the early ſorts muſt now be planted for the third crop, and at the end of this month the firſt crop of the large ſorts, as Windſor, long-podded, &c.

Beets, ſow, but let the ground be digged very deep.

Boorcole and brocoli will want earthing up, but let the dead leaves be firſt picked off.

Cabbages, ſow for the ſecond crop of ſugarloaf, and the firſt of red, and plant out thoſe ſown in Auguſt.

Carrots, ſow at the end of the month for the general crop, on a deep ſandy ſoil.

Cauliflowers under glaſſes muſt be examined, all the dead leaves picked off, and the earth ſtirred up. In mild weather

give them air, and plant ſome out, leaving only the two ſtrongeſt under each glaſs. Sow the ſecond crop on a gentle hotbed.

Celery, ſow for the firſt crop on a gentle hotbed, and draw earth up to blanch what remains in the ground, in dry weather.

Colcworts, ſow for the firſt crop.

Creſs and muſtard, ſow every week on hotbeds.

Cucumber-beds muſt be conſtantly attended to, to keep them up to a proper heat, and another made for the plants raiſed laſt month: when they have three or four rough leaves, plant them out, three or four to each light, and ſow more ſeed.

Endive, tye up for blanching, and plant out ſome for ſeed.

Eſchalots, garlic, and rocambole, ſhould not be deferred planting, or the roots will be very ſmall.

Ground lying vacant ſhould be digged and thrown up into ridges, to prepare it ready for ſowing.

Horſe-radiſh ſhould now be planted.

Hotbeds for cucumbers, melons, and ſmall ſallading, prepare, and have plenty of dung.

Leeks, ſow, and mark ſome for ſeed.

Lettuces from under glaſſes, plant out, if the weather be mild, and ſow the ſecond crop. Give plenty of air to the forced ones.

Melons, ſow at the beginning of the month for the firſt crop, and, when about three days old, plant each in a ſmall pot.

Mint, plant in pots on a hotbed.

Muſhroom-beds, defend from wet.

Onions, ſow at the end of the month or beginning of the next for the general crop, and weed thoſe ſown in autumn, and plant ſome for ſeed.

Parſley, ſow for edgings, and ſome curled, very thin on a bed, to grow large for garniſhing of diſhes, and the large-rooted.

Parſneps, ſow on ground digged very deep.

Peas out of the ground ſhould have the earth drawn up to them, as they advance, in dry weather, and will require ſticking.

Sow marrowfats and other large ſorts, and the third crop of hotſpurs.

Plant aſparagus for forcing, for the laſt crop.

Beans for a third crop. Windſors, the firſt.

Cauliflowers from under the glaſſes.

Endive for blanching and ſeed.

Eſchalots, garlic, and rocambole.

Horſe-radiſh, lettuces from under glaſſes.

Leeks, onions and parſley for ſeed.

Potatoes on hotbeds, for the firſt crop.

Radiſhes, uncover in mild weather, and put the ſtraw on again at night.

Sow Beets	Fennel	Parſley
Cabbages	Leeks	Parſneps
Carrots	Lettuces	Peas
Cauliflowers	Muſtard	Radiſhes
Coleworts	Onions	Spinach.
Sow on hotbeds,		
Cauliflowers	Cucumbers	Radiſh
Celery	Melons	Rape for ſallads.
Creſs	Muſtard	

Spinach, ſow the firſt crop, and hoe the winter crop if it be too thick. Water ſhould be carried away, if it ſtands after heavy rains, by cutting trenches.

Produce of the Kitchen-Garden.

Aliſanders	Beets, white	Boorcole, green
Beets	Boorcole, or kale	Brocoli
— red	— purple	— purple
Brocoli, white	Garlic	Salſafy
— green	Horſe-radiſh	Savoy cabbages
Cabbages	Jeruſalem artichoke	Savory
— red	Leeks	Scorzoneras
— large white	Lettuces	Sorrel
— ſugarloaf	Onions	Spinach
Carrots	Parſley	Sprouts of cabbages
Celery	Parſneps	Thyme
Chervil	Potatoes	Turneps
Coleworts	Rocambole	Water-creſſes.
Endive	Sage	
Eſchalot		

On the Hot-Beds.

Aſparagus	Kidney-beans	Muſhrooms
Creſs	Lettuces	Muſtard
Cucumbers	Mint	Radiſhes.

The FLOWER-GARDEN *and* SHRUBBERY.

Anemones and ranunculuſes ſhould not be deferred planting the firſt mild weather, or they will flower weak; and the beds ſhould be prepared ſome time before hand.

Annual flowers which are hardy, ſuch as ſweet peas, larkſpurs, candy-tuft, alyſſon, corn-bottles, perſicarias, and ſome few others, may be now ſown, and they will flower very early.

Auriculas muſt be defended by mats from wet, the decayed leaves conſtantly pulled off, and freſh earthed.

Box for edgings may be planted in mild weather.

Bulbous roots of every kind unplanted ſhould not be deferred the firſt opportunity which offers of mild weather; and let the beds be thrown up into ridges before hand.

Bulbous roots in boxes, pots, or glaſſes, will require a regular attention to water them; and the earth ſhould be ſtirred up once every week.

Carnations muſt be freſh potted, and ſheltered from heavy rains by mats.

Flowering-ſhrubs and foreſt-trees of all ſorts, except evergreens, may be planted at the end of the month.

Graſswalks, if intended to be made next month, ſhould have the ground prepared by levelling it.

Hotbeds for ſowing amaranths, balſams, and other tender annuals, ſhould be prepared, and the ſeed ſown at the end of the month.

Hyacinths, which are above ground, ſhould be covered with mats ſupported by hoops.

Mignonette muſt be ſown on a hotbed, or it will do in a pot placed in a warm room where the ſun comes; but let the ſeed be ſown very thin.

Perennial-rooted flowers, at the end of the month, may be removed from the ſeed-beds, and the old roots tranſplanted.

Plant anemones and ranunculuſes.

Box for edgings at the end of the month.

Bulbous and tuberous roots of all ſorts.

Flowering-ſhrubs and ornamental trees.

Foreſt-trees of all ſorts, except evergreens.

Shrubbery ſhould be digged over and raked ſmooth, to deſtroy the young weeds which are beginning to ſhoot; but the trees ſhould firſt be pruned.

Shrubs of all ſorts ſhould have the ſuckers taken off, and, if ſmall, be planted in beds a foot aſunder until they are ſtronger; and any ſorts may now be planted.

Sow at the end of the month hardy annuals and mignonette.

Trees and Shrubs in flower.

Almonds	Mezereons
Cherry Plum	Phillyreas
Cornelian Cherry	Pyracantha in fruit
Glaftonbury Thorn	Spurge-laurel.
Lauruftinufes	

Flowers.

Aconites	Hepaticas
Alpine Alyffon	Irifes (Perfian)
Anemones	Perennial Adonis
Crocufes	Periwinkles
Cyclamens	Polyanthufes
Daffodils	Primrofes
Daifies	Snowdrops
Hearts-eafe	Wallflowers.
Hellebore (black)	

Forced Flowers.

Hyacinths	Pinks
Jonquils	Polyanthus-narciffus
Lilacs	Rofes
Lily of the Valley	Tulips
Mignonette	Violets.

The FRUIT-GARDEN *and* ORCHARD.

Apple and pear-trees fhould be finifhed pruning the firft mild weather.

Cuttings of currants and goofeberries, plant.

Grafts of apples and pears fhould be prepared.

Hurdles, place againft peaches, nectarines, and apricots, the beginning of the month; they fhould be about two feet higher than the walls, that they may be fet floping, and muft be faftened with ftakes, and remain there till the fruit is fet.

Kernels of apples and pears, fow for ftocks.

Planting all forts of fruit-trees fhould be finifhed early in the month, and the roots covered with mulch.

Pruning wall-trees fhould be finifhed.

Strawberries may be planted at the end of the month, and the old beds dreffed; thofe on hotbeds muft be frequently watered.

Vines, finifh pruning before they bleed.

Wall-trees, as apricots, nectarines, peaches, plums, pears, fhould be finifhed pruning early in the month, and thofe done in October muft be examined, and the dead ends cut off.

Fruits in Seafon.

Almonds.	Pears
Apples	— Bezi de Queffois
— Aromatic pippin	— Bonchretien
— Hervey apple	— Carmelite
— John apple	— Citron d'Hyver
— Golden pippin	— Colmar
— Holland pippin	— Eafter Bergamot
— Golden ruffet	— Saint Martial
— Nonpareil	— Winter rouffelet
— Pile's ruffet	— Terling.
— Pearmains	Pears for baking
— Stone pippin	— Black Worcefter
— Wheeler's ruffet	— Cadillac
— Rouen jelly apple.	— Double-flowered
Chefnuts.	— Englifh warden.
Nuts.	Walnuts.

The GREENHOUSE.

Air, give very freely in mild weather.

Earth the top of the pots, but firft take out the old an inch deep.

Fire muft be made in foggy weather to dry the houfe.

Leaves this month decay very faft; therefore they will require picking off almoft every day, but efpecially from the geraniums.

Myrtles, oranges, winter-cherries, and fome others, water frequently, but not too much at a time.

Succulent plants, as aloes, ficoides, muft not have any water given them this month, for it will caufe them to rot.

Water the plants which require it, frequently, but very fparingly; for too much moifture in the houfe will injure the plants.

Windows may be opened for a few hours in the middle of the day, but fhould be fhut again about two o'clock, or whenever it begins to be foggy.

MARCH.

The KITCHEN-GARDEN.

Alifanders fown in autumn, fhould be hoed to a foot afunder, and more feed fown.

Aromatic fhrubs and herbs on beds, weed and frefh earth, early in the month; and fow and plant more of all forts.

Artichokes, drefs, and take the fuckers off for a frefh plantation.

Afparagus feed muft now be fown to raife roots for forcing, and for frefh beds; at the end of about twelve years, deftroy the old beds, but take up the roots and force them: by now and then making one new bed, you keep up a conftant fucceffion in full vigour.

Plant out that which was fown laft year.

Fork up the beds, and rake them fmooth, but do not leave the alleys above fix inches lower than the top of the bed.

Water the beds in a morning, in dry weather, early in the month, with the drainings from a dunghill, and it will forward it.

Make frefh plantations in moift weather.

Beans, plant for the fourth early crop, and the fecond of Windfors.

Cut off the tops of thofe in flower.

Beets, finifh fowing.

Boorcole of various forts, fow for the firft crop.

Brocoli, fow of the early fort for the firft crop.

Cabbages, fow the third crop of fugarloaf, the fecond of red, and the firft of favoys.

Carrots, for the principal crop now fow.

Capficums for pickling, fow on a hotbed.

Cauliflowers muft be planted out, leaving two only of the ftrongeft to each glafs: draw earth up to the ftems, and prop up the glaffes.

Prick out thofe fown laft month, and fow the third crop.

Celery, prick out the firft crop from the feedbed, and fow the fecond.

Chardons muft be fown, and cives planted.

Colewort, prick out the firft crop.

Crefs, muftard, radifh, and rape, may now be fown in the open ground for fallading, and cover the feed for a few days with a mat, or place hand-glaffes over it.

Crefs and muftard, fow very thin for feed.

Cucumber-beds muft be kept to a good heat, by cutting off fome around the fides, and adding frefh hot dung inftead of it.

Plant out the fecond crop on a frefh bed.

About the twentieth fow feeds of the turkey, and fome for bell-glaffes.

Hotbeds prepare for planting cucumbers, and melons.

Jerufalem artichokes, plant. Leeks, fow.

Kidney-beans, fow at the end of the month, on a warm border.

Lettuces, plant out from under the glaffes.

Sow the third crop of cos or other forts.

Melons, plant out from the firſt hotbed.

Sow cantaleupes for the ſecond crop, and ſome on a tan-bed, and for bell-glaſſes.

Mint-beds, weed and earth, and plant more.

Muſhroom beds, make for ſummer uſe.

Naſturtiums for pickling, ſow at the end of the month.

Onion-beds, carefully weed before the weeds are high; and finiſh ſowing the principal crop.

Parſley, ſow both curled and large-rooted.

Parſneps, finiſh ſowing.

Pears, earth up in dry weather, and ſtick.

Sow the ſecond crop of marrowfats.

Plant Artichokes	Cucumbers	Melons
Aſparagus	Jeruſalem Artichokes	Muſhrooms
Beans		Potatoes
Cives	Lettuces	Tarragon.

Plant aromatic herbs and ſhrubs, as

Balm	Pennyroyal	Sage
Camomile	Roſemary	Savory
Lavender	Rue	Thyme, &c.
Mint		

Pot and ſweet-herbs ſhould now be ſown.

Slip pot-marjoram, ſavory, and thyme.

Potatoes, weed, and plant the principal crop.

Radiſhes, ſow the fourth crop, and rampions.

Salſafy, ſcorzonera, ſkirrets, and ſorrel, ſow.

Sow Aliſanders	Clary	Parſneps
Angelica	Corianders	Peas
Aſparagus	Creſs	Purſlane
Baſil	Cucumbers	Radiſhes
Beets	Dill	Rampions
Borage	Fennel	Salſafy
Boorcole	Hyſſop	Savory
Brocoli	Kidney-beans	Scorzonera
Burnet	Leeks	Sea-kale
Cabbages	Lettuces	Skirrets
Capſicums	Marjoram	Sorrel
Carrots	Marygolds	Spinach
Cauliflowers	Melons	Tarragon
Celery	Muſtard	Thyme
Celeriac	Naſturtiums	Tomatoes
Chardons	Onions	Turneps
Chervil	Parſley	Water-creſſes.

Spinach, weed, and ſow the ſecond crop.

Tarragon, plant, and ſow tomatoes.

Turneps, ſow the firſt crop.

Water-creſſes, ſow in a moiſt place, or where it may be conſtantly ſupplied with waſte water from the pump.

Weeds, deſtroy while ſmall, which will ſave future trouble.

Produce of the Kitchen-Garden.

Aliſanders	Cabbages red	Lettuces
Aſparagus	— large white	Marjoram
Balm	— early	Mint
Beets	Carrots	Onions
— red	Celery	Parſley
— white	Chardons	Parſley-roots
— green	Chervil	Parſneps
Boorcole or kale	Coleworts	Potatoes
— purple	Corn-ſallad	Radiſhes
— green	Creſs	Rocambole
Borage	Endive	Sage
Brocoli	Eſchalots	Salſafy
— purple	Garlic	Savory
Burnet	Horſe-radiſh	Savoy cabbages
— white	Jeruſalem Artichokes	Scorzoneras
— green		Sorrel
Cabbages	Leeks	Spinach
Sprouts of	*On the Hotbeds.*	Muſhrooms
— Cabbages	Aſparagus	Muſtard
Thyme	Creſſes	Peas
Turneps	Cucumbers	Potatoes
Water-creſs.	Kidney-beans	Radiſh
	Lettuces	Strawberries.

The FLOWER-GARDEN *and* SHRUBBERY.

Anemones and ranunculuſes, if any remain unplanted, muſt not be deferred longer than the firſt mild day.

Anemones in flower ſhould be covered with mats in windy or rainy weather.

Annual flowers which are tender, (See Gen. Catalogue, § 2.) if ſown early in the month, will require a ſecond hotbed to be tranſplanted to; and if not ſown, ſhould not be deferred any longer, to have them early and ſtrong. Sow thoſe alſo mentioned in § 2. of the General Catalogue, on a moderate hotbed.

Annual flowers of all the hardy ſorts in the Catalogue may be ſown about the middle of the month in ſmall patches where they are to remain; hollow the earth out in the form of a baſon, fifteen inches over, and an inch deep, and ſow the ſeeds very thin all over it, and not a ſmall patch in the middle, as is too frequently the cuſtom.

Auriculas ſhould be removed into the ſtand, and if ſome flat oyſter-ſhells be laid on the earth, they will keep it moiſt, and ſave trouble in watering them.

Borders of the flower-garden will require to be hoed over or weeded, to deſtroy the young weeds which are beginning to ſhoot, and then raked, that they may appear neat.

Box for edgings, plant in mild weather.

Bulbous roots in beds ſhould be covered with mats in rainy or ſtormy weather, and the earth ſtirred gently up with your fingers to deſtroy the weeds; thoſe alſo in the houſe muſt be conſtantly attended to.

Carnations, if not potted laſt month, ſhould be done the beginning of this.

Evergreen ſhrubs, and trees of all ſorts, may be planted in mild weather; then cover the roots with turf turned downwards, moſs, fern, pea-ſtraw, or ſome ſuch things, to keep the ground moiſt, which is better and leſs trouble than watering.

Flowering-ſhrubs and foreſt-trees of all ſorts, plant early in the month, and cover the roots.

Graſs walks muſt be ſwept and rolled.

Gravel walks will want turning and rolling, after being weeded, and cleaned from moſs with a birch broom.

Hyacinths muſt be covered with mats or canvaſs, to prevent their flowers being ſpoiled, but not kept too cloſe.

Larkſpurs, in beds or patches, muſt be thinned and not left nearer than eight or ten inches.

Mignonette, ſown laſt month, ſhould be tranſplanted, and more of it ſown.

Myrtles, winter-cherries, and other hardy greenhouſe plants, planted againſt walls, ſhould have the mats rolled up in fine weather, and the duſt waſhed off from their leaves, but covered again at night.

Perennial and biennial flowers muſt be ſown on beds, very thin, that they may be ſtrong; thoſe ſown laſt year ſhould be tranſplanted, and the old roots of the perennials divided.

Plant annuals from the firſt hotbed.

Biennials and perennials from the ſeedbed.

Box for edgings.

Evergreens of all ſorts.

Perennials, by dividing their roots, and ſeedlings of laſt year's ſowing.

Shrubs and trees early in the month.

Strawberries and thrift for an edging.

Shrubberies ſhould be pruned early in the month: the ſuck-

ers taken off, and planted a foot at leaft afunder, and the rows two feet apart: the ground hoed or digged, and then raked over, that it may appear neat and clean.

Sow tender annual flowers on a hotbed.

Annuals that are hardy in the open ground.

Biennials and perennials on beds.

Shrubs and trees of almoft every fort.

Strawberries, plant for an edging to the fhrubbery, at fix inches afunder; the flowers make a pleafing appearance, and afterwards you will have very large fruit by their being in a fingle row.

Strawberry-trees, plant againft a fouth wall, which will preferve the flowers, and ripen the fruit, which when well ripened are very agreeable to eat.

Weeds, conftantly deftroy by hoeing while fmall, with a Dutch hoe, made to cut both ways, by which method you may always keep your fhrubbery in order, with a very little trouble.

Trees and Shrubs in flower.

Almond-trees	Mezereons
Cornelian Cherry	Peach-trees
Larches	Portugal Laurel
Lauruftinus	Sea Buckthorn
Laurel	Spanifh Travellers Joy
Manna Afh	Spurge-laurel.

Flowers.

Anemones	Narciffufes
Alyffons	Perfian Irifes
Auriculas	Panfies
Crocufes	Periwinkles
Crown-Imperials	Pilewort
Cyclamens	Polyanthufes
Daffodils	Primrofes
Daifies	Scarlet Ranunculufes
Dogs-tooth-Violet	Snowdrop (great)
Fritillaries	Tulips
Hepaticas	Violets
Hyacinths	Wallflowers.

Forced Flowers.

Carnations	Lilacs
Honeyfuckles	Pinks
Jafmins	Polyanthus-narciffus
Jonquils	Rofes.

The Fruit-Garden *and* Orchard.

Apricot, nectarine, and peach-trees, fhould have hurdles placed before them, if not already done, to defend the bloffoms from hail; or elfe ftick branches of yew, fern, or fir, amongft them, but hurdles are the beft.

Fig-trees which have mats nailed over them fhould have them taken away by degrees, by firft unnailing them at the bottom, towards the end of the month.

Graft trees, and cut down the budded ones.

Hurdles, place before the wall trees.

Peach and nectarine trees ought to be finifhed pruning at the beginning of the month, if omitted till then; the heads of thofe lately planted fhould be cut off.

Planting and pruning trees of all forts fhould be entirely finifhed at the beginning of the month.

Strawberry-beds fhould now be attended to; hoe them firft to deftroy the weeds, and ftir up the earth between them, then fpread fome very rotten dung and earth over them.

Thofe on hotbeds want frequent watering, and the dead leaves fhould be conftantly picked off, to let the fun come to the fruit.

New plantations may now be made.

Vines may now be layered; draw fome ftrong bearing branches through the bottom of the pot, and plunge the pot into the ground; and then they may be tranfplanted the next feafon, and produce fruit the firft year; plant cuttings.

Wall-trees, finifh pruning, and mulch thofe lately planted.

Fruits in Seafon.

Almonds.	Pears, Bonchretien
Apples	— Barrel pear
— Golden ruffet	— Eafter bergamot
— French pippin	— German mufcat
— Kentifh pippin	— Souler's bergamot
— Holland pippin	— Saint Germain
— John apple	— Terling
— Loan's pearmain	— Winter orange pear
— Nonpareil	— Winter rouffelet.
— Pile's ruffet	Pears for baking
— Pomme d'Api	— Cadillac
— Stone pippin	— Double flowering
— Wheeler's ruffet	— Englifh warden.
— Rouen jelly apple.	Walnuts.
Chefnuts.	
Pears	*On the Hotbeds.*
— Bergamot Bugi	Strawberries.

The Greenhouse.

Air, give freely in the middle of the day, except the wind be very cold.

Earth the tops of the pots, but take the old earth out an inch deep.

Geraniums, place near the windows to prevent their being drawn up weak.

Myrtles, winter-cherries, and other hardy plants, will want frefh potting, and, if the weather be mild, may be taken out to make more room, but fet them in a fheltered place at firft.

Orange-trees, if their leaves be mildewed, will want wafhing with a fpunge and warm water.

Thofe with ill-fhaped heads fhould be cut down, and placed on a ftrong hotbed.

Sow kernels in pots, good ftrong feed, and if they are fet an inch afunder, they will grow fafter.

Succulent plants may now have a little water, but not much at a time.

Water the plants in the middle of the day, and only when the fun fhines; but the water fhould be fet in the houfe for two or three days to take off the chillnefs, and ufe foft water.

Windows may be opened for a few hours in the middle of all fine days.

APRIL.

The Kitchen-Garden.

April being the lateft time for fowing the principal crops of the kitchen-garden, if any thing directed to be performed laft month were omitted, or the weather would not permit, let it be done early in this.

Aromatic herbs and fhrubs of all the following forts fhould now be planted, as

Balm	Spear-mint	Rue
Camomile	Tanfey	Sage
Pennyroyal	Lavender	Southernwood
Pepper-mint	Rofemary	Wormwood.

Afparagus, finifh both fowing and planting early in the month.

Let the beds be forked and raked fmooth, and watered twice a-week with drainings of a dung-hill.

Cut off every bud, however fmall; for, if they be left on, they weaken the others; this method is in general only practifed by the London kitchen-gardeners.

Never ſuffer any weeds to remain after they are an inch high, for they weaken the aſparagus very much.

Beans in flower ſhould have their tops cut off, and draw the ſtalks of the firſt crop cloſe to the wall by ſtrings, and earth them up.

Plant the third crop of Windſors.

Boorcole and brocoli ſhould have the firſt crop pricked out, and the ſecond ſown.

Cabbages of the early ſort ſhould have their leaves tied up to forward their cabbaging.

Prick out from the ſeedbed the third crop of ſugarloaf, the ſecond of red, and the firſt of ſavoys.

Capſicums, prick out from the ſeedbed, to prevent their growing weak, upon another hotbed.

Carrots, weed and thin the firſt crop, and ſow the ſecond to draw young.

Caterpillars, ſearch for upon cabbages and apple-trees particularly.

Cauliflowers ſhould have the earth drawn up very high to raiſe the glaſſes, and a piece of brick put under each corner, and at the end of the month taken quite away.

Break down the leaves when the flowers of any begin to appear; earth the ſecond crop, and prick out the third.

Celery, prick out the ſecond crop, and ſow the third.

Creſs and muſtard, ſow every week.

Cucumber-beds muſt be attended to, and plenty of air given them, when mild; and, if the heat declines, freſh dung muſt be added to the ſides. Make a gentle hotbed within the ground for thoſe that are to be under bell or hand-glaſſes, and plant them on it at the end of the month.

Sow more ſeed, that you may have plenty of plants.

Endive planted out for ſeed ſhould be earthed up, and the firſt crop ſown.

Finochio, ſow in drills a foot aſunder, for the firſt crop.

Hotbeds for ſowing of melons for bell-glaſſes muſt be prepared, and loam and rotten dung procured, to be ready.

Kidney-beans, ſow the ſecond crop and the firſt of the ſcarlet-flowering.

Lettuces, tie up to aſſiſt their cabbaging; thoſe in beds ſhould be thinned to a foot diſtance, others planted out, and the fourth crop ſown very thin in an airy place.

Melon-beds will require to be kept up to a good heat, and the ſecond and third crop planted out.

Muſhroom-beds, finiſh making early in the month, which will laſt till September.

Onion-beds muſt be attended to, to keep clear from weeds as ſoon as any appear, and ſow the ſecond crop to draw young.

Parſley for garniſhing diſhes, thin, and leave thoſe plants which have the beſt curled leaves.

Sow the large-rooted.

Peas, earth up frequently, and ſtick them as ſoon as any tendrils appear.

Sow the third crop of marrowfats.

Plant aromatic herbs and ſhrubs,

Aſparagus	Muſhrooms	Potatoes
Beans	Pot-herbs	Sweet herbs.
Lettuces		

Plant on freſh hotbeds cucumbers and melons.

Potatoes ſhould be finiſhed planting.

Pot and ſweet-herbs may ſtill be ſown and planted, and weed and earth the beds.

Prick out from the ſeedbeds,

Boorcole	Cabbages	Cauliflowers
Brocoli	Capſicums	Celery.

Purſlane, ſow on a warm border in rich earth.

Radiſhes, ſow for a fifth crop in a cool place.

Roſemary, rue, ſage, ſavory, and thyme, ſlip and plant out laſt year's.

Snails and ſlugs ſearch frequently for.

Sow aromatic herbs and ſhrubs,

Aſparagus	Finochio	Purſlane
Boorcole	Kidney-beans	Pot-herbs
Brocoli	Lettuces	Radiſhes
Carrots	Muſtard	Spinach
Celery	Onions	Sweet-herbs
Endive	Peas	Turneps.

Sow on a hotbed, cucumbers, melons.

Spinach, ſow the third crop in a cool place.

Turneps, hoe the firſt crop and ſow the ſecond.

Weed all the beds of ſeedlings, while the weeds are ſmall, and any other crops alſo.

Produce of the Kitchen-Garden.

Aſparagus	Corn-ſallad	Salſafy
Balm	Creſſes	Savory
Beans	Endive	Savoy cabbages
Beets	Eſchalots	Scorzoneras
— red	— dry & green	Sorrel
— white	Fennel	Spinach
Boorcole or kale	Garlic	Sprouts of cabbages
— purple	Horſe-radiſh	
— green	Jeruſalem Artichokes	Thyme
Borage		Turneps
Brocoli	Leeks	Turnep-tops
— purple	Lettuces	Water-creſſes.
— white	Marjoram	
— green	Mint	*On the Hotbeds.*
Burnet	Muſtard	Aſparagus
Cabbages	Onions	Carrots
— red	Parſley	Cucumbers
— early	Parſley-roots	Kidney-beans
Carrots	Parſneps	Lettuces
Celery	Peas	Muſhrooms
Chardons	Potatoes	Potatoes
Chervil	Radiſhes	Purſlane
Cives	Rocambole	Strawberries
Colewort	Sage	Turneps.

The FLOWER-GARDEN *and* SHRUBBERY.

Anemones in ſtormy weather will ſtill require covering with mats.

Annual flowers on hotbeds will require thinning, and ſome of the ſtrongeſt muſt be planted into ſingle pots.

Hardy annuals, if not already ſown as directed in March, ſhould be deferred no longer, and ſown very thin.

Auriculas in bloom muſt be conſtantly attended to, and defended from violent winds, but yet have plenty of air in mild weather; the ſeedbeds will want frequent and gentle waterings.

Balm of gilead may be ſown or ſlipped, but the ſtrongeſt plants will be raiſed from ſeed.

Biennial and perennial flowers, finiſh ſowing early in the month.

Borders of the ſhrubbery and flower-garden, weed or hoe and rake frequently.

Box for edgings, ſtill plant in mild weather.

Bulbous-rooted flowers, which were planted in boxes or glaſſes, as ſoon as the flowers are decayed, ſhould be planted in the ground, to ſtrengthen the roots.

Carnation-ſeed may now be ſown, and ſtir up the earth frequently of thoſe in pots.

Crocus-leaves are by many perſons cut off; but it greatly weakens the young roots, for the old ones decay, and new roots are formed every year; if they hang over into the walks, tie them up in a knot.

Evergreen-trees and ſhrubs, finiſh planting, and ſow the ſeed.

Graſs walks muſt be ſwept, rolled, and mowed; if any places be bare, lay down ſome pieces of freſh turf, or ſow ſome hay-ſeeds. Prepare the ground by levelling, early in the month, where freſh walks are to be made.

Gravel walks muſt be frequently rolled in dry weather, and turned if the top be dirty, but ſweep them well firſt.

Hyacinths in bloom, ſhade with mats or canvas.

Kidney-beans, with ſcarlet flowers, will form a pleaſing ſhady walk towards the end of the ſummer: they muſt be ſown on each ſide of a walk three or four feet wide, at ſix inches aſunder, and ſticks of eight or nine feet long placed to them, or ſticks of five feet long will do with ſome oziers to form the arch at the top.

Larkſpurs muſt now be thinned for the laſt time, and left eight or ten inches aſunder; if taken up carefully with a trowel, they may be planted again; by this method your flowers will be ſtrong, and you will have plenty of ſeed.

Layer lauruſtinuſes and various other ſhrubs, but omit the roſe-trees till June.

Mignonette, ſow on a warm border.

Myrtles and hardy greenhouſe plants againſt walls towards the end of the month may have the mats taken away, and freſh ones planted where neceſſary.

Perennials and biennials ſhould be finiſhed ſowing early in the month, thoſe from the ſeedbeds tranſplanted, and the old roots of the perennials divided.

Phillyreas (the olive-leaved), plant to make noſegays, as the leaves greatly reſemble myrtle.

Plant annuals from the hotbeds into pots, and plunge them into another hotbed.

Biennials and perennials on the borders.

Myrtles, heaths, and other hardy greenhouſe plants.

Hollies and quick for hedges.

Strawberries and thrift for edgings.

Shrubs and trees of all ſorts early in the month.

Tuberoſes in pots on a hotbed.

Seedling beds of flowers, ſhrubs, and trees, water frequently, but very little at a time.

Shrubberies ſhould be finiſhed digging and raking, and frequently hoed when any weeds appear.

Shrubs or flowers in pots are beſt to be ſet in pans, which will ſave much trouble in watering.

Sow annual and biennial flowers of all ſorts.

Balm of gilead in pots.

Carnations and pinks in boxes or pots.

Evergreen ſhrubs and trees.

Mignonette, ſcarlet kidney-beans.

Perennial flowers of all ſorts.

Shrubs and trees of every kind on ſhady borders, or in boxes.

Seeds which are ſmall, mix firſt with ſome dry earth, that they may not be ſown too thick.

Tobacco, ſow very thin on a bed of fine rich earth.

Tuberoſes, plant in pots on a hotbed.

Turf ſhould be finiſhed laying, and frequently watered in dry weather.

Water ſeedling beds and ſhrubs lately planted, in a morning, during this month, on account of the froſts.

Weeds ſhould be deſtroyed while very ſmall, to prevent their running up to ſeed, eſpecially on beds of ſeedlings.

Trees and Shrubs in flower.

Almond-trees
Bay-trees
Berberry-trees
Bird cherry-trees
Cherry plum-tree
Cherry plum-tree double-flowering
Honeyſuckles (early)
Hypericums
Laburnums
Laurel
Lauruſtinuſes
Lilacs
Peach-tree } double-
Pear-tree } flower'd.
Privet
Scorpion ſena
Service-tree.

Flowers.

Alyſſon (Cretan)
Anemones
Auriculas
Columbines
Crown-Imperials
Cyclamens
Daffodils
Daiſies
Dogs-tooth-violet
Fritillaries
Fumatory
Gentianellas
Hepaticas
Jonquils
Iriſes
Lady-ſmocks
Lily of the valley
Lychnis
Moth mullein
Ornithogalums
Peonies
Periwinkles
Pilewort
Polyanthus
Polyanthus-narciſſuſes
Pulſatillas
Ranunculuſes
Saxifrage
Stock July-flowers
Tulips—with ſeveral of the laſt month.

Forced Flowers.

Auriculas
Carnations
Honeyſuckles
Jonquils
Lilacs
Pinks
Polyanthus-narciſſuſes
Roſes.

The FRUIT-GARDEN *and* ORCHARD.

Apricots commonly growing in cluſters require to be thinned three different times: as ſoon, therefore, as they are the ſize of a horſe-bean, it is proper to begin.

Budded fruit-trees, ſuch as apricots, cherries, nectarines, peaches, plums, muſt be examined to pull off all the ſhoots which come from the ſtock.

Caterpillars may now be readily found in their webs, but more particularly on apple-trees.

Grafted fruit-trees, as apples, cherries, pears, muſt frequently be examined to pull off the ſhoots below the grafts, and replace any clay which is cracked or fallen off.

Hogs-dung, apply to any fruit-trees which are blighted.

Hurdles, take away when the fruit is ſet.

Nectarines and peaches, finiſh planting and pruning.

Planting and pruning ſhould be entirely finiſhed early in the month; and if any trees be removed ſo late, it ſhould be thoſe which have been planted in baſkets and trained.

Snails, ſearch for in the holes of walls.

Strawberry-beds, finiſh dreſſing and planting, but plant only ſtrong runners of the laſt year, and at the following diſtances—for, in general, they are planted too cloſe, which cauſes the fruit to be mouldy for want of air.

On beds four feet wide, plant four rows, at one foot aſunder, of the ſcarlet, alpine, wood, and green.

Hautbois, three rows, at ſixteen inches aſunder. Bath chili, Devonſhire chili, Carolina and pine-apple chilis, three rows, and each plant twenty inches aſunder. Chilis, three rows, at two feet aſunder at leaſt: theſe are but little known; the Carolinas are generally taken for them, which are pale, hollow in the centre, and frequently woolly: when there are three rows, plant them in quincunx order in the following manner:

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*   *   *   *   *   *   *   *
  *   *   *   *   *   *   *
*   *   *   *   *   *   *   *
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Decayed leaves from the forced ones ſhould be conſtantly picked off, and frequently watered.

Vines ſhould be examined when they firſt begin to ſhoot, and all buds pulled off which grow in improper places.

Cuttings, plant early in the month.

Wall-trees of all ſorts ſhould not be deferred pruning longer than the beginning of the month.

Fruits in Seaſon.

Almonds.	Pears
Apples	— Bonchretien
— Golden ruſſet	— Carmelite
— John apple	— Eaſter bergamot
— Pile's ruſſet	— German muſcat
— Stone pippin	— Saint Martial
— Wheeler's ruſſet	— Winter orange
— Rouen jelly apple.	— Terling
Apricots } for tarts.	— Lent St. Germain
Currants } for tarts.	— Gobert.
Gooſeberries } for tarts.	Pears for baking
Cheſnuts.	— Cadillac
Strawberries.	— Engliſh warden.

On the Hotbeds.

Strawberries.

The GREENHOUSE.

Air, give very freely by keeping the windows open all day, except in ſtorms of hail.

American aloes may have water very often, and ſhould be freſh potted.

Earth the tops of all the pots, with the compoſt which each plant requires; and ſhift thoſe which are in too ſmall pots.

Geraniums ſhould be removed as near as poſſible to the windows, to prevent their being drawn up weak; branches which begin to rot muſt be cut off, and decayed leaves conſtantly pulled off.

Inarch orange and lemon-trees.

Leaves, conſtantly pull off, when decayed, from all plants, but eſpecially the geraniums.

Myrtles, if prevented from being ſet out laſt month, may be removed in this, but it ſhould be in a ſheltered place.

Prune and freſh pot any plants that want it.

Orange-trees muſt be freſh potted after the myrtles are taken out; leaves which are mildewed muſt be cleaned with a ſpunge and water a little warm, and the ſtems well bruſhed.

Seeds of any ſort which are ripe may ſtill be ſown on a hotbed.

Succulent plants will require frequent watering, but give very little at a time.

Water the plants only when the ſun ſhines, and keep the windows ſhut for two or three hours after.

Windows may be opened on all fine days, from about nine in the morning till four, except when it hails.

MAY.

The KITCHEN-GARDEN.

Aromatic herbs and ſhrubs may ſtill be ſown and planted.

Artichokes ſhould have the young ſhoots pulled off, leſt they rob the principal one.

Aſparagus-beds ought to be frequently weeded, as it prevents you from ſeeing the buds ſo readily, if the weeds be not pulled up; and in very dry weather watering them will not be amiſs.

Beans will require to have the tops cut off as they come into flower, and the earth drawn up to their ſtems.

Boorcole, prick out the ſecond crop, and be ſure to have plenty of plants, for in all long froſty winters its utility is fully proved.

Cabbages will want frequent hoeing and earthing up.

Plant the ſecond crop, and the firſt of red.

Sow the fourth crop, and the ſecond of ſavoys.

Cabbage-turneps, turnep-rooted cabbages, American and white Scotch cabbages, and Anjou boorcole, muſt now be ſown; as they are chiefly intended for feeding cattle (although very good for eating), and are more profitable when very large, therefore ſow the ſeed very thin.

Capſicums, plant out where they are to flower, and tomatoes into rich ground, or between the bell-glaſſes of cucumbers.

Carrots ſhould be weeded before the weeds over-top them, and thinned by hoeing.

Caterpillars may now be readily found in the webs, and particularly on apple-trees.

Cauliflowers to be cut from October to December, now ſow, plant out the ſecond crop.

Celery, prick out the third crop, ſow the fourth.

Coleworts, plant out the firſt crop.

Creſs and muſtard, ſow every week on a cool border; and hoe that which is intended for ſeed.

Cucumbers for the fourth crop may be planted out, and let ſome be againſt walls, both for ſeed and their ſuperior flavour.

Sow now in the open ground.

If plants be attacked with black flies, fumigate them with tobacco-ſmoke.

Endive, thin the firſt crop and ſow the ſecond.

Eſchalots, garlic, and rocambole, may have a few roots taken up for preſent uſe.

Finochio, ſow for the ſecond crop.

Hoe or weed the beds of beets, carrots, leeks, lettuces, onions, parſley, parſneps, turneps, &c. and thin them before they are too much crowded.

Kidney-beans, ſow the third crop of dwarfs and the ſecond of runners.

Lettuces in beds, thin, and ſow the fifth crop.

Melons on the tan-bed muſt be thinned.

Sow ſeed for an autumn crop; prick out each into a ſmall pot, as ſoon as the rough leaves appear. Fumigate with tobacco ſmoke any that are attacked with red ſpiders.

Muſhroom-beds will want frequent but gentle waterings.

Naſturtiums, thin to a foot aſunder, and place ſome ſticks amongſt them to prevent their trailing upon the ground.

Onions will want weeding and hoeing.

Thoſe planted for ſeed will require ſtakes and ſtrings to ſupport them.

Sow the third crop to draw young.

Parſley for garniſhing diſhes, thin to eight or ten inches aſunder.

Peas, ſow the fourth crop of marrowfats in a cool place, and earth and ſtick thoſe which require it.

Plant Capſicums	Cucumbers	Sage
Cauliflowers	Lettuces	Tomatoes.
Coleworts	Radiſhes	

Potatoes, hoe the ground before the plants appear.

Pot-herbs and ſweet-herbs in beds muſt be frequently weeded, particularly ſeedlings.

Prick out from the ſeedbeds, boorcole, brocoli, cabbages, melons.

Radiſhes for ſeed ſhould now be planted, and chooſe only the ſtraight well-ſhaped ones, and which are of a good colour.

Sage may ſtill be ſlipped and planted.

Seeds of all ſorts nearly ripe will often require ſtaking, and defending from birds.

Slugs and ſnails may eaſily be found and deſtroyed after rain, or early in the morning.

Sow Brocoli	Cucumbers	Onions
Cabbages	Endive	Peas
Cabbage-turnep	Finochio	Purſlane
Cauliflowers	Kidney-beans	Radiſhes
Celery	Lettuces	Spinach
Creſs	Melons	Turneps.

Spinach, ſow the ſixth crop in a cool place.

Turneps, ſow the third crop, and hoe the others.

Water often, in dry weather, beds of ſeedlings.

Weeds of no ſort ſhould be ſuffered to ſeed, and many ſorts when cut down will ſtill ripen their ſeeds, if not raked up and carried away.

Weed, before the weeds overtop the young plants, the ſeed-beds and crops of

Boorcole	Endive	Onions
Brocoli	Finochio	Pot-herbs
Cabbages	Leeks	Spinach
Carrots	Lettuces	Turneps.

Produce of the Kitchen-Garden.

Aſparagus	Cauliflowers	Onions
Balm	Chardons	Parſley
Beans	Chervil	Parſley-roots
Beets	Cives	Parſneps
— red	Coleworts	Peas
— white	Corn-ſallad	Potatoes
— green	Creſs	Radiſhes
Boorcole or kale	Endive	Rocambole
— purple	Eſchalots	Sage
— green	Fennel	Sorrel
Borage	Garlic	Spinach
Brocoli	Horſe-radiſh	Sprouts of
— purple	Jeruſalem artichokes	— Broccoli
— green		— Cabbages
Burnet	Leeks	Tanſey
Cabbages	Lettuces	Thyme
— early	Marjoram	Turneps
— ſugarloaf	Mint	Turnep-tops
Carrots	Muſtard	Water-creſſes.

On the Hotbeds.

Aſparagus	Kidney-beans	Peas
Beans	Lettuces	Potatoes
Carrots	Melons	Purſlane
Cucumbers	Muſhrooms	Strawberries.

The FLOWER-GARDEN *and* SHRUBBERY.

Annuals from the hotbeds ſhould be removed into larger pots, and encouraged in their growth as much as poſſible, by conſtantly being watered.

Annuals ſown on borders will require thinning, weeding, watering in dry weather, and the earth drawn up to ſupport them, but leave a ridge around them to retain the water.

Auriculas out of bloom, and the ſeed boxes, ſhould be removed into a ſhady place.

Biennial and perennial flowers in the ſeedbeds, weed, and thin if neceſſary.

Borders of the ſhrubbery and flower garden, hoe, and frequently rake, that they may always look neat.

Bulbous roots, which flower early, as aconites, anemones, crocuſes, iriſes, ſnowdrops, and ſeveral others, ſhould be taken up as ſoon as the leaves are withered, and before they entirely diſappear, for then they are more readily found. Thoſe in boxes or glaſſes which have done flowering ſhould be put into the ground to ſtrengthen the roots.

Carnations will require ſticks to be placed to them, as ſoon as they begin to ſpindle, and you ſhould ſtir up the earth frequently.

Evergreen ſhrubs and trees lately planted muſt be frequently watered, and they may alſo be layered.

Graſs walks, weed, roll, and mow frequently.

Gravel walks will require frequent rolling.

Hyacinths, as ſoon as the leaves begin to decay, ſhould be taken up, then laid on a ridge of earth with their leaves downwards, and covered with earth two or three inches thick, to harden and ripen the roots.

Inſects of various ſorts, as earwigs, caterpillars, ſnails, &c. ſhould be ſearched for and deſtroyed.

Mignonette may be ſown in the open ground, for a ſucceſſion in the autumn.

Myrtles, heaths, and other hardy greenhouſe plants againſt walls, will frequently want watering.

Plant bulbous roots which have been forced in boxes or glaſſes into the open ground, to ſtrengthen the roots.

Annuals into larger pots, and on the borders, and cover them with a pot till they have taken root.

Ranunculuſes ſhould be weeded, and the earth gently ſtirred with your fingers.

Roſe-trees infected with green flies or grubs muſt be conſtantly examined; waſh off the flies with water, and pinch thoſe leaves which have grubs in them with your finger and thumb.

To have roſes late in the autumn, cut off every flower-bud which now appears, from two or three trees, and water them well for about ten days afterwards.

Seeds of any ſort of flowers which are ripe ſhould be gathered.

Shrubberies ſhould be frequently hoed with a Dutch hoe, to deſtroy the young weeds; and ſhrubs and flowers in pots ſhould be ſet in pans, and conſtantly watered.

Sow annuals to flower late in the autumn, as

Alyſſon	Lupines (yellow)
Candy-tuft	Mignonette
Cornbottles	Poppies
Fumitory (yellow)	Stock (dwarf)
Larkſpurs	Panſeys
Lavateras	Peas (ſweet-ſcented).

Tuberoſes, ſtill plant to flower late in the autumn.

Tulips, if out of bloom, ſhould have their ſeed-veſſels broken off, and the early ones taken up.

Water annuals, ſeedlings newly planted, and ſhrubs and trees, very frequently in dry weather.

Weeds ſhould particularly be prevented from going to ſeed: the moſt expeditious method is to cut them up with a Dutch hoe, made to cut both ways; and if neatly done, the borders will not require raking afterwards, if cut while very ſmall.

Trees and Shrubs in Flower.

Almonds (dwarf)	Jeſſamines
Azaleas	Judas-trees
Bay-trees	Kalmias
Berberry-trees	Laburnums
Cherry (doub. flowering)	Lilacs
Elder-trees	Roſes
Gueldres roſe	Snowdrop-tree
Hawthorns	Syringa
Honeyſuckles	Sweet-briars

Flowers.

Anemones	Monkſhood
Bachelor's buttons	Narciſſuſes
Candy-tuft	Ornithogalums
Canterbury bells	Peonies
Catchfly	Pinks
Columbines	Polyanthus-narciſſus
Cowſlip, American	Poppies
Feverfew	Ranunculuſes
Foxgloves	Rockets
Fraxinellas	Saxifrage
Gentianella	Scabious
Globe-flower	Scarlet lychnis
Honeſty	Sea pink
Hyacinths	Solomon's ſeal
Jonquils	Spiderwort
Iriſes	Stock July flower
Lily of the valley	Sweet peas
Lilies	Tulips—with ſeveral others of the laſt month.
London pride	
Lychnideas	

Forced Flowers.

Carnations	Myrtles
Geraniums	Orange trees
Jeſſamines	Roſes.

The FRUIT-GARDEN *and* ORCHARD.

Apricots ſhould be thinned for the ſecond time, and all fore-right ſhoots pulled off.

Blighted trees ſhould have hogs-dung ſpread over the border, then fork up the ground and water it well.

Pull off curled leaves, water the trees all over, and ſtrew tobacco duſt on the leaves, or ſumigate them with tobacco ſmoke, which will greatly help to deſtroy the inſects.

Budded trees, examine often to pull off improper ſhoots.

Caterpillars muſt be ſearched for upon apple trees.

Diſbud all wall-trees, by pulling off buds which come out in improper places.

Eſpalier-trees ſhould be examined to diſbud them and train in the ſhoots.

Grafted trees ſhould have the clay taken off, if properly united.

Nectarines and peaches will require thinning for the firſt time, and the trees to be diſbudded.

Strawberries which are forced ſhould have the dead leaves pulled off, and be frequently watered.

Thoſe alſo which are beginning to flower, or have been lately planted, muſt be conſtantly watered in dry weather.

It is not in general known, that hautbois-ſtrawberries and the chilis do not, like all the others, produce hermaphrodite flowers, but male and female flowers on ſeparate plants; and perſons ignorant of this fact, allege their hautbois are blind; whereas thoſe flowers which turn black in the middle are male plants, and *never will produce fruit.* To make a plantation properly, let a perſon ſkilled in botany examine them when in flower; he will then eaſily diſtinguiſh them by the male ſtamina above a quarter of an inch high. Moſt of them ſhould be pulled up, and mark with a ſtick the male ones, for you cannot diſtinguiſh them when out of flower; it is true the females will produce fruit, but neither ſo large nor well-flavoured, and frequently ill-ſhaped, and the ſeed will not grow, unleſs impregnated by the male flowers. In making a new plantation, do it in the following manner:

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m * m * m
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The male plants may be tranſplanted when in flower, if you cover them with a flower-pot for a few days after; three males will do for every fourteen females.

Vines will require a conſtant attendance to pull off weak ſhoots, eſpecially where two come together, and to nail the branches.

Water-trees lately planted, or any infected with inſects.

Fruits in Seaſon.

Almonds.		Cherries, May duke.
Apples		Pears
— John apple		— Bonchretien
— Stone pippin		— German muſcat
— Franche rennet		— Imperial oak-leaved
— Pile's ruſſet		— Winter beauty
— Wheeler's ruſſet		— Gobert pear
— Haute bonté.		— Holland bergamot
Apricots	for tarts.	— Saraſin.
Currants	for tarts.	Pears for baking
Gooſeberries	for tarts.	— Pope.
Cherries		Walnuts.
— Early dwarf		

On the Hotbeds.

Melons.	Strawberries.

The GREENHOUSE.

Air muſt be given very freely, except on cold nights.

American aloes muſt be frequently watered, and placed near the windows.

Geraniums take out towards the end of the month, except thoſe with variegated leaves.

Myrtles which are ſmall, turn out of the pots, and plant them in a bed of rich light earth.

Orange-trees muſt be freſh potted, if not done laſt month; and as ſoon as the leaves of mulberry-trees are the ſize of a half crown, it ſhews that the weather is ſettled, and they may ſafely be ſet out.

Water conſtantly the young trees ſown in March, or any on the hotbeds.

Seedling plants ſhould be attended to, and ſhaded with mats, when the ſun is hot in the middle of the day, and be frequently watered.

Succulent plants ſhould be earthed at the top, but not ſhifted, and ſtill remain in the houſe towards the windows, and be often but ſparingly watered.

Water plants frequently, and a little at a time, rather than too much at once.

Windows may be kept open all day, and, towards the end of the month, all night, to inure the plants by degrees to the open air.

JUNE.

The KITCHEN-GARDEN.

Aromatic-herbs, flowers, and ſhrubs, for drying and diſtilling, gather when dry; they are in the greateſt perfection juſt as the flowers begin to open.

Beans will ſtill require earthing, and the tops of thoſe which are in flower ſhould be cut off.

Beets ſhould be thinned to their proper diſtance of ten or twelve inches at leaſt.

Boorcole, plant the firſt crop, and ſow the third.

Brocoli, plant the firft, prick out the third, and fow the fourth crop.

Cabbages, plant the third crop, prick out the fourth, and fow the fifth.

Red cabbages, plant the fecond crop, and fow the third.

Savoys, plant the firft crop, prick out the fecond, and fow the third.

Cabbage-turneps, &c. for cattle, as defcribed laft month, fow for the fecond crop.

Carrots and parfneps, finifh hoeing, and leave them at eight or ten inches at leaft.

Capficums, finifh planting out, and hoe and water them frequently in dry weather, for in late feafons they will not ripen unlefs brought very forward early.

Caterpillars, fearch for on cabbages and apple-trees.

Cauliflowers, plant the third crop, and prick out the fourth.

Celery, plant the firft crop, prick out the fourth, and fow the fifth.

Colefeed and rape may now be fown, if the ground be in proper order.

Coleworts, fow the fecond crop.

Crefs and muftard, intended to ftand for feed, fhould now be hoed for the laft time; the crefs left at fix inches diftance, and the muftard at eight.

Cucumbers againft walls, nail up or ftick.

Thin and draw up earth to the ftems of thofe under bell-glaffes, and water them frequently.

Endive, plant out the firft crop, thin the fecond, and fow the third.

Finochio, or Italian fennel, fow the third crop.

Hoe or weed the beds of beets, carrots, leeks, lettuces, onions, parfley, parfneps, turneps, &c. to their proper diftances.

Kidney-beans, fow the fourth crop, and place fticks to the runners.

Lavender, rofemary, rue, and fage-cuttings, plant in the fhade.

Leeks, hoe and thin to about four inches diftance, to be ready for tranfplanting in July.

Lettuces, fow the fixth crop in a cool place, and thin thofe for feed to a foot diftance.

Melons in frames, cover with mats in the middle of the day, and lay pieces of broken earthen plates or difhes under the fruit.

Plant out thofe for the oiled papers.

Mufhroom-beds, examine frequently, that they do not want water.

Onions, thin to fix or eight inches diftance.

Parfley in beds for garnifh, and the large rooted, thin to eight or ten inches diftance.

Parfneps muft be thinned to ten or twelve inches.

Peas, fow the laft marrowfats in a cool place.

Plant Boorcole	Celery	Melons
Brocoli	Endive	Rofemary
Cabbages	Lavender	Rue
Cauliflowers	Lettuces	Sage.

Pot-herbs and fweet-herbs, weed frequently, and gather for drying, juft before they begin to flower; then tie them up in fmall bunches, and hang them acrofs lines in a fhady room to dry.

Prick out brocoli, cabbages, cauliflowers, celery.

Radifhes, fow the feventh crop, and turnep rooted, and black Spanifh, in a cool place.

Rape and colefeed may now be fown.

Seeds of all forts muft be gathered as they ripen, and defended from birds.

Sow Boorcole	Finochio	Rape
Cabbages	Kidney-beans	Spinach
Celery	Lettuces	Turneps
Colefeed	Peas	Turnep radifhes.
Coleworts	Radifhes	
Endive		

Spinach, fow the fifth crop thin in a cool place.

Thin the following crops, and leave them at their proper diftances, as

Beets, at ten or twelve inches at leaft.

Carrots, at eight or ten inches.

Leeks may be left at only four inches, and tranfplanted in July.

Lettuces intended for feed, at leaft a foot afunder; but fifteen inches is better.

Onions, at fix or eight inches.

Parfley, in beds at eight or ten inches.

Parfneps, to ten or twelve inches.

Turneps, at fix or eight inches.

Turneps, fow the fourth crop, and hoe the others.

Water all beds of feedlings and cuttings frequently.

Weeding the young crops is of the utmoft confequence this month, efpecially if it be a rainy feafon, and muft not on any account be omitted; nor let any weeds run to feed.

Produce of the Kitchen-Garden.

Artichokes	Cives	Peas
Afparagus	Crefs	Potatoes
Balm	Efchalots (green)	Purflane
Bafil	Fennel	Radifhes
Beans	Horfe-radifh	Sage
Beets	Leeks	Savory
— green	Lettuces	Sorrel
Borage	Marjoram	Spinach
Brocoli	Marygold	Sprouts of Brocoli
Burnet	Mint	Tanfey
Cabbages	Muftard	Thyme
Carrots	Onions	Turneps
Cauliflowers	Parfley	Water-creffes.
Celery	Parfley-roots	
Chervil		

On the Hotbeds.

Carrots	Kidney-beans	Mufhrooms
Cucumbers	Melons	Strawberries.

The FLOWER-GARDEN *and* SHRUBBERY.

Anemones, take up before their leaves are quite withered, and they will be more readily found.

Annuals from the hotbeds will require frefh potting, and may be placed in the open air if it be fettled and warm, but will want frequent watering.

Annuals on the borders fhould have the earth ftirred up with a hoe, and be often watered, and more fown to flower in autumn, as defcribed laft month.

Biennials and perennials, tranfplant from the feedbeds.

Borders of the flower-garden and fhrubbery, frequently hoe and rake.

Box may be clipped, but always do it in moift weather.

Bulbous-rooted flowers of every fort, whofe leaves are nearly withered, fhould be taken up before the leaves entirely difappear, and put into fhallow wooden boxes, as directed for hyacinths, as foon as dry.

Carnations will require to be examined frequently, to tie them up to the fticks, and fearch for the earwigs.

Evergreens may be clipped in moift weather.

Grafs and gravel walks will frequently require weeding, but

t ſhould be done after rain, for then the roots may be drawn out without breaking: they will often want mowing and rolling alſo.

Hyacinths, as ſoon as dried, ſhould be taken out of the ground, then rubbed with a woollen cloth to clear them entirely from earth, and laid in ſhallow wooden drawers; but they ſhould never be put into flower-pots, earthen pans, or laid on brick floors, for they will contract a mildew or mouldineſs, which will cauſe them to rot.

Inſects of all ſorts ſhould be ſought for and deſtroyed.

Kidney-beans will want earthing, ſticking, and the runners to be trained to the ſticks.

Mignonette, from the ſeedbeds, ſhould be tranſplanted into ſmall pots, and only three put into each; it will then be ready to put into larger pots, or upon the borders.

Myrtles, and other greenhouſe plants againſt walls, ſhould be frequently watered, all foreright ſhoots pulled off while ſmall, and the others nailed to the walls with long narrow ſhreds of fine cloth.

Perennials and biennials, plant out from the ſeedbeds in ſhowery weather; and, if the ſun ſhould be very hot ſoon after, cover each plant with a flower-pot, until they have taken root.

Pinks may now be increaſed by making pipeings or cuttings, but a glaſs muſt be placed over them.

Plant out all annuals from the ſeedbeds and hotbeds.

Biennials and perennials from the ſeedbeds.

Mignonette both in pots and on borders.

Pipeings of carnations and pinks.

Ranunculuſes, attend to and take up, as ſoon as the leaves are quite withered.

Roſe-trees may now be layered and budded, and ſome very rotten dung ſpread on the ground, and digged in, and frequently watered; the flies and grubs muſt alſo be attended to in this month.

Seedlings of trees, ſhrubs, or flowers, ſhould be covered with mats in the day-time, and frequently watered; but, if in pots, remove them into the ſhade.

Seeds of all ſorts which are ripening ſhould be attended to, and gathered before they drop out of the pods. By a little attention to them, in moſt ſeaſons, you may have enough for the next year, and ſave the expence of buying.

Shrubberies ought frequently to be looked over, all ſtraggling branches ſhould be cut off or tied up, and the grounds ſtirred with a Dutch hoe.

Shrubs in pots, ſet in pans, and water frequently.

Sow annuals as deſcribed laſt month, to flower in autumn, in any vacancies that there may be on the borders of the ſhrubbery or flower-garden.

Tulips ſhould be taken up before their leaves are quite decayed, that you may find them more readily; and if any of the offsets be very ſmall, plant them again directly, and lay the roots to dry in ſhallow boxes.

Tulips produce new bulbs every year, and the old ones decay entirely; therefore they ſhould never be taken up until the new bulbs are quite formed.

Water annuals in pots conſtantly; ſeedbeds of all ſorts; and ſhrubs and trees lately planted.

Weeds in this month are of the utmoſt conſequence to be deſtroyed, before they flower, and when cut down ſhould be raked up and carried away, for many ſorts will otherwiſe ripen their ſeeds while they remain on the ground.

Trees and Shrubs in Flower.

Azaleas	Gueldres roſe
Bay-tree	Honeyſuckles
Berberry-tree	Horſe-cheſnuts
Jeſſamines	Roſes
Kalmias	Roſe acacia
Laburnums	Roſemary
Lavender	Sage-tree
Lilacs	Snowdrop-tree
Magnolias	Sweet-briars
Maple (ſcarlet).	Syringa
Mountain aſh	Tulip-tree—and ſome others.
Priv-	

Flowers.

Amaranths	Lupines
Annual ſtock	Lychnideas
Apocynums	Mallows
Balſams	Martagons
Bear's-breech	Marygolds
Campanulas	Narciſſuſes
Carnations	Naſturtium
Chineſe pinks	Orchiſes
Chryſanthemum	Ornithogalums
Convolvulus	Peonies
Cornflower	Periwinkles
Cowſlip (American)	Pinks
Everlaſting flower	Poppies
Feverfew	Ranunculuſes
Foxgloves	Rockets
Fraxinellas	Saxifrage
Fritillaries	Scabious
Gentianellas	Scarlet lychnis
Gladiolus	Snapdragon
Globe-flower	Spiderwort
Golden-rod	Stocks
Hollyhocks	Sunflowers
Honeſty	Sweet Williams
Iriſes	Sweet peas
Ladies ſlipper	Tulips
Larkſpurs	Wall-flowers—and many others.
Lily of the valley	

The FRUIT-GARDEN *and* ORCHARD.

Apple-trees in eſpaliers muſt be frequently examined; all foreright ſhoots ſhould be taken off while ſmall, and the others regularly trained to their proper diſtances; and ſearch for caterpillars.

If the ſtandard apple-trees be infected with caterpillars, light ſome damp ſtraw, and with a fork direct the ſmoke through the tree, and they will ſoon be ſuffocated, and inſtantly drop down.

Apricots muſt be thinned for the third and laſt time, and the ſhoots frequently nailed up.

Blighted trees muſt be conſtantly attended to, as directed laſt month.

Bud apricots, cherries, and peach-trees.

Caterpillars, ſearch for upon apple-trees.

Cherry-trees againſt walls ſhould be covered with nets, to defend the fruit from birds.

Eſpalier-trees, look over frequently, and train in the ſhoots in regular order.

Fig-trees, nail up with very ſtrong ſhreds.

Nail up every week ſhoots of wall-trees.

Nectarines and peaches will require thinning the ſecond time, the ſhoots nailing up, and pinching off the ends where vacancies want filling up.

Pears and plums, nail up as they ſhoot, and pull off all foreright ſhoots.

Stocks, intended to be budded, keep free from weeds.

Strawberries in flower will want frequent watering in dry weather.

Lay tiles or wheat-ſtraw under the fruit of the ſcarlets, and pull off all decayed leaves; this will keep the fruit clean, and cauſe it to ripen ſooner by ſeveral days.

Cut off all runners as faſt as they ſhoot; but, if you want to make ſome freſh beds, reſerve the firſt runners as they are the ſtrongeſt.

Attend to the flowering of the hautbois, as directed laſt month.

Vines will require conſtant attendance, in rubbing off improper buds, and nailing up the ſhoots.

Water thoſe trees frequently which are blighted.

All newly-planted trees in dry weather.

Strawberries which are in flower.

Fruits in Seaſon.

Almonds.	Pears
Apples	— Gobert
— John apple	— Holland bergamot
— Franche rennet.	— Saraſin.
Apricots } for tarts.	Pears for baking
Currants } for tarts.	— Pope.
Gooſeberries } for tarts.	Strawberries
Cherries	— Alpine
— Early dwarf	— Scarlet.
— May duke.	Walnuts.
Melons.	
Nectarines } for tarts.	
Peaches } for tarts.	

The GREENHOUSE.

Air may now be given very freely in the greenhouſe, and the windows may be kept open all night.

Aloes, freſh earth, and place near the windows, but take out the Americans.

Cuttings of various ſorts, plant under bell or hand-glaſſes at the end of the month.

Earth all the plants every month at top, if not ſhifted; it cauſes them to look neater, and to grow better.

Geranium ſeedlings ſown in March will now require pricking out, and cuttings planted under glaſſes.

Inarch jeſſamines, lemons, and oranges.

Layer jeſſamines, oleanders, and many others.

Myrtle cuttings, plant at the end of the month under glaſſes, but never take them off till they have grown two inches.

Orange-trees, if not taken out at the end of laſt month, will require it at the beginning of this. Clean well the leaves which are mildewed, or have inſects on them, with a ſpunge and warm water.

Inarching may now be performed.

Thoſe on hotbeds, and the young ſeedlings, muſt be attended to, and the ſtems of the old trees ſhould be frequently waſhed.

Seedling plants of all ſorts, frequently water, and ſhade in the middle of the day, and prick out the ſtrongeſt to make room for the others.

Succulent plants may now be ſhifted, the offsets taken off, placed near the windows, and be frequently watered.

Watering ſome of the plants will be neceſſary almoſt every day.

JULY.

The KITCHEN-GARDEN.

Aromatic herbs, flowers, and ſhrubs, gathered laſt month, if hung on lines will ſoon be dried; it is then better to ſtrip off the leaves and flowers from the ſtalks, and put them into paper-bags, which will preſerve their flavour better, and keep them free from duſt. Continue to gather them before their flowers are too much opened.

Aſparagus, if you like to have ſome in autumn, muſt be attended to at the beginning of this month; the ſtalks muſt be cut down, and, if it be dry weather, the beds muſt be very well watered with the draining which comes from a dunghill; the next day fork them up lightly, and rake them ſmooth; if the weather continues dry, water it every night for a week, and in about eight or ten days it will be fit to cut.

If you practiſe this every year, leave two or three beds uncut at ſpring, and make ſome more beds to allow for this double crop.

Beans, plant the fifth crop of mazagan, and the fourth of Windſors, for late crops.

Beets, finiſh thinning to their proper diſtance.

Boorcole, plant the ſecond crop, prick out the third, and the firſt of Anjou.

Brocoli, plant out the third crop, and prick out the fourth.

Cabbages, plant the fourth crop, and prick out the fifth.

Red cabbages, prick out the third crop.

Savoys, plant the ſecond crop, and prick out the third.

Cabbage turneps, &c. for cattle, prick out the firſt crop.

Carrots to draw young, ſow the third crop.

Capſicums, earth up and frequently water.

Cauliflowers, plant out the fourth crop.

Celery, plant the ſecond crop, and prick out the fifth.

Coleſeeds, coleworts, and rape, finiſh ſowing.

Prick out the ſecond crop of coleworts.

Cucumbers on the open ground, ſtick with branches of elm or other ſticks.

Endive, lay tiles on it, or tie up the firſt crop, plant the ſecond, thin the third, and ſow the fourth crop very thin.

Eſchalots and garlic, take up ſome for preſent uſe.

Finochio, ſow the fourth crop.

Kidney beans, ſow on a ſouth border the fifth and laſt crop.

Lavender and roſemary cuttings, ſtill plant.

Leeks, plant out in double rows, at ſix inches diſtance, and a foot between the rows.

Lettuces, ſow the ſeventh crop in a cool place, and hoe thoſe intended for ſeed.

Melons muſt be frequently attended to.

Muſhrooms, water in dry weather.

Onions, when their leaves begin to wither, pull out of the ground.

Sow the firſt crop of Welſh, and the laſt crop to draw young.

Parſley, ſow the third crop near a ſouth wall.

Peas ſown laſt month will want ſticking; and ſow the fourth crop of hotſpurs.

Plant Beans	Cauliflowers	Lettuces
Boorcole	Celery	Red cabbages
Brocoli	Lavender	Roſemary
Cabbages	Leeks	Savoys.

Pot-herbs and ſweet-herbs, gather for drying, and, as ſoon as dried, ſtrip off the leaves and put them into paper-bags.

Prick out boorcole, brocoli, cabbages, celery, and coleworts.

Radiſhes, ſow the eighth crop, alſo turnep-rooted, and black Spaniſh, and hoe the firſt.

Seeds of all ſorts muſt be attended to, and gathered as they ripen.

Sow Carrots	Kidney-beans	Radiſhes
Coleſeed	Lettuces	Rape
Coleworts	Onions	Spinach
Endive	Parſley	Turneps
Finochio	Peas	Turnep-radiſh.

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Spinach, fow the fixth crop, and the firft of prickly, in a cool place, very thin.

Turneps, fow the fifth and principal crop for winter ufe, and hoe the other crops.

Water beds of feedlings and all young crops.

Weeds muft be conftantly attended to, and raked off the ground, or elfe many forts will ripen as they lay on the ground.

Produce of the Kitchen-Garden.

Angelica	Leeks
Artichokes	Marjoram
Afparagus (if cut down)	Marygolds
Balm	Melons
Bafil	Mint
Beans	Mufhrooms
Beet (green)	Muftard
Borage	Onions
Burnet	Parfley
Cabbages	Peas
Carrots	Potatoes
Cauliflowers	Purflane
Chervil	Radifhes
Cives	Rocambole
Crefs	Rofemary
Cucumbers	Sage
Endive	Savory
Efchalots	Sorrel
Fennel	Spinach
Garlic	Tanfey
Horfe-radifh	Thyme
Kidney-beans	Turneps.
Lavender	

The FLOWER-GARDEN *and* SHRUBBERY.

Annuals in pots require a conftant attention, that they do not want water, and alfo thofe on the borders, which will require fticking and tying.

Seeds nearly ripe muft be watched and gathered, or elfe many forts will be loft.

Annuals, to flower late in autumn, may ftill be fown.

Auriculas and polyanthufes from the feedbed fhould be tranfplanted upon a fhady border, and, if poffible, in rainy weather.

Box and evergreen fhrubs, finifh cutting.

Bud the curious forts of jeffamines, rofes, and feveral other forts.

Bulbous roots muft ftill be attended to, to take up dry and clean, and then put in fhallow wooden boxes. Saffron-crocus, and many other forts, which flower in autumn, may now be planted.

Carnations muft be conftantly watered, earwigs fearched for, and layers and pipeings made.

Evergreens, if required, may now be tranfplanted, but it fhould be done in rainy weather; and let the clipping be finifhed.

Grafs and gravel walks muft be conftantly weeded, mowed, and rolled.

Hyacinths fhould be examined to fee that there is no mouldinefs among them; and if any be decayed, they muft be taken away.

Kidney-beans muft be examined that they are trained to the fticks, and watered in dry weather.

Lilies of many forts, if they have done flowering, may be taken up; but the roots are fo full of moifture, that the fmall offsets muft be planted again directly.

Mignonette fhould now be fown to flower in winter, and more put into pots.

Myrtles, and other greenhoufe plants againft walls, will require frequent nailing and watering.

Perennials and biennials, finifh planting from the feedbeds.

Pinks, finifh making pipeings or cuttings.

Plant auricula and polyanthus feedlings.

Biennial and perennial feedlings.

Cuttings of fcarlet lychnis and pinks.

Evergreens, if the weather be rainy.

Mignonette into pots. Offsets of lilies.

Offsets of autumnal-flowering bulbs.

Pipeings of carnations and pinks.

Saffron-crocus.

Ranunculufes muft be taken up, and laid in the fhade to dry, then well cleaned from earth, and laid in fhallow boxes, or put into paper boxes

Rofe-trees, finifh layering and budding.

Seedling-trees, fhrubs, and flowers, muft be properly fhaded and watered.

Seeds now begin to ripen very faft; therefore muft be conftantly attended to, and gathered.

Shrubberies will require frequent attention in pruning or hoeing.

Sow the laft crop of hardy annuals and mignonette.

Tulips fhould be finifhed taking up, and, as foon as dry, the earth fhould be rubbed off, and then laid in fhallow boxes.

Water annuals in pots frequently, feedbeds, and young trees and fhrubs planted this fpring.

Weeds, if it be rainy this month, grow very faft; therefore the ground fhould be frequently hoed, and no weeds fuffered to run to feed.

Trees and Shrubs in Flower.

Azaleas	Honeyfuckles	Rofe-acacias
Bramble	Jeffamines	Rofes
Broom	Iteas	Rofemary
Button-wood	Kalmias	Syringa
Ciftufes	Laburnums	Sweet-briar
Climber	Magnolias	Tulip-trees.

Flowers.

African marygold	Mallows
Amaranths	Martagons
Balfams	Marvel of Peru
Bachelor's buttons	Nafturtiums
Campanulas	Ornithogalums
Candy-tufts	Panfeys
Carnations	Peonies
Catchfly	Periwinkles
Chinefe pinks	Pinks
Chryfanthemums	Poppies
Cockfcombs	Ranunculufes
Columbines	Rockets
Convolvulus	Saxifrage
Egg-plants	Scabious
Feverfew	Scarlet beans
French marygolds	Scarlet lychnis
Globe-flower	Spiderwort
Golden-rods	Stocks
Hollyhocks	Sunflower
Honefty	Sweet peas
Irifes	Sweet fultan
Larkfpurs	Sweet Williams
Lavateras	Tricolors
Lilies	Tuberofes
London pride	Veronicas
Lupines	Wall-flowers—and many others.
Lychnideas	

The Fruit-Garden *and* Orchard.

Ants, flies, and wafps, begin to deftroy as foon as they appear, by hanging bottles half filled with fugar, or honey and water.

Apricot-trees, frequently look over; pull off all foreright fhoots, and nail thofe which are to remain.

Blighted trees attend to, and water the borders frequently.

Budding of apricots, cherries, and peaches, finifh.

Currants, intended to be preferved till autumn, fhould now be covered with mats.

Efpalier-trees, examine frequently, and train in the fhoots.

Fig-trees require nailing up as they fhoot with ftrong nails and long fhreds.

Fruit fhould be gathered in the morning as foon as the fun has dried the dew from it, and before it is heated, and then laid in a cool room.

Fruit-room fhould now be prepared; it fhould be fituated to the fouth, the fhelves neat and clean, the walls covered with tiles, or elfe white-wafhed or painted white.

Infects of all forts deftroy.

Nail up every week the the fhoots of wall-trees.

Nectarines and peaches, thin for the third and laft time, and nail up the fhoots.

Strawberries, in flower, water conftantly in dry weather, and pull off decayed leaves.

Tie up the fruit of the hautbois and other large forts to fticks.

Cut off all runners after the firft, and thefe fhould be planted out as foon as fome rain falls.

Vines muft be very frequently attended to, to nail up the fhoots, and to pull off all improper buds.

Wall-trees will require a conftant attention to nail up, and water in very dry weather.

Water the blighted and new planted trees.

Strawberries in flower, or runners lately planted.

Fruits in Seafon.

Apples	Peaches, Yellow alberge
— Juneating	— Early red.
— Codlin.	Pears
Apricots	— Small mufcat
— Early mafculine.	— St. John's
Cherries	— Aurate.
— Dukes	Plums
— Hearts	— Early Tours
— Kentifh	— Blue primordian
— Carnation.	— Early yellow.
Currants.	Strawberries
Figs	— Scarlet
— Early long blue.	— Alpine
Goofeberries.	— Hautbois
Grapes	— Carolina
— Sweet water	— Red wood
— Mufcadine	— White wood
— Black clufter.	— Bath chili
Melons.	— Devonfhire chili
Peaches	— Chili.
— Early Anne	

The Green-House.

African aloes, and other fucculent green-houfe plants, may now be fet out in the open air.

Cuttings of afters, geraniums, grewias, myrtles, and any other forts you choofe to propagate, fhould now be planted under bell or hand-glaffes; but the glaffes fhould not be taken off until they have grown an inch.

Earth the tops of all the pots, firft taking a little out.

Geranium cuttings, plant, and prick out the feedlings before they are too thick.

Thofe with variegated leaves do better in alcoves, or under a little fhelter.

Greenhoufe, paint and whitewafh.

Inarching and layering various forts may ftill be performed.

Myrtle cuttings, plant under glaffes, and water frequently near the glafs, without taking them off; and the fmall ones may be planted in beds.

Orange-trees muft be examined, if there be not infects under the leaves, and wafh them off.

Thofe on hotbeds, fhade and water often.

Inarching may ftill be performed.

Stocks, when four inches high, plant in feparate pots.

Pans fhould be placed under all the pots, as it is better for the plants, and faves much trouble in watering.

Seedling plants, fhade, water, and prick out.

Succulent plants, as aloes, cereufes, ficoides, Indian figs, torch-thiftles, &c. may now be fet abroad.

Watering the plants muft be attended to every day.

AUGUST.

The Kitchen-Garden.

Alifanders, angelica, and chervil, fow.

Afparagus cut down laft month will require conftant watering.

Beans planted laft month will want watering.

Boorcole, brocoli, cabbages, cauliflowers, and coleworts, lately planted, will require hoeing around them, and earth muft be drawn up to their ftems.

Brocoli, plant out the third crop.

Cabbages, for the firft crop at fpring, fhould be fown about the tenth or twelfth day of the month.

Cabbage-turneps, prick out the fecond crop.

Carrots, fown laft month, weed as foon as they appear.

Cauliflowers, for the firft fpring crop, fow about the twentieth in rich earth, but fhade them in the middle of the day by mats.

Celery, earth the firft crop for blanching, and plant out the third.

Coleworts, plant out fome of the fecond crop.

Corn fallad, fow on beds.

Cucumbers for pickling, either large or fmall, to have them fine, fhould now be gathered; and they will be free from fpots, and fave much trouble in greening; and train them regularly into the fticks.

Endive, frequently tye up for blanching, plant out the third crop, and thin the fourth.

Efchalots, garlic, and rocambole, take up if the ftalks be quite withered, clean them from earth, and keep them in a dry place.

Kidney-beans, fown for the laft crop, muft be watered in dry weather.

Leeks, finifh planting out.

Lettuces, for ftanding through the winter, and for forcing, muft now be fown very thin at three different times in the month, and plant out the laft fown, on a fouth border.

Melons, in rainy weather, muft be defended from wet by putting hand-glaffes over them, and place fticks for the pickling melons to run up.

Mufhroom-beds prepare, by having dung and fpawn ready for the next month.

Onions muft be frequently turned, that they may be well dried.

Sow the fecond crop of Welfh onions.

Pepper-mint, gather for diſtilling as ſoon as it begins to flower.

Peas, ſow ſome hotſpurs on a ſouth border for the fifth and laſt crop.

Plant celery, endive, leeks, and lettuces.

Prick out Anjou, Bruſſels boorcole, cabbage-turneps, and turnep-rooted cabbages.

Radiſhes, ſow the ninth and laſt crop.

Seeds, nearly ripe, muſt be guarded from birds, particularly radiſhes.

Sow Aliſanders	Creſs	Radiſhes
Angelica	Fennel	Sorrel
Cabbages	Lettuces	Spinach
Cauliflowers	Muſtard	Turneps.
Chervil	Onions	
Corn-ſallad	Peas	

Spinach, ſow the ſecond crop of prickly broadcaſt, and then, at ſpring, hoe it into beds four feet wide, with paths of eighteen inches between the beds.

Turneps, hoe, and ſow the ſixth crop.

Water ſeedling-beds in a morning.

Weeds begin to grow very faſt in moiſt weather, therefore muſt be hoed frequently, raked together and carried away, or they will grow.

Produce of the Kitchen-Garden.

Angelica	Creſſes	Parſley-roots
Artichokes	Endive	Peas
Aſparagus, if cut down	Eſchalots	Potatoes
	Fennel	Purſlane
Balm	Finochio	Radiſhes
Baſil	Garlic	Rocambole
Beans	Horſe-radiſh	Roſemary
Beets	Lavender	Sage
— green	Leeks	Savory
Borage	Lettuces	Savoy cabbages
Burnet	Marjoram	Sorrel
Cabbages	Marygolds	Spinach
Carrots	Melons	Tanſey
Cauliflowers	Mint	Thyme
Celery	Muſhrooms	Tomatoes
Chervil	Muſtard	Turneps
Cives	Onions	Turnep-radiſhes
Cucumbers, and for pickling	Parſley	Water-creſſes.

The FLOWER-GARDEN *and* SHRUBBERY.

Annuals in pots will want frequent watering, thoſe on borders ſticking and tying, and the ſeeds gathering of thoſe nearly ripe.

Anemone and auricula ſeeds are ſown now by many, but it is better in January or February; ſlip and freſh-pot the auriculas.

Balſams, in pots, intended to raiſe ſeed from, muſt be removed into ſhelter.

Bulbous roots, flowering in autumn, plant early in the month.

Bulbous roots of all ſorts ſhould have their offsets planted at the end of the month.

Carnation layers, take off, and plant out the pipeings from under the glaſſes.

Evergreen trees and ſhrubs, finiſh clipping.

Graſs-walks and lawns require frequent mowing.

Gravel walks muſt be weeded and rolled.

Lilies, take up if their leaves be decayed; but the offsets muſt be planted again directly.

Mignonette, to flower in winter, plant in pots, and place them under a ſouth wall.

Myrtles and greenhouſe plants againſt walls muſt be pruned and nailed, and conſtantly watered.

Pinks, plant out the pipeings, if they have ſtruck roots.

Plant autumnal-flowering bulbous roots.

Guernſey lilies and mignonette in pots.

Offsets of all ſorts of bulbous roots.

Seeds of all ſorts of flowers and ſhrubs, attend to, and gather them as they ripen.

Seedlings in pots, remove to where they will have the morning ſun.

Shrubberies will want frequent hoeing to keep down the weeds.

Strawberry runners will require to be conſtantly taken off as they ſhoot out, to keep the borders and walks neat.

Water plants in the morning, at the end of the month.

Weeds muſt be frequently deſtroyed to prevent their running to ſeed.

Trees and Shrubs in Flower.

Althæas	Roſe-acacia
Brooms	Roſes
Ciſtuſes	Spiræas
Climbers	Syringas
Honeyſuckles	Tamariſk
Jeſſamines	Trumpet-flower
Paſſion-flowers	Tulip-trees
Pomegranates	Virgin's bower.

Flowers.

African marygolds	Lavateras
Amaranths	London pride
Aſters	Love-apples
Auriculas	Lupines
Balſams	Marvel of Peru
Campanulas	Mignonette
Candy-tufts	Naſturtiums
Capſicums	Nigella
Carnations	Pinks
Catchfly	Polyanthus
China aſters	Poppies
China pinks	Scarlet beans
Chryſanthemums	Spider worts
Cockſcombs	Starworts
Columbines	Stocks
Convolvulus	Sunflowers
Daiſies	Sweetpeas
Egg-plants	Sweet ſultans
Feverfew	Sweet Williams
French marygolds	Tricolors
Golden-rods	Tuberoſes
Hollyhocks	Wall flowers
Larkſpurs	Zinnias, and many others.

The FRUIT-GARDEN *and* ORCHARD.

Ants, flies, and waſps, deſtroy, by ſupplying freſh bottles of ſugar, or honey and water.

Apple-trees on eſpaliers will require frequent examining.

Budding of all trees, finiſh, and pull off buds and ſhoots from the ſtocks.

Currants intended to be preſerved, finiſh covering with mats.

Eſpalier-trees, conſtantly examine to train in the ſhoots.

Fig-trees, nail up with ſtrong nails.

Fruit, gather early in the morning, and lay it in a cool room.

Fruit-room, finiſh it by white-waſhing or painting, and putting the ſhelves in order.

Inſects of all ſorts deſtroy.

Nail up every week the fruit-trees.

Nectarines and peaches nail up frequently.

Pear and plum-trees, both on walls and againſt eſpaliers, attend to conſtantly.

Strawberry runners if rooted, tranſplant in rainy weather, and cut off all the others as they ſhoot.

Vines muſt be conſtantly nailed up, for they ſhoot very faſt, and the bunches of grapes begin to be heavy, and all weak ſhoots muſt be conſtantly taken off.

Water ſtrawberry runners lately planted, or any blighted fruit-trees.

Fruits in Seaſon.

Apples	Peaches, Large mignon
— Codlins	— Early chevreuſe
— Dutch codlin	— Royal George
— Margaret apple	— Red Magdalen
— Summer pearmain.	— White pavy
Apricots	— Malta
— Tranſparent	— Chancellor
— Algiers	— Belle garde
— Roman	— Tranſparent
— Bruſſels	— Chevreuſe.
— Breda	Pears
— Turkey.	— Magdalen
Cherries	— Queen's pear
— Harriſon's duke	— Belliſſime
— Carnation	— Muſk bourdon
— Ox heart	— Great blanquet
— Bleeding heart	— Summer arch-duke
— Flemiſh	— Supreme
— Lukeward	— Skinleſs
— Caroon	— Early ruſſet
— Brandy black.	— Summer bergamot
Currants.	— Red orange
Figs.	— Muſk orange
Gooſeberries.	— Ladies fleſh
Grapes	— Jargonelle
— Black July	— Green muſcat
— White July	— Royal ſummer
— Black ſweetwater	— Auguſt perfume
— White ſweetwater	— Summer bonchretien
— Muſcadine	— Summer muſk
— Currants	— Engliſh beurrée.
— Black cluſter.	Plums
Mulberries.	— Royal Tours
Nectarines	— Mirabelle.
— Fairchild's early	Raſpberries
— Violet	— Red
— Elruge	— White
— White Italian.	— Double-bearing.
Peaches	Strawberries
— Yellow alberge	— Red Alpine
— White Magdalen	— White Alpine
— Early Newington	— Red Wood.

The Greenhouse.

Aloes, both African and American, take off the offsets, and plant them in ſeparate pots.

Cuttings of myrtles, geraniums, &c. often water.

Earth the tops of all the pots.

Geraniums and myrtles, conſtantly water, but pour on the water gently.

Oranges, ſtill bud till the middle of the month.

Prune any which require it, as this is the ſeaſon of their ſhooting.

Water the young ſtocks and thoſe on hotbeds.

Painting and white-waſhing the greenhouſe, now finiſh.

Seedling plants, finiſh pricking out, and water and ſhade them.

Shift the plants which require it into larger pots, and earth the others.

Succulent plants ſhould be ſhifted, and if the end of the month be rainy, take them in.

Water very freely if dry weather, but do it in the morning.

SEPTEMBER.

The Kitchen-Garden.

Aromatic herbs and ſhrubs ſhould have their decayed ſtalks cut down to ſtrengthen them, and tranſplant them.

Beans planted in July muſt be earthed up, and the tops pinched off as ſoon as they begin to flower.

Boorcole, plant out the third crop, and the firſt of Anjou ; hoe the other crops and earth them up.

Brocoli, plant out part of the fourth crop, and earth up the other crops.

Cabbages, plant out the fifth crop ; prick out the firſt crop on a ſouth border, and earth up any that want it.

Plant out the third crop of ſavoys and red cabbages.

Cabbage-turneps, plant out the firſt crop.

Carrots ſown in July, hoe, and leave at ſix inches diſtance.

Cauliflowers ſown laſt month muſt be pricked out, watered, and ſhaded until they are rooted.

Earth up the fourth crop, and break down the leaves if they begin to flower.

Celery, plant out the fourth crop, and earth up the firſt and ſecond to blanch.

Chardons will require blanching.

Coleworts, plant out more of the ſecond crop, a few at a time, to thin the bed.

Creſs and muſtard, ſow every week, and at the end of the month under glaſſes.

Cucumbers for pickling ſhould be finiſhed gathering ; which will ſhow to you the advantage of ſticking them, and pickling early.

Endive, plant out a little of the fourth crop to thin it, and give the reſt more room.

Tie up ſome to blanch.

Eſchalots, garlic, and rocambole, ſhould have the offsets and ſmall roots planted.

Lettuces muſt be thinned early in the ſeedbed, if ſown thick, and pricked out on a ſouth border to about four or five inches aſunder.

Melons for pickling will be fit to gather.

Muſhroom-beds, make at the beginning of the month.

Naſturtiums, gather for pickling.

Onions, finiſh ſowing early in the month the ſecond crop of Welſh.

Weed thoſe ſown laſt month, before the weeds are high.

Plant Boorcole	Endive	Rocambole
Brocoli	Eſchalots	Tarragon
Cabbages	Garlic	Water-creſſes.
Coleworts		

Prick out cabbages, cauliflowers, lettuces.

Seeds gather conſtantly as they ripen.

Sow Creſs	Onions	Turneps
Muſtard	Spinach	Water-creſſes.

Spinach, finiſh ſowing for ſpring uſe, and hoe that ſown laſt month.

Tarragon, roots plant.

Turneps, turnep-radiſhes, and black Spaniſh radiſhes, hoe and thin.

Water in dry weather any crops lately planted out.

Weeds muſt be particularly attended to amongſt the onions, carrots, and lettuces, while they are ſmall.

Produce of the Kitchen-Garden.

Artichokes	Eſchalots	Peas
Beans	Fennel	Potatoes
Beets	Finochio	Purſlane
— red	Garlic	Radiſhes
— white	Horſe-radiſh	Rocambole
— green	Kidney-beans	Roſemary
Borage	Lavender	Sage
Brocoli	Leeks	Savory
— early	Lettuces	Savoy cabbages
Burnet	Marjoram	Spinach
Cabbages	Marygolds	Sprouts of Cabbages
Carrots	Melons, and for pickling	Tanſey
Cauliflowers	Mint	Thyme
Celery	Muſhrooms	Tomatoes
Chervil	Muſtard	Turneps
Creſs	Onions	Turnep-radiſhes
Cucumbers and for pickling	Parſley	Water-creſſes.
Endive	Parſley-rooted	

The FLOWER-GARDEN *and* SHRUBBERY.

Anemones, ſingle-flowered, plant at the end of the month to flower early.

Annuals in pots muſt be frequently watered to ripen the ſeeds.

Auriculas, remove, that they may have the morning ſun, and finiſh ſlipping them.

Balſams, cockſcombs, egg-plants, or other curious annuals in pots, which you would wiſh to raiſe ſeeds from, muſt be placed under ſhelter in an alcove, greenhouſe, or room fronting the ſouth, and then the ſeeds will ripen.

Beds for planting bulbous roots, prepare early in the month.

Box for edgings, plant at the beginning of the month, or as ſoon as any rain falls.

Bulbous roots of all ſorts, plant, but the offsets and lilies and crown-imperials firſt, early in the month.

Evergreens, plant at the end of the month, if the ground be moiſt.

Graſs walks may now be repaired, or new ones made.

Gravel walks, weed and roll frequently.

Hyacinths, jonquils, lilies, narciſſuſes, polyanthus-narciſſuſes, &c. plant at the end of the month.

Laurel cuttings, plant in the ſhade.

Lauruſtinus and other ſhrubs, layer.

Lilies which flower late, take up as ſoon as their leaves are decayed, but plant the offsets again directly, and all other ſorts of lilies.

Mignonette in pots, place under ſhelter.

Myrtles and greenhouſe plants againſt walls muſt be conſtantly watered in dry weather.

Perennial ſeedlings, plant out, and divide the old roots.

Plant box for edgings, and evergreens.

Bulbous roots of all ſorts, the offsets firſt.

Crown-imperials and lilies early in the month.

Cuttings of laurel, honeyſuckles, jeſſamines.

Shrubs and trees of all ſorts, but not until after there has been ſome rain.

Strawberries and thrift for edgings.

Seeds, gather in the middle of the day.

Seedling-beds, weed and earth.

Shrubberies, prune, hoe, and rake.

Sow hardy annuals, as cornbottles, larkſpurs, panſeys, perſicarias, poppies, ſweet peas, &c. to flower early in ſpring.

Strawberry runners, conſtantly take off, and replace any of the edgings which want, but dig up entirely the old plants, then take away ſome of the earth, and bring in freſh loam.

Tulips, and all ſorts of bulbous roots, plant, the offsets firſt.

Turf, lay down for graſs walks.

Weeds, conſtantly hoe and rake off the ground; in dry weather the ſeeds will ripen, and in wet weather the roots will ſtrike again.

Trees and Shrubs in flower.

Althæas	Lauruſtinuſes
Bramble	Paſſion-flower
Broom	Pomegranates
Chaſte-tree	Roſes
Climbers	Spiræas
Honeyſuckles	Strawberry-tree in fruit, and flower.
Jeſſamines	

Flowers.

African Marygolds	Larkſpurs
Amaranths	Lavateras
Annual ſtock	Lupines
Aſters	Marvel of Peru
Auriculas	Mignonette
Balſams	Naſturtiums
Campanulas	Nigellas
Candy-tuft	Panſies
Capſicums	Pinks
Carnations	Polyanthuſes
Catchfly	Poppies
China aſters	Saffron
China pinks	Scarlet beans
Chryſanthemums	Spiderwort
Colchicums	Starworts
Colvolvulus	Stocks
Cornflowers	Sunflowers
Cyclamens	Sweet peas
Daiſies	Sweet ſultans
Egg-plants	Tricolors
Feverſew	Tuberoſes
French Marygolds	Veronicas
Golden rods	Wall-flowers
Guernſey lily	Zinnias—and ſome others.
Hollyhocks	

The FRUIT-GARDEN *and* ORCHARD.

Ants, flies, and waſps, conſtantly deſtroy.

Cherry kernels, ſow on beds.

Currant and gooſeberry cuttings and trees, plant.

Fig-trees, nail up frequently with ſtrong ſhreds.

Fruit-room, attend to, and pick out the rotten pears, or any other ſorts which begin to decay.

Grapes, put into bags of crape, gauze, or paper.

Inſects of all ſorts, deſtroy.

Plant currants, gooſeberries, raſpberries, ſtrawberries.

Strawberries ſhould be planted early in the month, if not done, and then they will be well rooted before the froſt begins.

Dreſs the beds, and plant ſome ſtrong roots in pots to force.

Plant ſome alpines in pots, and put them under a frame, and you will have fruit till January.

Top-dreſſing, in cold wet weather, of ſoot, ſalt, or aſhes, is proper to be ſpread on the borders of fruit-trees.

Vines will require frequent nailing, and take off all the weak ſhoots, that the grapes may not be too much ſhaded.

Fruits in Season.

Almonds.	Peaches, Nobleſſe
Apples	— Royal George
— Codlins	— Venus's nipple
— Summer pearmain	— Late chevreuſe
— Rambour	— Nivette
— Summer ruſſet	— Late purple
— Summer pippin	— Perſique
— Summer calville	— Double-flowered
— Summering	— Red pavy
— Quince apple.	— Late admirable
Apricots	— Double Montagne
— Dutch	— Hemſkirk.
— Temple	Pears
— Breda.	— Beurrée
Berberries.	— Long green
Cherries	— Striped long green
— Morello.	— White beurrée
Cheſnuts.	— Monſieur John
Currants.	— Swiſs bergamot
Figs.	— Autumn bergamot
Filberts.	— Autumn bonchretien
Grapes	— Green ſugar
— White chaſſelas	— Pear de vigne
— Burgundy	— Lanſac
— Black muſcadine	— Franchipan
— Black Hamburgh	— Vermilion
— Malmſey	— Grey dean
— Parſley-leaved.	— Rouſſeline
Melons.	— Marquis
Mulberries.	— Spaniſh bonchretien
Nectarines	— Good Louis
— Small violet	— Craſan
— Newington	— Striped craſan
— Scarlet	— Paſtoral.
— Red Roman	Plums
— Murray	— Muſcle
— Golden	— Swiſs
— Temple	— Red perdrigon
— Italian	— September damaſin
— White	— White bonum magnum
— Genoa.	— Red bonum magnum.
Nuts.	Raſpberries
Peaches	— Twice-bearing.
— Admirable	Strawberries
— Bourdine	— Red alpine
— Incomparable	— White alpine.
— Montauban	Walnuts.
— Pavy royal	

The Greenhouse.

Aloes, remove into the greenhouſe the beginning of the month, but leave out the American ones till the end.

Cuttings and ſeedlings, plant in ſeparate pots, and earth the tops of all the pots.

Geraniums with variegated leaves, ſet in early in the month, and leave off watering the leaves.

Myrtles, take out of the ground and pot.

Orange-trees, freſh earth, thin the fruit, or moſt of it will fall off, and take them into the houſe at the end of the month.

Succulent plants of all ſorts, take in early in the month, and give them very little water.

Take in aloes, variegated geraniums, and ſucculent plants, at the beginning of the month.

Orange-trees and tender plants at the end, but myrtles and hardy plants may remain out till the beginning of the next month, unleſs there is an appearance of froſty nights.

Water in the morning, and keep the windows open all night; leave off watering the geraniums over the leaves.

OCTOBER.

The Kitchen-Garden.

As October is the only time to crop a kitchen-garden before winter, omit not any thing ordered now, till next month, and if it can be done at the beginning, inſtead of the end of the month, it will be much better, leſt the rains hinder you.

Aromatic herbs and ſhrubs in beds, weed, and ſpread ſome earth over them.

Aſparagus ſtalks, cut down, hoe the weeds, and ſpread earth from the paths on them, but firſt a little rotten dung.

Hotbeds, prepare for forcing, and plant (three year old plants) for the firſt crop.

Beans, the early mazagan, muſt be planted on a ſouth border, for the firſt crop.

Boorcole (Anjou) plant out the ſecond crop early in the month, and hoe the ground around the others.

Brocoli, plant out the reſt of the fourth crop.

Cabbages, ſown in Auguſt, of the early ſorts, plant half out in a warm ſituation.

Cabbage turneps, plant early in the month, and earth up the others.

Carrots, ſown in July, finiſh hoeing.

Cauliflowers, beginning to flower, attend to, by breaking down the leaves.

Thoſe intended for glaſſes will want planting out; let there be ſix to each glaſs, and the reſt in a frame, or under a ſouth wall.

Celery, plant out the fifth and laſt crop, and earth up the ſecond to blanch.

Coleworts, finiſh planting.

Creſs, muſtard, and radiſh, ſow under glaſſes, and on a hotbed at the end of the month.

Endive, tie up to blanch, or lay tiles on it, and plant more.

Eſchalots, garlic, and rocambole, plant.

Ground, which is vacant, throw up into ridges.

Hoe boorcole, brocoli, cabbages, and cabbage-turneps, and draw up earth to their ſtems.

Hoe carrots and ſpinach.

Hotbeds, prepare, for forcing aſparagus and lettuees.

Lettuces, plant out, cabbage and brown Dutch on aſparagus beds, ſome under glaſſes, and others on hotbeds for forcing.

Melons for pickling, finiſh gathering.

Mint, plant in pots on a hotbed.

Muſhroom-beds, cover well with ſtraw and mats, to defend them from rain.

Onions will require to be very well weeded, and ſhould be examined two or three times in the month.

Peas, the early hotſpurs, ſow on a ſouth border near the wall, for a firſt crop.

Plant on hotbeds aſparagus for the firſt crop, and lettuces and mint.

Plant Beans	Cauliflowers	Garlic
Boorcole	Celery	Lettuces
Brocoli	Coleworts	Mint
Cabbages	Endive	Rocambole.
Cab. turneps	Eſchalots	

Plant out to ſtand for ſeed,

Beets	Carrots	Parſneps
Cabbages	Parſley	Turneps.

Pot-herbs and ſweet-herbs on beds, weed, ſtir up the earth, and ſpread ſome over them.

Seeds of all ſorts ſhould be threſhed out, dried and put into bags.

Sow creſs and muſtard on hotbeds.

Peas on a ſouth border.

5

Spinach, hoe for the laſt time before winter.

Weeds in every part of the garden muſt be deſtroyed.

Produce of the Kitchen-Garden.

Artichokes	Finochio	Savoy-cabbages
Beans	Garlic	Sorrel
Beets	Horſe-radiſh	Spinach
— red	Kidney-beans	Sprouts of cabbages
— white	Leeks	Thyme
— green	Lettuces	Tomatoes
Brocoli	Marjoram	Turneps
— early	Melons	Turnep radiſhes
Cabbages	Onions	Water-creſſes.
Carrots	Parſley	
Cauliflowers	Parſley-roots	
Celery	Peas	
Chervil	Potatoes	
Cucumbers	Radiſhes	
Endive	Rocambole	
Eſchalots	Sage	
Fennel	Savory	

On the Hotbeds.

Aſparagus
Creſs
Lettuces
Mint
Muſhrooms
Muſtard.

The Flower-Garden *and* Shrubbery.

Any thing ordered laſt month, if it happens to be omitted, finiſh early in this, becauſe the beginning of this month is the proper time when the flower-garden and ſhrubbery ſhould be put into order before the winter.

Anemones, to flower early, finiſh planting, the firſt week in the month.

Auriculas and carnations, remove into ſhelter, and in wet weather cover them with mats.

Balſams, cockſcombs, egg-plants, &c. intended to raiſe ſeed from, muſt be conſtantly attended to, to haſten the ripening of the ſeed.

Beds and compoſts for bulbous roots, frequently turn over.

Box for edgings, finiſh planting early in the month.

Bulbous roots for forcing, in pots or boxes, plant, and finiſh planting all others before the rain ſets in.

Crocuſes, aconites, ſnowdrops, and any bulbous roots which flower early in the ſpring, plant at the beginning of the month.

Evergreens of all ſorts, plant early in the month.

Graſs walks, finiſh laying, and repair any places which want.

Gravel walks, weed, and take the opportunity of rolling them in dry weather.

Hyacinths, jonquils, lilies, narciſſuſes, polyanthus-narciſſuſes, plant early in the month.

Layering of ſhrubs, finiſh, if not done.

Layers and ſuckers, take off, if rooted.

Mignonette ſhould be removed under glaſſes, or elſe into a greenhouſe or warm cloſet.

Perennials, finiſh planting.

Plant bulbous roots early in the month, as

Aconites	Hyacinths	Polyanthus-narciſſuſes
Amaryllisſes	Jonquils	
Anemones	Iriſes	Ranunculuſes
Cornflags	Lilies	Snowdrops
Crown-imperials	Martagons	Star of Bethlehem
Daffodils	Narciſſuſes	Tulips, &c.
Garlic Moly	Pancratiums	

Box and thrift early in the month.

Perennials at the beginning of the month.

Shrubs and trees of all ſorts.

Strawberries and thrift for edgings.

Tulips and other bulbous roots.

Seedlings in pots, place under a ſouth wall in the ground; and weed and earth ſeedlings in beds.

Seeds, gather in the middle of the day.

Shrubberies, finiſh pruning and hoeing, to lay neat for the winter.

Shrubs and trees, finiſh planting.

Suckers and layers, take off, and, if ſmall, plant them in beds two feet aſunder, to be ready againſt the next ſeaſon.

Tulips, finiſh planting early in the month, and all ſorts of bulbous roots.

Turf, finiſh laying early in the month.

Weeds, hoe and rake off, or they will root again.

Leave nothing ordered this month, if it be poſſible, unfiniſhed, on account of the uncertainty of the weather in the ſucceeding month.

Trees and Shrubs in flower.

Althæas	Lauruſtinuſes
Bramble	Paſſion-flower
Broom	Roſes
Climber	Strawberry-trees in fruit and flower.
Honeyſuckles	
Jeſſamines	

Flowers.

African marygolds	Marvel of Peru
Anemones	Mignonette
Aſters	Naſturtiums
Auriculas	Panſeys
Balſams	Pinks
Campanulas	Polyanthuſes
Carnations	Primroſes
China aſters	Saffron
China pinks	Scarlet beans
Chryſanthemums	Scabiouſes
Colchicums	Starworts
Cyclamens	Stocks
Daiſies	Sunflowers
French marygolds	Sweet peas
Golden rods	Sweet Sultans
Guernſey lilies	Tuberoſes
Lupines	Wall flowers, and ſome others.

The Fruit-Garden *and* Orchard.

Apples and pears, gather in the middle of fine dry days.

Apple-trees, plant at the end of the month.

Currants, gooſeberries, and raſpberries, plant.

Grapes in bags, examine to ſee that they are not mouldy or decayed.

Nectarines and peaches, gather in the middle of the day.

Orchards or fruit-trees intended to be planted ſhould have the ground prepared, and the holes digged ſome weeks beforehand; if the ſoil be not very good, ſome loam and rotten dung ſhould be mixed together, and the trees planted in it. If the orchard be wet, bring a cart load of earth at leaſt for each tree; form the earth into a little hill about a foot high, and plant the tree upon it, but dig up the tuft firſt a foot deep in a circle of four or five feet over.

Peaches, gather in the middle of the day, and, if not ripe, lay them in the ſun for a few days in a window: they are much improved by roaſting gently as you do apples, and eating them with ſugar and wine.

Peach-trees, plant at the end of the month.

Plant fruit-trees of all ſorts.

Prune all ſorts of wall-trees, but ſweep off all the leaves firſt with a birch broom.

Strawberry beds, finiſh dreſſing, and water the alpines frequently under the frames.

Vines in pots ſhould now be tranſplanted; make the holes ready, pour water into them, and then gently turn them out of

the pot, or place the pot in the hole and break it, and then the roots cannot be difturbed, and you will have fruit the next year.

Wall-trees, finifh pruning and planting early in the month.

Fruits in Seafon.

Almonds.	Nectarines—Old Newington.
Apples	Nuts.
— Loans pearmain	Peaches
— Royal pearmain	— Late violet
— Autumn calfille	— Yellow admirable
— Aromatic ruffet	— Bloody
— Violet apple	— Late Newington
— Lemon pippin	— Late Magdalen
— Kentifh pippin	— Yellow pavy
— Holland pippin	— Dwarf Orleans
— Royal ruffet.	— Catherine.
Cherries	Pears
— Morello.	— Beurries
Currants, if preferved by mats.	— Monfieur John
	— Great ruffelet
Filberts.	— French bergamot
Grapes	— Swans egg
— Red chaffelas	— Mufcat fleury
— Red Hamburgh	— Deans.
— Frontiniacs	Plums
— Alicants	— Bricette
— Claret	— Emprefs
— Raifin.	— Bullace.
Melons.	Rafpberry
Mulberries.	— Twice-bearing.
Nectarines	Strawberries
— Yellow	— Alpine.
— Peterborough	Walnuts.

The GREENHOUSE.

Air, give very freely in the day-time, and leave fome of the windows open at night until the end of the month.

Earth the tops of the pots.

Geraniums, take in early in this month, if not done the laft; water them fparingly, or they will begin fhooting afrefh, and pick off conftantly all decayed leaves.

Leaves, clean well before the plants are fet in order, and dead ones pick off.

Myrtles, take in towards the end of the month.

Orange-trees fhould not remain out this month; examine the leaves before you fet them in for infects, which faften themfelves underneath, and pick them off; if any leaves be mildewed, wafh them with warm water and a fpunge.

Succulent plants, water fparingly.

Water myrtles, orange-trees, winter cherries, and all woody plants frequently.

Windows, open every fine day, but keep them clofe fhut in foggy weather.

NOVEMBER.

The KITCHEN-GARDEN.

Any thing ordered laft month, if it be omitted, finifh early in this, before the rain prevents you.

Artichoke ftalks, cut down, and earth them up.

Afparagus on hotbeds muft have air given to it; and make and plant the fecond bed; cut down the ftalks and finifh dreffing the beds.

Beans, finifh planting for the firft crop.

Beets, cabbages, and carrots, plant for feed.

Carrots, take up and lay in fand.

Cauliflowers under glaffes and frames, give fome air to, in the middle of fine days.

Celery, earth up when dry, to blanch.

Crefs, muftard, and radifhes, fow on hotbeds.

Endive, not planted out, take up, and plant on the fouth fide of a ridge, raifed up two feet high.

Ground which is vacant, throw up into ridges.

Hotbeds, prepare for forcing afparagus and lettuces.

Lettuces on hotbeds, attend to, and give them air in the middle of the day.

Mufhroom-beds, guard from wet.

Parfneps and large-rooted parfley, take up.

Peas and beans above ground, draw earth to, and place traps to catch mice.

Plant afparagus on a hotbed for the fecond crop.

Endive on the fouth fide of a ridge.

Beets, cabbages, and carrots, for feed.

Potatoes dig up, fort them, pick out the damaged ones, and referve the beft for ufe in winter.

Radifhes, early fhort-topped, fow about the tenth, and fpread wheaten ftraw over the beds.

Salfafy, fkirrets, and fcorzoneras, dig up.

Sow crefs, muftard, and radifhes, on hotbeds for fmall fallading.

Spinach, hoe again if it be too thick.

Water, drain off if it ftands any where.

Weed all the crops, and rake off the weeds to prevent their rooting again.

Produce of the Kitchen-Garden.

Artichokes	Horfe-radifh	Scorzonera
Beets	Leeks	Sorrel
— red	Lettuces	Spinach
— white	Marjoram	Sprouts of cabbages
— green	Onions	
Boorcole	Parfley	Thyme
Brocoli	Parfley-roots	Turneps
Cabbages	Parfneps	Water-creffes.
Carrots	Peas	*On the Hotbeds.*
Cauliflowers	Potatoes	
Celery	Radifhes	Afparagus
Chardons	Rocambole	Crefs
Chervil	Sage	Lettuces
Endive	Salfafy	Mint
Efchalots	Savory	Mufhrooms
Garlic	Savoy cabbages	Muftard.

The FLOWER-GARDEN *and* SHRUBBERY.

November being generally a very rainy month, if any thing happened to be omitted from being finifhed laft month, let it be done early in this.

Bulbous roots intended for blowing in water early may now be placed on the glaffes, and let all others be finifhed planting at the beginning of the month.

Thofe in pots or boxes muft be frequently watered, and place them all as much in the fun and light as poffible, for if in the fhade they will draw up weak.

Compofts wanted for flowers in fpring fhould now be collected, fuch as loam, fand, willow earth, rotten tan, dung, &c.; let them be laid in dry funny places, and be frequently turned over, but by no means in cold wet places.

Gravel walks near the houfe fhould be rolled a little when the weather will permit; their being kept hard prevents weeds from growing; but never throw them up into ridges.

Leaves fhould be conftantly fwept up as they fall, or they will fpoil the walks.

Myrtles planted againft walls fhould have two boards about fix inches wide fixed, one on each fide, with a third at the top, on which a mat fhould be nailed, to roll up and down occafionally.

4

Plant early in the month all bulbous roots.

Bulbous roots for forcing.

Shrubs and trees of all ſorts at the beginning of the month.

Shrubberies ſhould be pruned, and digged or hoed, if not already done.

Shrubs and trees ſhould be finiſhed planting early in the month, and then long litter, ſtraw, or turf, turned downwards, ſhould be laid over the roots to keep out the froſt.

Trenches ſhould be digged, and drains made to carry off the water wherever it ſtands; a large flower-pot, placed downwards in the earth, will carry off a great quantity of water.

Trees and Shrubs in flower.

Honeyſuckles	Pyracantha, in fruit
Lauruſtinuſes	Roſes
Mezereons	Strawberry-tree, in fruit and flower.
Paſſion-flower	

Flowers.

Anemones	Polyanthuſes
Aſters	Primroſes
Chineſe aſters	Starworts
Colchicums	Stocks
Cyclamens	Striped lilies, in leaf
Daiſies	Sun-flowers
Golden rods	Wall-flowers.
Panſies	

The Fruit-Garden *and* Orchard.

Any thing ordered laſt month, if omitted, finiſh early in this.

Apples and pears, finiſh gathering; after they have lain together and ſweated, the moſt valuable ſorts, which keep long, ſhould be wiped dry with a cloth.

Apple and pear-trees, prune and plant.

Eſpaliers and ſtandards, prune and plant.

Figs, prune, and pull off the green ones.

Fruit-room, attend to, pick out every leaf, and all ſpecked and decayed apples or pears.

Orchards, finiſh planting at the beginning of the month, and ſtake the trees.

Planting and pruning of eſpaliers, ſtandard and wall-trees, finiſh early in the month.

Strawberries in pots for forcing, place under frames, and attend to the alpines.

Wall trees, finiſh pruning and planting.

Fruits in Seaſon.

Almonds.	Nectarines and
Apples	Peaches, ſome few of the laſt month.
— Golden rennet	Nuts.
— Golden pippin	Pears, beſides thoſe of laſt month, the
— Aromatic ruſſet	— Winter thorn
— Aniſe apple	— Winter's wonder
— Holland pippin	— Bezi of Queſſois
— Monſtrous rennet	— Chaſſery
— Winter pearmain	— Dauphin.
— Nutmeg apple	Plums
— Partridge apple.	— Empreſs
Cheſnuts.	— Bricette
Currants, if preſerved with mats.	— Bullaces.
Filberts.	Quinces
Grapes, many of thoſe of laſt month, if preſerved in bags.	— Portugal.
Medlars	Raſpberries
— Large Dutch	— Twice-bearing.
— Italian pear-fruited	Services.
— Nottingham.	Strawberries
	— Alpine.
	Walnuts.

The Greenhouse.

Air, give in the middle of the day, unleſs when it is very foggy.

Earth the tops of any of the pots, when you perceive any mould on them.

Geranium leaves, conſtantly pick off, as they decay more than any others, and give them water very ſparingly.

Leaves decayed, conſtantly pick off, for they corrupt the air of the houſe very much.

Succulent plants, as aloes, ficoides, &c. will require but very little water, large aloes the moſt.

Water woody plants often, but give them only a little at a time, as dampneſs is more prejudicial in a greenhouſe than cold.

D E C E M B E R.

The Kitchen-Garden.

Aſparagus muſt be planted for the third crop, and give it both light and air to colour it; if the beds be not warm enough, line them with freſh dung.

Boorcole, brocoli, and cabbages, muſt be well earthed up, to keep them upright, and pick off all decayed leaves.

Cauliflower plants muſt have air when the weather is mild, and pick off dead leaves.

Celery when dry, earth up for blanching.

Creſs, muſtard, and radiſhes, ſow on hotbeds every week.

Dunghills, weed and turn over in froſty weather.

Endive, tie up for blanching.

Hotbeds muſt be attended to, and plenty of hot dung and loam provided for cucumbers and melons.

Lettuces under glaſſes muſt have air given them in the middle of mild days.

Muſhroom-beds muſt have dry ſtraw, if wanted.

Peas and beans above ground, earth up.

Roots to be preſerved in ſand, as carrots, potatoes, &c. ſhould be finiſhed before the froſt ſets in.

Snails, ſearch for in the holes of the walls.

Sow creſs, muſtard, and radiſhes, on hotbeds every week.

Tools, repair, grind and put in order, while you have leiſure.

Traps, ſet to catch mice.

Trenches, make to drain off the water.

The produce of the Kitchen-Garden.

Artichokes	Lettuces	Spinach
Beets	Marjoram	Sprouts of cabbages
— red	Onions	Thyme
Boorcole	Parſley	Turneps
Brocoli	Parſley-roots	Water-creſſes.
Cabbages	Parſneps	
Carrots	Potatoes	*On the Hotbeds.*
Cauliflowers	Radiſhes	
Chardons	Rocambole	Aſparagus
Celery	Sage	Creſs
Endive	Salſafy	Lettuces
Eſchalots	Savory	Mint
Garlick	Savoy cabbages	Muſhrooms
Horſe-radiſh	Scorzonera	Muſtard.
Leeks	Sorrel	

The Flower-Garden *and* Shrubbery.

Auriculas, examine frequently, and pick off all decayed leaves.

Bulbous roots for forcing muſt be conſtantly attended to, to give them water, which ſhould always be ſoft; and change that in the glaſſes when foul.

Carnations in pots ſhould be plunged into the ground: but if aſhes or ſand be put between the pots, it will keep them drier than earth.

Flowers and ſhrubs in pots ſhould be plunged into the ground, to keep the froſt from the roots.

Foreſt-trees may ſtill be planted, if there be not much froſt; otherwiſe it is better to defer it till ſpring.

Shrubs and trees may ſtill be pruned, and lay long litter, &c. over the roots of thoſe lately planted.

Trenches and drains ſhould be made wherever the water ſtands.

Trees and Shrubs in flower.

Glaſtonbury-thorn	Pyracantha, in fruit
Honeyſuckles	Roſes
Lauruſtinuſes	Strawberry-tree, in fruit and flower.
Mezereons	

Flowers.

Aconites	Polyanthuſes
Anemones	Primroſes
Cyclamens	Stocks
Daiſies	Striped lilies, in leaf
Hellebore	Wall-flowers.
Panſies	

The FRUIT-GARDEN *and* ORCHARD.

Apples and pears in the fruit-room, examine; pick out ſuch as appear the ſoundeſt of the beſt ſorts, and wrap each in a piece of paper; it will cauſe them to keep ſeveral weeks longer.

Eſpaliers, repair, prune the trees, ſpread ſome rotten dung on the border, and fork it in.

Fig-trees, finiſh pruning.

Fruit-room, guard from froſt, but give it ſome air when the weather is not very damp nor froſty.

Orchard, examine, and take care that the newly-planted trees are well ſtaked and mulched, and cut out the dead wood from the ſtandard trees.

Wall-trees, finiſh pruning and planting early in the month.

Fruits in Seaſon.

Almonds.	Medlars.
Apples	Nuts.
— Golden pippin	Pears, beſides thoſe of October and November, the
— Nutmeg apple	— Virgoleuſe
— Kirton pippin	— Ambrette
— Wheeler's ruſſet	— Chaſſery
— Pile's ruſſet	— Garden pear
— Nonpareil	— Roman angelic.
— Winter pearmain	Quinces.
— Grays pippin	Services.
— Coſtard apple	Strawberries
— Rouen jelly apple.	— Alpine.
Cheſnuts.	Walnuts.
Filberts.	
Grapes, many of thoſe of October, if preſerved in bags.	

The GREENHOUSE.

Air muſt be given whenever the weather is mild and will permit it.

Earth the tops of the pots, but firſt take out a little of the old.

Froſt muſt be guarded againſt, by keeping the doors and windows cloſe, when it begins to freeze.

Leaves decayed, conſtantly pick off.

Myrtles and other greenhouſe plants againſt walls will require to have mats placed before them, and, in the middle of fine days before the froſt ſets in, rolled up, but let down again at night. Long litter or rotten tan ſhould alſo be laid over the roots to preſerve them from the froſt.

Myrtles may alſo be preſerved in deep pits made againſt a ſouth wall, and covered in very froſty weather with mats and ſtraw near a foot thick. Many are preſerved in the nurſeries near London, with only hurdles laid over the pit, without any glaſs, and covered very thick in froſt with ſtraw and mats.

Succulent plants will require but very little water.

Water thoſe plants which require it very ſparingly.

Windows, open for three or four hours in the middle of the day.

A TABLE *ſhewing at one View the* NUMBER *of* CROPS *required of each Sort of Vegetable to have a regular Succeſſion through the Year; and alſo the* TIME *of* SOWING *and* PLANTING.

Kitchen-Garden Plants, Seeds, and Roots.

	No. of Crops.	*Time of Sowing, &c.*
Aliſander	2	Mar. Aug.
Angelica	2	Mar. Aug.
Artichoke	1	Mar. or Apr.
Aſparagus	1	Mar. or Apr.
— forced	5	Oct. Nov. Dec. Jan. Feb.
— in autumn	1	July, if cut down.
Balm	1	Mar. or Apr.
Baſil	1	Mar. or Apr.
Beans, early	5	Oct. Jan. Feb. Mar. July
— late	4	Feb. Mar. Apr. July
Beets	1	Feb. or Mar.
Boorcole or kale	3	Mar. Apr. June
— Anjou	2	May, June
Borage	1	Feb. or Mar.
Brocoli	4	Mar. Apr. May, June
Burnet	1	Mar. or Apr.
Cabbages, early	1	Aug.
— late	4	Feb. Mar. May, June
— red	3	Feb. Mar. June
— Savoy	3	Mar. May, June
— for cattle	2	May, June
— for ſeed	1	Oct. or Nov.
Cabbage-turnep	2	May, June
Camomile	1	Mar. or Apr.
Capſicums	1	Mar. or Apr.
Carrots, to draw young	3	Jan. Apr. July
— principal crop	1	Feb. or Mar.
— for ſeed	1	Feb.
Cauliflowers	4	Aug. Feb. Mar. May
Celery	5	Feb. Mar. Apr. May, June
Chardons	1	Mar. or Apr.
Chervil	2	Mar. Aug.
Cives	1	Mar. or Apr.
Clary	1	Mar. or Apr.
Coleſeed	1	June or July
Coleworts	2	Feb. June or July
Corn-ſallad	2	Mar. Aug.
Creſs, for ſeed	1	Mar. or Apr.
— for ſallad		Mar. to Sept.
— on hotbeds		Oct. to Mar.
Cucumbers	5	Jan. Feb. Mar. Apr. May
— on hotbeds	3	Jan. Feb. Mar.
— for bellglaſſes	1	Apr.
— open ground	1	May or June
Dill	1	Mar. or Apr.

	No. of Crops.	Time of Sowing, &c.
Endive - -	4	Apr. May, June, July
Efcalions - -	1	Jan. or Feb.
Efchalot - -	2	Feb. Sept.
Fennel - -	2	Feb. Aug.
Finochio - -	4	Apr. May, June, July
Garlic - -	2	Feb. Sept.
Horfe-radifh -	1	Feb. or Mar.
Hyffop - -	1	Mar. or Apr.
Jerufalem artichokes	1	Feb. or Mar.
Kidney-beans -	5	Mar. Apr. May, June, July
— Runners -	2	Apr. May
Lavender - -	1	May, or June
Leeks - -	1	Feb. or Mar.
Lettuces - -	7	Feb. to Aug.
Marjoram - -	2	Mar. Apr.
Marygolds -	1	Feb. to Apr.
Melons - -	3	Feb. Mar. Apr.
— for autumn -	1	May
Mint - -	1	Mar. or Apr.
Mufhrooms -	2	Mar. Sept.
Muftard, for feed -	1	Mar. or Apr.
— for fallad		Mar. to Sept.
— on hotbeds		Oct. to Mar.
Nafturtiums -	1	Mar. or Apr.
Onions, to draw young	4	Jan. Apr. May, July
— principal crop -	1	Feb. or Mar.
— for feed -	1	Feb. or Mar.
— Welfh - -	2	July, Aug.
Parfley - -	3	Feb. Mar. July
— large-rooted -	2	Feb. Apr.
Parfneps - -	2	Feb. Mar. or Apr.
Peas, hotfpurs -	5	Oct. Jan. Feb. July, Aug.
— Marrowfats -	5	Feb. Mar. Apr. May, June
Pennyroyal -	1	Mar. or Apr.
Potatoes - -	3	Feb. Mar. Apr.
— on hotbeds -	1	Jan. or Feb.
Purflane - -	3	Mar. Apr. May
Radifhes - -	9	Jan. to Aug. and Nov.
— on hotbeds -	2	Jan. Feb.
— for fallad		Mar. to Sept.
— for feed -	1	May
Rampion - -	1	Mar. or Apr.
Rape - -	1	June or July
— for fallad		Mar. to Sept.
Rocambole - -	2	Feb. Sept.
Rofemary - -	1	May, or June
Rue - -	1	Mar. or Apr.
Sage - -	1	Mar. or Apr.
Salfafy - -	1	Mar. or Apr.
Savory - -	1	Mar. or Apr.
Savoy cabbage -	3	Mar. May, June
Scorzonera - -	1	Mar. or Apr.
Scotch kale -	3	Mar. Apr. June
Sea kale - -	1	Mar. or Apr.
Skirrets - -	1	Mar. or Apr.
Sorrel - -	2	Mar. Aug.
Spinach - -	6	Feb. to July
— Winter -	2	July, Aug. or Sept.
Tanfey - -	1	Mar. or Sept.
Tarragon - -	1	Mar. or Sept.
Thyme - -	1	Mar. or Apr.
Tomatoes - -	1	Mar. or Apr.
Turneps - -	6	Mar. to Aug.
— for feed -	1	Feb.
Turnep-cabbage -	2	May, June
Turnep-radifh -	2	June, July
Water-crefs -	2	Mar. Sept.

A general Catalogue *of* Flowers, Shrubs, *and* Trees, *ufually cultivated.*

§ 1. *Tender Annual Flowers,*

To be fown on a ftrong hotbed the laft week in February, or firft in March, tranfplanted afterwards upon another at four inches diftance, then planted in fmall pots in May, afterwards in larger, and at the end of June placed in the open air.

1. Amaranths
2. Balfams
3. Cockfcombs
4. Egg-plants
5. Glo. amaranths
6. Humble-plant
7. Ice-plant
8. Senfitive-plant
9. Stramoniums.

§ 2. *Annual Flowers,*

To be fown on a moderate hotbed in March or April, tranfplanted afterwards before they are too thick, in rich light earth, and covered with mats, and in a month or fix weeks into pots, or borders of the flower-garden.

1. African marygolds
2. Blue browallia
3. Capficums
4. Cape marygolds
5. Chinefe afters
6. Chinefe or Indian pinks
7. Chryfanthemums
8. French marygolds
9. Marvel of Peru
10. Mignonette
11. Nolana
12. Palma Chrifti
13. Stock-Julyflowers
14. Sultan (yellow)
15. Zinnias.

As you fow them, fix numbers to them correfponding with thefe, and you will readily know each fort when they appear.

§ 3. *Hardy Annual Flowers,*

To be fown in March or April on the borders of the flower-garden. Hollow the earth out in form of a little bafon, about a foot over, and two inches deep; draw a circle near the edge half an inch deep, and drop a few feeds in it; thin them foon after they appear, and leave them at fix inches diftance, but the large forts wider. In dry weather they will want frequent watering. Gather the feeds as they ripen, and you may fave the expence of buying another feafon.

1. Adonis flower*
2. Alkekengi
3. Alyffon
4. Amaranths
5. Amethyfica
6. Balm (Moldavian)
7. Belvidere
8. Candy tuft*
9. Catchfly (Lobel's)*
10. Caterpillar-trefoil
11. Clary (red and white)
12. Convolvulus
13. Cornbottles*
14. Cucumber (fpurting)
15. Fumatory (yellow)
16. Hedgehog-trefoil
17. Honeywort
18. Indian corn
19. Ketmia
20. Larkfpurs*
21. Lavateras
22. Lupines
23. Mallows
24. Mignonette
25. Nafturtiums*
26. Nigella, or devil in a bufh*
27. Panfeys, or hearts-eafe
28. Peas (fweet-fcented)*
29. Perficaria*
30. Poppies*
31. Safflower, or baftard faffron
32. Snail trefoil
33. Snap-dragon
34. Stock-Julyflowers*
35. Sun-flowers
36. Sweet fultans
37. Tobacco
38. Venus's looking-glafs*
39. Venus's navelwort
40. Xeranthemums.

Thoſe marked thus * being very hardy may be ſown the beginning of February, to flower early.

In July ſow again annual ſtock, candy tuſt, convolvulus minor, cornbottles, Lobel's catchfly, and yellow lupines, and they will flower until the froſt kills them.

§ 4. *Biennial Flowers,*

To be ſown in March or April in beds very thin; as ſoon as the plants touch one another, thin them, and leave them at four or ſix inches aſunder; thoſe you draw out, plant at the ſame diſtance. In July tranſplant them all upon beds, at eight inches aſunder; there they muſt remain till the end of September, when they muſt be planted upon the borders of the flower-garden, and they will produce their flowers the next ſummer, after which they will perfect their ſeeds and die.

1. Canterbury bell
2. Colutea (Æthiopian)
3. French honeyſuckles
4. Globe thiſtle
5. Honeſty, or moonwort
6. Mallow (tree)
7. Poppy (yellow horned)
8. Rocket
9. Scabious
10. Stock-Julyflower
11. Sweet-Williams
12. Tree-Primroſe
13. Wall-flowers.

§ 5. *Perennial-rooted Flowers,*

Which if ſown in the ſame manner as the biennials, and tranſplanted into the borders of the flower-garden, will continue for ſeveral years.

1. Alyſſon
2. Auriculas
3. Bee-larkſpurs
4. Campanulas
5. Carnations
6. Columbines
7. Flax
8. Fox-gloves
9. Hawkweeds
10. Hollyhocks
11. Ox-eye daiſy
12. Peas (everlaſting)
13. Pinks
14. Polyanthuſes
15. Rhubarb
16. Roſe-campion
17. Snap-dragons
18. Valerian
19. Greek valerian.

§ 6. *Perennial-rooted Flowers,*

Which are propagated by dividing their roots in ſpring, in March or April; or in the autumn, in September.

1. Adonis flower
2. Anemones
3. Aſphodel
4. Aſters
5. Bachelors button
6. Bean-caper
7. Bears-breech
8. Borage
9. Buglofs
10. Campanulas
11. Campion
12. Cardinal flower
13. Chriſtmas roſe
14. Cowſlip
15. Caneſbill
16. Crowfoot
17. Daiſies
18. Dog-tooth violet
19. Dragons
20. Dropwort
21. Eternal flower
22. Fennel-giant
23. Feverfew
24. Flag
25. Foxglove
26. Fraxinellas
27. Fumatory
28. Garlic
29. Gentianella
30. Golden locks
31. Golden rod
32. Greek valerian
33. Hellebore
34. Hepatica
35. Herb-bennet
36. Houſeleek
37. Ladies-mantle
38. Ladies-ſlipper
39. Ladies-ſmock
40. Lily of the valley
41. Lion's tail
42. London-pride
43. Looſeſtriſe
44. Lupine
45. Lychnis
46. Lychnidea
47. Madwort
48. Marſh-Mary-gold
49. Meadow-ſweet
50. Milfoil
51. Milk-vetch
52. Mint
53. Moth-mullen
54. Navelwort
55. Peony
56. Pilewort
57. Plantain
58. Primroſe
59. Ragged-Robin
60. Ranunculuſes
61. Reed
62. Rhubarb
63. Saxifrage
64. Skullcap
65. Sneezewort
66. Side-ſaddle flower
67. Soapwort
68. Solomon's ſeal
69. Spiderwort
70. Spurge
71. Stonecrop
72. Sunflower
73. Swallowwort
74. Thrift
75. Throatwort
76. Toadflax
77. True love
78. Valerian
79. Vervain
80. Veronica
81. Violet
82. Vipers-bugloſs
83. Wake robin
84. Willow-herb
85. Wolfsbane
86. Wormwood and ſome others, but with very little beauty to recommend them.

§ 7. *Bulbous and Tuberous-rooted Flowers.*

1. Aconites
2. Amaryllifes
3. Anemones
4. Bulbocodiums
5. Cornflags
6. Crocuſes
7. Crown-imperials
8. Cyclamens
9. Daffodils
10. Garlic Moly
11. Hyacinths
12. Jonquils
13. Iriſes
14. Lilies
15. Martagons
16. Narciſſuſes
17. Pancratiums
18. Polyanthus-Narciſſus
19. Ranunculuſes
20. Siſyrinchiums
21. Snowdrops
22. Star of Bethlehem
23. Tuberoſes
24. Tulips,

To be taken up in April, May, and June, as ſoon as their leaves are withered, and planted again in September or October, but their offsets in Auguſt.

The ranunculuſes and anemones not to be planted till February.

The ſeed to be ſown in February in boxes.

§ 8. *Bulbous-rooted Flowers.*

1. Amaryllifes
2. Colchicums
3. Crocuſes
4. Cyclamens
5. Daffodil (ſea)
6. Lily (Belladonna)
7. — Guernſey
8. Saffron.

Theſe flower in autumn. They require to be planted in Auguſt, and to be taken up in April or May, as ſoon as their leaves are decayed, but their offsets in July.

§ 9. *Deciduous Flowering-Shrubs and Ornamental Trees,*

To be planted in March, April, September and October.

1. Acacia (roſe-flowering)
2. Almond trees
3. Allſpice
4. Althæas
5. Aſh-tree (mountain)
6. Annona, or papaw-tree
7. Azaleas
8. Berberry-trees
9. Bignonia, or Trumpet-flower
10. Bladder ſena
11. Bramble
12. Buckthorn
13. Caragana
14. Caſſioberry buſh
15. Catalpa, or Trumpet-flower
16. Ceanothus
17. Cephalanthus
18. Cherry-trees
19. Cinquefoil (ſhrubby)
20. Clethra
21. Cornel-tree
22. Crab-tree
23. Cytiſus
24. Diervilla
25. Dogwood
26. Fothergilla
27. Gingo, or maiden-hair-tree
28. Gueldres roſe
29. Haleſia
30. Hamamelis
31. Hawthorn
32. Hickery-nut
33. Honeyſuckles
34. Honeyſuckle (upright)
35. Hypericums
36. Jaſmin
37. Jeſuits-bark tree (falſe)
38. Indigo (baſtard)
39. Ironwood-tree
40. Judas tree
41. Kidney-bean-tree
42. Laburnums
43. Lac, or varniſh tree
44. Leatherwood
45. Lilacs
46. Mezereons
47. Nightſhades
48. Olive-tree (Wild)
49. Paſſion-flower
50. Peach-trees
51. Periploca, or Virginian ſilk
52. Plum-trees
53. Poiſon trees
54. Pomegranate-tree
55. Privet
56. Raſpberry
57. Reſtharrow

58. Rofe-tree, 80 varieties
59. St. Peter's wort
60. Saffafras-tree
61. Service-tree
62. Snowdrop, or fringe-tree
63. Spindle-tree
64. Spiræas
65. Sumach-trees
66. Syringas
67. Tamarifk
68. Tea-tree
69. Toothach-trees
70. Travellers joy
71. Tupelo-tree
72. Viburnums
73. Weeping willow-tree.

§ 10. *Deciduous Foreft-Trees,*

To be planted from the middle of February till the beginning of April, and from September till December.

1. Acacias
2. Alders
3. Afh-trees
4. Beech-trees
5. Birch-trees
6. Chefnut-trees
7. Crab-trees
8. Cyprefs
9. Elder-trees
10. Elm-trees
11. Hickery-nut
12. Hornbeams
13. Horfe-chefnuts
14. Larch-trees
15. Lime-trees
16. Magnolias
17. Maple-trees
18. Nettle-trees
19. Oak-trees
20. Plane-trees
21. Poplar-trees
22. Tulip-trees
23. Walnut-trees
24. Willow-trees.

§ 11. *Evergreen Flowering Shrubs and ornamental Trees.*

To be planted in March, April, September and October.

1. Alaternus
2. Andromeda
3. Arbor-vitæ
4. Arbutus
5. Bay-tree
6. Bignonia
7. Box
8. Brooms
9. Caffine, or South-fea-tea-tree
10. Ciftus, or rock rofe
11. Crab-tree
12. Cytifus (hairy evergreen)
13. Groundfel-tree
14. Holly-trees
15. Honeyfuckles
16. Juniper
17. Ivy
18. Kalmias
19. Lavenders
20. Laurels
21. Lauruftinufes
22. Magnolia
23. Phillyreas
24. Privet
25. Purflane-tree
26. Pyracantha
27. Rhododendron
28. Rofe-tree
29. Rofemary
30. Rue
31. Savin
32. Spindle tree
33. Sweetbrier
34. Tea-trees
35. Widow-wail.

§ 12. *Evergreen Foreft-Trees,*

To be planted from the middle of February till the end of April, and from September till December.

1. Cedar-trees
2. Cork-trees
3. Cyprefs-trees
4. Fir-trees
5. Oak-trees
6. Pine-trees
7. Yew-tree.

§ 13. *Fruit-Trees and Fruits,*

To be planted in February, March, October, and November.

1. Almonds
2. Apples
3. Apricots
4. Berberries
5. Cherries
6. Crab-trees
7. Currants
8. Figs
9. Filberts
10. Goofeberries
11. Medlars
12. Nectarines
13. Nut-trees
14. Peaches
15. Pears
16. Plums
17. Quinces
18. Rafpberries
19. Services
20. Vines
21. Walnuts.

The following method may be taken for *preferving the bloffoms* of fruit-trees in fpring. Procure fome fheep-hurdles, made of hazel or willow-branches, about two or three feet higher than the walls. At fpring, juft before the bloffoms of the fruit-trees begin to open, place thefe before the trees, and faften them in windy weather with ftakes, and by their being taller than the walls are high, they may be fet floping about two feet from the bottom of the walls, which will keep them fteady. When the fruit is fet, and entirely out of danger, take them quite away, and by keeping in a dry place, they will laft many years, and will be always worth one-third of the firft coft, for lighting of fires, when unfit for any other ufe.

In an experiment that was made, the hurdles were placed before the trees in December; they alfo defended a crop of peas, and both feemed to be much benefited, particularly the peas. It is poffible that vines might alfo be thus defended in the fpring, and come forwarder; at leaft it is worth trying where the walls are not too high.

§ 14. *Hardy Greenhoufe Plants,*

To be planted againft a fouth wall, in the open ground, the roots covered with tan or long litter. Thefe will not be killed except in very fevere frofts, and then they generally fhoot up afrefh from their roots.

By this method, many curious plants, formerly only kept in greenhoufes, will now ornament the walls, where they will appear in greater vigour and beauty, and many may produce both flowers and fruit, which they will not do when confined in pots in a greenhoufe.

1. Bay-tree
   — Blue-berried Carolinian
2. Boxthorn
   — African
3. Broom
   — Starry
   — Montpelier
4. Cedar-tree
   — Bermudian
   — Goa
5. Fig (Indian)
6. Heath
   — Many-flowered
   — Mediterranean
   — Three-flowered
7. Jafmin (Catalonian)
8. Laurel (Alexandrian)
9. Myrtle
   — Broad-leaved Roman
   — Double-flowered
   Myrtle, Portugal
   — Upright Italian
10. Magnolia (evergreen)
11. Oleander
   — Red
   — White
12. Olive-tree
   — Box-leaved
   — Province
13. Piftachia-nut-tree
14. Pomegranate (dwarf)
15. Ragwort (fea)
16. Rofe-tree (Chinefe)
17. Rofemary (filver-leaved)
18. Sophora
   — Small-leaved Otaheite
19. Strawberry-tree
20. Tea-tree (green)
21. Winter cherry.

For the particular operations in gardening, fee the articles PLANTING, PRUNING, GRAFTING, INOCULATING, ORCHARD, GREEN-*Houfe*, HOT-*Houfe*, &c. &c. and the culture and management of different plants under their refpective names.

GARDINER (Stephen), bifhop of Winchefter, and lord chancellor of England, born at Bury St. Edmunds in Suffolk, natural fon to Richard Woodville, brother to queen Elizabeth wife to Edward IV. was learned in the canon and civil laws, and in divinity. He figned the divorce of Henry VIII. from Katharine of Spain, abjured the pope's fupremacy, and wrote *De vera*

et falsa obedientia, in behalf of the king; yet in Edward's reign he opposed the reformation, and was punished with imprisonment; but queen Mary coming to the throne, she enlarged him. He drew up the articles of marriage between the queen and Philip of Spain, which were very advantageous to England. He was violent against the reformers; but on his death-bed was dissatisfied with his life, and often repeated these words: *Erravi cum Petro, sed non flevi cum Petro.* He died in 1555.

GARGARISM, from γαργαρίζω, "to wash the mouth;" a gargle. Its use is for washing the mouth and throat when inflamed or ulcerated, &c. A small quantity may be taken into the mouth, and moved briskly about, and then spit out; or, if the patient cannot do this to any advantage, the liquor may be injected by a syringe. When gargles are required, their use should be more frequently repeated than occurs in common practice.

GARGET, a disease of cattle, consisting in a swelling of the throat and the neighbouring parts; to prevent which, bleeding in the spring is recommended.

GARGIL, a distemper in geese, which frequently proves mortal. Three or four cloves of garlic, beaten in a mortar with sweet butter and made into little balls, and given the creature fasting, are the ordinary cure.

GARIDELLA, in botany; a genus of the trigynia order, belonging to the decandria class of plants, and in the natural method ranking under the 26th order, *Multisiliquæ*. The calyx is pentaphyllous, with leaves resembling flower-petals; there are five bilabiate and bifid nectaria; the capsules are polyspermous, and adhering together.

GARLAND, a sort of chaplet made of flowers, feathers, and sometimes precious stones, worn on the head in the manner of a crown. The word is formed of the French *guirlande*, and that of the barbarous Latin *garlanda*, or Italian *ghirlanda*. Menage traces its origin from *gyrus*, through *gyrulus*, to *gyrulare*, *gyrlandum*, *ghirlandum*; and at length *ghirlanda* and *guirlande*; so that *guirlande* and *garland* are descended in the sixth or seventh degree from *gyrus*. Hicks rejects this derivation, and takes the word from *gardel banda*, which in the northern language signify a *nosegay artfully wrought with the hand*.

GARLAND also denotes ornaments of flowers, fruits, and leaves intermixed, anciently much used at the gates of temples, where feasts and solemn rejoicings were held; or at any other place where marks of public joy or gaiety were required, as in triumphal arches, tournaments, &c.

GARLIC. See ALLIUM.

GARMENT, that wherewith any person is clothed. See DRESS and HABIT.

GARNET, in natural history, a very beautiful gem, of a red colour, with some admixture of blue. See GARNATE. When pure and free from blemishes, it is little inferior in appearance to the oriental ruby, though only of a middle degree of hardness between the sapphire and common crystal. It is found of various sizes, from that of a pin's head to an inch in diameter. Among our lapidaries and jewellers, genuine garnets are known by different names according to their different degrees of colour. 1. The garnet, simply so called, is the finest and most valuable kind, being of a very deep blood-red, with a faint admixture of blue. 2. The rock-ruby; a name very improperly given to the garnet when it is of a very strong but not deep red, and has a fairer cast of the blue: this is a very beautiful gem. 3. The forane or serain garnet; that of a yet brighter red, approaching to the colour of native cinnabar, with a faint blue tinge. 4. The almandine, a garnet only a little paler than that called the rock-ruby.

The making *counterfeit garnet* in paste is done as follows:— Take prepared crystal, two ounces; common red-lead, six ounces; manganese, 16 grains; zaffre, three grains; mix all well, put them into a crucible, cover it with lute, and set it in a potter's kiln for 24 hours. Or, take crystal, two ounces; minium, five ounces and a half; manganese, 15 grains; zaffre, four grains: mix them well together, and let all be baked, in a pot well luted, in a potter's kiln 24 hours.

GARONNE, a fine river of the S. of France, which rises in the Pyrenees, and taking a N. W. direction, waters Toulouse and Bourdeaux, below which it is joined by the Dordogne, and thence to its entrance into the bay of Biscay is called the Gironde. It has a navigable communication with the Mediterranean by its junction with the ci-devant Royal Canal. See the article CANAL.

Upper GARONNE, a department of France, which contains part of the late province of Languedoc. Toulouse is the capital.

GARRICK (David), Esq. the great Roscius of his age and country, who for near forty years shone the brightest luminary in the hemisphere of the stage, was born at the Angel Inn at Hereford in the year 1716. His father, Captain Peter Garrick, was a French refugee, and had a troop of horse which were then quartered in that city. This rank he maintained in the army for several years, and had a majority at the time of his death; which event, however, prevented him from long enjoying it. Mr. Garrick received the first rudiments of his education at the free-school at Lichfield; which he afterwards completed at Rochester under the celebrated Dr. Colson, since mathematical professor at Cambridge. Dr. Johnson and he were fellow-students at the same school; and it is a curious fact, that these two celebrated geniuses came up to London, with the intention of pushing themselves into active life, in the same coach. On the 9th of March 1736, he was entered at the honourable society of Lincoln's-Inn. The study of the law, however, he soon quitted, and followed for some time the employment of a wine-merchant: but that too disgusting him, he gave way at last to the irresistible bias of his mind, and joined a travelling-company of comedians at Ipswich in Suffolk, where he went by the name of *Lyddle*. Having in this poor school of Apollo got some acquaintance with the theatric art, he burst at once upon the world in the year 1740-1, in all the lustre of perfection, at the little theatre in Goodman's Fields, then under the direction of Henry Gifford.

The character he first performed was Richard III. in which, like the sun bursting from behind a cloud, he displayed in the earliest dawn a somewhat more than meridian brightness. His excellence dazzled and astonished every one; and the seeing a young man, in no more than his 24th year, and a novice in reality to the stage, reaching at one single step to that height of perfection which maturity of years and long practical experience had not been able to bestow on the then capital performers of the English stage, was a phenomenon that could not but become the object of universal speculation and of as universal admiration. The theatres at the west end of the town were deserted; Goodman's Fields, from being the rendezvous of citizens and citizens wives alone, became the resort of all ranks of men; and Mr. Garrick continued to act till the close of the season.

Having very advantageous terms offered him for the performing in Dublin during some part of the summer (1741), he went over, and there likewise found the same just homage paid to his merit which he had received from his own countrymen. To the service of the latter, however, he esteemed himself more immediately bound; and therefore, in the ensuing winter, engaged himself to Mr. Fleetwood, then manager of Drury Lane: in which theatre he continued till the year 1745, when he again went over to Ireland, and continued there the whole season, joint manager with Mr. Sheridan in the direction and profits of the theatre-royal in Smock Alley. From thence he returned to England, and was engaged for the season of 1746 with Mr. Rich at Covent-Garden. This was his last performance as a

hired actor: for in the close of that season, Mr. Fleetwood's patent for the management of Drury-lane being expired, and that gentleman having no inclination further to pursue a design by which, from his want of acquaintance with the proper conduct of it, or some other cause, he had considerably impaired his fortune, Mr. Garrick, in conjunction with Mr. Lacy, purchased the property of that theatre, together with the renovation of the patent; and in the winter of 1747 opened it with the greatest part of Mr. Fleetwood's company, and with the great additional strength of Mr. Barry, Mrs. Pritchard, and Mrs. Cibber, from Covent-Garden.

Were we to trace Mr. Garrick through the several occurrences of his life—a life so active, so busy, and so full of occurrences as his, we should swell this account to many pages. Suffice it to say, he continued in the unmolested enjoyment of his fame and unrivalled excellence to the moment of his retirement. His universality of excellence was never once attacked by competition. Tragedy, comedy, and farce; the lover and the hero, the jealous husband who suspects his wife without cause, and the thoughtless lively rake who attacks it without design, were all alike his own. Rage and ridicule, doubt and despair, transport and tenderness, compassion and contempt; love, jealousy, fear, fury, and simplicity; all took in turn possession of his features, while each of them in turn appeared to be the sole possessor of his heart. In the several characters of Lear and Hamlet, Richard, Dorilas, Romeo, and Lusignane, in his Ranger, Bayes, Drugger, Kitely, Brute, and Benedick, you saw the muscular conformations that your ideas attached to them all. In short, Nature, the mistress from whom alone this great performer borrowed all his lessons, being in herself inexhaustible, this her darling son, marked out for her truest representative, found an unlimited scope for change and diversity in his manner of copying from her various productions. There is one part of theatrical conduct which ought unquestionably to be recorded to Mr. Garrick's honour, since the cause of virtue and morality, and the formation of public manners, are considerably dependent upon it; and that is, the zeal with which he aimed to banish from the stage all those plays which carry with them an immoral tendency, and to prune from those which do not absolutely, on the whole, promote the interests of vice, such scenes of licentiousness and liberty, as a redundancy of wit and too great liveliness of imagination have induced some of our comic writers to indulge themselves in, and which the sympathetic disposition of our age of gallantry and intrigue has given sanction to. The purity of the English stage has certainly been much more fully established during the administration of this theatrical minister, than it had ever been during preceding managements. He seems to have carried his modest, moral, chaste, and pious principles with him into the very management of the theatre itself, and rescued performers from that obloquy which stuck to the profession. Of those who were accounted blackguards, unworthy the association of the world, he made gentlemen, united them with society, and introduced them to all the domestic comforts of life. The theatre was no longer esteemed the receptacle of all vice; and the moral, the serious, the religious part of mankind did not hesitate to partake of the rational entertainment of a play, and pass a cheerful evening undisgusted with the licentiousness and uncorrupted by the immorality of the exhibition.

Notwithstanding the numberless and laborious avocations attendant on his profession as an actor, and his station as a manager, yet still his active genius was perpetually bursting forth in various little productions in the dramatic and poetical way, whose merit cannot but make us regret his want of time for the pursuance of more extensive and important works. It is certain, that his merit as an author is not of the first magnitude: but his great knowledge of men and manners, of stage-effect, and his happy turn for lively and striking satire, made him generally successful; and his prologues and epilogues in particular, which are almost innumerable, possess such a degree of happiness both in the conception and execution as to stand unequalled. His Ode on the death of Mr. Pelham ran through four editions in less than six weeks. His Ode on Shakespeare is a masterly piece of poetry; and, when delivered by himself, was a most capital exhibition. His alterations of Shakespeare and other authors have been at times successful, and at times exploded. The cutting out the grave-diggers' scene from Hamlet will never be forgiven him by the frequenters of the gallery at Drury. Though necessary to the chasteness of the scene, they cannot bear to lose so much true sterling wit and humour; and it must be owned that exuberances of that kind, though they hurt the uniformity, yet increase the luxuriance, of the piece. Among his alterations the following are found: Every Man in his Humour, altered from Ben Jonson; Romeo and Juliet, Winter's Tale, Catherine and Petruchio, Cymbeline, Hamlet, &c. altered and made up from Shakespeare; Gamesters, a comedy, from Shirley; Isabella, from Southerne. To these we add, as original productions, The Farmer's Return, and Linco's Travels, interludes; Guardian, Lethe, Lying Valet, Miss in her Teens, Male Coquet, Irish Widow, and other comedies in two acts; Enchanter, a musical entertainment; Lilliput. The Christmas Tale is ascribed to him, besides many other dramatic pieces.

We now bring him to the period of his retirement in the spring of 1776; when, full of fame, with the acquirement of a splendid fortune, and growing into years, he thought proper to seek the vale of life, to enjoy that dignified and honourable ease which was compatible with his public situation, and which he had so well earned by the activity and the merits of his dramatic reign. But very short indeed was the period allotted to him for this precious enjoyment: for on the 20th of January 1779 he departed this life; leaving no one rival in excellence upon earth to compensate for his loss, or a hope of our ever meeting with his like again.

GARRISON, in the art of war, a body of forces disposed in a fortress, to defend it against an enemy, or to keep the inhabitants in subjection, or even to be subsisted during the winter-season: hence *garrison* and *winter-quarters* are sometimes used indifferently for the same thing, though sometimes they denote different things. In the latter case, a garrison is a place wherein forces are maintained to secure it, and where they keep regular guard, as a frontier town, a citadel, castle, tower, &c. The garrison should be always stronger than the townsmen. Du Cange derives the word from the corrupt Latin *garnisio*, which the latter writers use to signify all manner of munition, arms, victuals, &c. necessary for the defence of a place and sustaining of a siege. Winter-quarters signify a place where a number of forces are laid up in the winter season without keeping any but a trifling guard.

Garrison, a town of Ireland, in the county of Fermanagh, 10 miles S. E. of Ballyshannon. W. long. 7. 43. N. lat. 54. 25.

GARSTANG, a town in Lancashire, 223 miles from London, in the post road between Preston and Lancaster. It is a large populous place, near a mile in length, but built in a very irregular manner, with dirty streets and very indifferent houses. The church is a stately Gothic structure. By the late inland navigation, it has communication with the rivers Mersey, Dee, Ribble, Ouse, Trent, Darwent, Severn, Humber, Thames, Avon, &c. which navigation, including its windings, extends above 500 miles, in the counties of Lincoln, Nottingham, York, Westmoreland, Chester, Stafford, Warwick, Leicester, Oxford, Worcester, &c.

GARTER, a ligature for tying up the ſtocking, but particularly uſed for the badge of a noble order of knights, hence denominated the

Order of the GARTER, a military order of knighthood, the moſt noble and ancient of any lay-order in the world, inſtituted by Edward III. The knights-companions are generally princes and peers: and the king of England is the ſovereign or chief of the order. The number of knights was originally 26; but ſix were added in 1786, on account of the increaſe of the royal family. They are a college or corporation, having a great ſeal and little ſeal.

Their officers are a prelate, chancellor, regiſter, king at arms, and uſher of the black rod. They have alſo a dean, with 12 canons, and petty canons, vergers, and 26 penſioners or poor knights. The prelate is the head. This office is veſted in the biſhop of Wincheſter, and has ever been ſo. Next to the prelate is the chancellor; which office is veſted in the biſhop of Saliſbury, who keeps the ſeals, &c. The next is the regiſter, who, by his oath, is to enter upon the regiſtry, the ſcrutinies, elections, penalties, and other acts of the order, with all fidelity. The dean of Windſor is always regiſter *ex officio*. The fourth officer is garter and king-at-arms, being two diſtinct offices united in one perſon. Garter carries the rod and ſceptre at the feaſt of St. George, the protector of this order, when the ſovereign is preſent. He notifies the elections of new knights, attends the ſolemnity of their inſtallations, carries the garter to the foreign princes, &c. He is the principal officer within the college of arms, and chief of the heralds. See KING-*at-Arms*.

All theſe officers except the prelate have fees and penſions. The college of the order is ſeated in the caſtle of Windſor, within the chapel of St. George, and the charter-houſe, erected by the founder for that purpoſe. The habit and enſign of the order are, a garter, mantle, cape, george, and collar. The three firſt were aſſigned the knights-companions by the founder, and the george and collar by Henry VIII.

The garter challenges pre-eminence over all the other parts of the dreſs, by reaſon that from it the noble order is denominated; that it is the firſt part of the habit preſented to foreign princes and abſent knights, who, and all other knights-elect, are therewith firſt adorned; and it is of ſo great honour and grandeur, that, by the bare inveſtiture with this noble enſign, the knights are eſteemed companions of the greateſt military order in the world. It is worn on the left leg between the knee and calf, and is enamelled with this motto, HONI SOIT QUI MAL Y PENSE; i. e. *Shame to him that thinks evil hereof*: The meaning of this is, that king Edward, having laid claim to the kingdom of France, retorted ſhame and defiance upon him that ſhould dare to think amiſs of the juſt enterpriſe he had undertaken for recovering his lawful right to that crown; and that the bravery of thoſe knights whom he had elected into this order was ſuch as would enable him to maintain the quarrel againſt thoſe that thought ill of it.

The mantle is the chief of theſe veſtments made uſe of upon all ſolemn occaſions. The colour of the mantle is by the ſtatutes appointed to be blue. The length of the train of the mantle alone diſtinguiſhes the ſovereign from the knights-companions. To the collar of the mantle is fixed a pair of long ſtrings, anciently wove with blue ſilk only, but now twiſted round, and made of Venice gold and ſilk, of the colour of the robe, with knobs or buttons, and taſſels at the end. The left ſhoulder of the mantle has, from the inſtitution, been adorned with a large garter, with the device, HONI SOIT, &c. Within this is the croſs of the order, which was ordained to be worn at all times by king Charles I. At length the ſtar was introduced, being a ſort of croſs irradiated with beams of ſilver.

The collar is appointed to be compoſed of pieces of gold in faſhion of garters, the ground enamelled blue, and the motto gold. When the knights wear not their robes, they are to have a ſilver ſtar on the left ſide; and they commonly bear the picture of St. George, enamelled on gold, and beſet with diamonds, at the end of a blue ribbon, croſſing the body from the left ſhoulder. They are not to appear abroad without the garter, on penalty of 6s. 8d. to be paid to the regiſter.

When the ſovereign deſigns to elect a companion of the garter, the chancellor belonging to this order draws up the letters, which, paſſing both under the ſovereign's ſign-manual and ſignet of the order, are ſent to the perſon by garter principal king-at-arms. The garter, which is of blue velvet bordered with fine gold-wire, having commonly the letters of the motto of the ſame, is, at the time of election, buckled upon the left leg by two of the ſenior companions, who receive it from the ſovereign, to whom it was preſented upon a velvet cuſhion by garter king-at-arms, with the uſual reverence, whilſt the chancellor reads the following admonition, enjoined by the ſtatutes: "To the honour of God omnipotent, and in memorial of the bleſſed martyr St. George, tie about thy leg, for thy renown, this noble garter; wear it as the ſymbol of the moſt illuſtrious order, never to be forgotten or laid aſide; that thereby thou mayeſt be admoniſhed to be courageous; and having undertaken a juſt war, in which thou ſhalt be engaged, thou mayeſt ſtand firm, valiantly fight, and ſucceſſively conquer." The princely garter being then buckled on, and the word of its ſignification pronounced, the knight-elect is brought before the ſovereign, who puts about his neck, kneeling, a dark blue ribbon, whereunto is appendant, wrought in gold within the garter, the image of St. George on horſeback, with his ſword drawn, encountering with the dragon. In the mean time, the chancellor reads the following admonition: "Wear this ribbon about thy neck, adorned with the image of the bleſſed martyr and ſoldier of Chriſt St. George, by whoſe imitation provoked, thou mayeſt ſo overpaſs both proſperous and adverſe adventures, that, having ſtoutly vanquiſhed thy enemies both of body and ſoul, thou mayeſt not only receive the praiſe of this tranſient combat, but be crowned with the palm of eternal victory." Then the knight elected kiſſes the ſovereign's hand, thanks his majeſty for the great honour done him, riſes up, and ſalutes all the companions ſeverally, who return their congratulations.

Since the inſtitution of this order, there have been eight emperors and twenty-eight kings, beſides numerous ſovereign princes, enrolled as companions thereof. Its origin is ſomewhat differently related. The common account is, that the counteſs of Saliſbury at a ball happening to drop her garter, the king took it up and preſented it to her with theſe words, "*Honi ſoit qui mal y penſe*;" i. e. Evil to him that evil thinks. This accident, it is ſaid, gave riſe to the order and the motto, it being the ſpirit of the times to mix love and war together: but, as in the original ſtatutes of this order there is not the leaſt conjecture to countenance ſuch a feminine inſtitution, credit cannot be given to this tradition. Camden, Fern, &c. take it to have been inſtituted on occaſion of the victory obtained by Edward over the French at the battle of Creſſy. That prince, ſay ſome hiſtorians, ordered his garter to be diſplayed as a ſignal of battle; in commemoration whereof, he made a garter the principal ornament of the order erected in memory of this ſignal victory, and a ſymbol of the indiſſoluble union of the knights.

It appears from Raſtel's chronicle, lib. vi. quoted by Granger in the ſupplement to his Biographical Hiſtory, that this order was deviſed by Richard I. at the ſiege of the city of Acres, when he cauſed twenty-ſix knights, who firmly ſtood by him, to wear thongs of blue leather about their legs; and that it was

perfected in the nineteenth year of Edward III. In 1551 Edward VI. made some alterations in the ritual of this order: that prince composed it in Latin, the original whereof is still extant in his own hand-writing. He there ordained, that the order should no longer be called the order of St. George, but that of the Garter; and, instead of the george hung at the collar, he substituted a cavalier, bearing a book on the point of his sword, with the word *protectio* graven on the sword, and *verbum Dei* on the book; with a buckle in the left hand, and the word *fides* thereon.

GARTER, *principal King at Arms*. This office was instituted by Henry V. Garter and principal king at arms are two distinct offices united in one person: Garter's employment is to attend the service of the order of the garter; for which he is allowed a mantle and badge, a house in Windsor-castle, and pensions both from the sovereign and knights, and, lastly, fees. He also carries the rod and sceptre at every feast of St. George, when the sovereign is present, and notifies the election of such as are new chosen; attends the solemnity of their installations, and takes care of placing their arms over their seats; and carries the garter to foreign kings and princes, for which service it has been usual to join him in commission with some peer or other person of distinction. Garter's oath relates only to services being performed within the order, and is taken in chapter before the sovereign and knights. His oath, as king at arms, is taken before the earl marshal.

GARTER is also a term in heraldry, signifying the moiety or half of a bend.

GARTH, is a name given in some parts of England to a little back-yard or close. It is an ancient British word. *Gardd* in that language signifies *garden*, and is pronounced and written *garth*. This word is also used for a dam or wear, &c.

GARTH-*men* is used in our statutes for those who catch fish by means of fish-garths, or wears. By statute it is ordained, that no fisher nor garth-man shall use any nets or engines to destroy the fry of fish, &c. 17 Ric. II. cap. 9. The word is supposed by some to be derived from the Scotch word *gart*, which signifies *forced* or *compelled*, because fish are forced by the wear to pass into a loop, where they are taken.

GARTH (Sir Samuel), an excellent English poet and physician, was descended from a good family in Yorkshire. He was admitted into the college of physicians at London in 1693. He at that time zealously promoted and encouraged the erecting of the dispensary for the relief of the sick poor, by giving them advice gratis and medicines at low rates. This work of charity having exposed him and many other physicians to the envy and resentment of several persons of the same faculty as well as apothecaries, he ridiculed them, with a peculiar spirit and vivacity, in a poem called the *Dispensary*, in six cantos, highly esteemed. He was one of the most eminent members of the famous society called the *Kit-Kat Club*, which consisted of noblemen and gentlemen distinguished by their excellent parts and affection to the house of Hanover. Upon the accession of George I. he was knighted, and made physician in ordinary to his majesty, and physician-general to the army. Nor were these more than just rewards even of his physical merit. He had gone through the office of censor of the college in 1702, and had practised always with great reputation, and a strict regard to the honour and interest of the faculty, never stooping to prostitute the dignity of his profession, through mean and sordid views of self-interest, to any even the most popular and wealthy apothecaries. In a steady adherence to this noble principle, he concurred with the much celebrated Dr. Radcliffe, with whom he was also often joined in physical consultations. He had a very extensive practice, but was very moderate in his views of advancing his own fortune; his humanity and good nature inclining him more to make use of the great interest he had with persons in power for the support and encouragement of other men of letters. He chose to live with the great in that degree of independency and freedom which became a man possessed of a superior genius, whereof he was daily giving fresh proofs to the public. One of his last performances in polite letters was his translation of the whole fourteenth book, and the story of Cinnus in the fifteenth book, of Ovid's Metamorphoses. These, together with an English version of the rest, were published in 1717; and he has prefixed an excellent preface to the whole, wherein he not only gives an idea of the work and points out its principal beauties, but shows the uses of the poem, and how it may be read to most profit. The distemper which seized him the ensuing year, and ended not but with his life, caused a general concern; which was particularly testified by lord Lansdown, brother-poet, though of a different party, in some admirable verses written on the occasion. He died, after a short illness, which he bore with great patience, in January 1719.

GARTZ, a town of Germany, in Pomerania, on the confines of the marche of Brandenburg, subject to the king of Prussia. Lon. 14. 18. E. Lat. 53. 23. N.

GARUMNA, a noble and navigable river of Gaul, which, rising from the Pyrenees, formerly bounded Aquitain on the north (Cæsar); but, by the new regulation of Augustus, divided it in the middle, emptying itself to the north of Burdegala into the Aquitanic ocean: now the *Garonne*. Mela observes concerning it, that, unless it is swelled by winter rains or the melting of the snow, it is for a great part of the year shoaly and scarce navigable: but when increased by the meeting tide, whereby its waters are repelled, it is somewhat fuller; and the farther the river advances it is broader, till at length it resembles a large frith or arm of the sea, not only bearing large vessels, but also swelling like a raging sea, tosses them extremely, especially if the direction of the wind be one way and that of the current another.

GAS, a general name for all fluids of the aerial kind, except the common air we breathe. It is derived from the German *gascht* or *gast*, signifying an irruption of wind, or the ebullition attending the expulsion of elastic fluids from substances in a state of fermentation or effervescence. It was originally given by Van Helmont to the vapour of charcoal, the same with the fluid afterwards called *fixed air* (now *carbonic acid*), and also to some other factitious airs. From him the term gas has been employed by modern philosophers as a general one for all the elastic fluids about which aerology is conversant.

Under the article AEROLOGY, the nature and properties of these fluids are explained according to the tenets and language of Dr. Priestley, and others, at the time when that writer's celebrated work *On different kinds of air* so much occupied the attention of the philosophical world. Many additional discoveries, however, having been since made, and a new language introduced, indicative of the component parts of the substances undergoing any chemical change or process, the reader will find the subject treated in a still more approved way in the several sections which compose Part II. of the article CHEMISTRY. For the apparatus employed in making the different experiments, see figures 15, &c. of plate 72, and the explanations under CHEMISTRY, page 497.

GASCOIGNE (Sir William), chief justice of the court of king's bench under Henry IV.; a most learned and upright judge, who, being insulted on the bench by the then prince of Wales, afterwards Henry V. with equal intrepidity and coolness committed the prince to prison; and by this seasonable fortitude laid the foundation of the future glory of that great monarch, who from this event dated his reformation from the licentiousness of his youth. It is not well authenticated that the prince struck Sir William, as recorded by Shakespeare; but all authors agree,

that he interrupted the courſe of juſtice to ſcreen a lewd ſervant. Sir William died in 1413.

GASCOIGNE (George), an Engliſh poet of ſome fame in the early part of the reign of queen Elizabeth, was born at Walthamſtow in Eſſex, of an ancient family, and educated at both univerſities, but principally at Cambridge. From thence he removed to Gray's Inn, and commenced ſtudent of the law; but, having a genius too volatile for that ſtudy, he travelled abroad, and for ſome time ſerved in the army in the Low Countries. He afterwards went to France, where he became enamoured of a Scottiſh lady, and married her. Being at length, ſays Wood, *weary of thoſe vanities*, he returned to England, and ſettled once more in Gray's Inn, where he wrote moſt of his dramatic and other poems. The latter part of his life he ſpent in his native village of Walthamſtow, where he died in the year 1578. He had the character of a polite gentleman, an eloquent and witty companion, *et vir inter poetas ſui ſeculi præſtantiſſimus*. His plays, firſt printed ſeparately, were afterwards, with ſeveral other poems, &c. re-printed in two volumes 4to; the firſt volume in 1577, the ſecond in 1587.

GASCOIN, or GASCOIGN, denotes the hinder thigh of a horſe, which begins at the ſtifle, and reaches to the ply or bending of the ham.

GASCONADE, a boaſt or vaunt of ſomething very improbable. The term has its riſe from the Gaſcoons, or people of Gaſcony in France, who are ſaid to have been diſtinguiſhed for bragging and rhodomontade.

GASCONY, a late province of France, bounded on the W. by the bay of Biſcay, on the N. by Guienne, on the E. by Languedoc, and on the S. by the Pyrenees. The character of the inhabitants has been long that of a lively people, famous for boaſting of their valour, which has occaſioned the name of gaſconade to be given to all bragging ſtories. This province, with Armagnac, now forms the department of Gers.

GASSENDI (Peter), one of the moſt celebrated philoſophers France has produced, was born at Chanterſier, about three miles from Digne in Provence, in 1592. When a child, he took particular delight in gazing at the moon and ſtars, as often as they appeared in clear unclouded weather. This pleaſure frequently drew him into bye-places, in order to feaſt his eye freely and undiſturbed; by which means his parents had him often to ſeek, not without many anxious fears and apprehenſions. They therefore put him to ſchool at Digne; where in a ſhort time he made ſuch an extraordinary progreſs in learning, that ſome perſons, who had ſeen ſpecimens of his genius, reſolved to have him removed to Aix, in order to ſtudy philoſophy under Feſay, a learned minor friar. This propoſal was ſo diſagreeable to his father, who intended to breed him up in his own way to country buſineſs, as being more profitable than that of a ſcholar, that he would conſent to it only upon condition that he ſhould return home in two years at fartheſt. Accordingly, young Gaſſendi, at the end of the appointed time, repaired to Chanterſier: but he had not been long there when he was invited to be profeſſor of rhetoric at Digne, before he was quite 16 years of age; and he had been engaged in that office but three years when, his maſter Feſay dying, he was made profeſſor in his room at Aix. When he had been there a few years, he compoſed his Paradoxical Exercitations; which coming to the hands of Nicholas Peireſc, that great patron of learning joined with Joſeph Walter, prior of Valette, in promoting him; and he, having entered into holy orders, was firſt made canon of the church of Digne and doctor of divinity, and then obtained the wardenſhip or rectorſhip of that church. Gaſſendi's fondneſs for aſtronomy grew up with his years; and, his reputation daily increaſing, he was in 1645 appointed royal profeſſor of mathematics at Paris. This inſtitution being chiefly deſigned for aſtronomy, our author read lectures on that ſcience to a crowded audience. However, he did not hold this place long; for a dangerous cough and inflammation of the lungs obliged him in 1647 to return to Digne for the benefit of his native air. Gaſſendi wrote againſt the metaphyſical meditations of Des Cartes, and divided with that great man the philoſophers of his time, almoſt all of whom were Carteſians or Gaſſendians. He joined to his knowledge of philoſophy and the mathematics an acquaintance with the languages and a profound erudition. He wrote, 1. Three volumes on Epicurus's Philoſophy; and ſix others, which contain his own philoſophy. 2. Aſtronomical Works. 3. The Lives of Nicholas de Peireſc, Epicurus, Copernicus, Tycho Brahe, Puerbachius, and Regiomontanus. 4. Epiſtles, and other treatiſes. All his works were collected together, and printed at Lyons in 1658, in ſix volumes folio. He died at Paris in 1655, aged 63.

GASTEROSTEUS, the STICKLE-BACK, in ichthyology. See BANSTICKLE.

GAST-HOUND. See GAZE-*Hound*.

GASTRELL (Francis), biſhop of Cheſter, was born in 1662, appointed preacher to the ſociety of Lincoln's Inn in 1694, and made biſhop of Cheſter in 1714. He preached a courſe of ſermons for Boyle's lectures, engaged in the Trinitarian controverſy with Mr. Collins and Dr. Clarke, and publiſhed two excellent pieces, the one intitled, Chriſtian Inſtitutes, and the other, A Moral Proof of a Future State. He vindicated the rights of the univerſity of Oxford againſt the archbiſhop of Canterbury, in the appointment of the warden of Mancheſter college; and oppoſed the violent proceedings againſt biſhop Atterbury in the houſe of lords, though he diſliked the biſhop as a man of arbitrary principles. He died in 1725.

GASTRIC, in general, denotes ſomething belonging to the ſtomach. GASTRIC-*Juice*, is a thin pellucid liquor, which is ſecreted copiouſly by certain glands in the ſtomach, for the dilution and diſſolution of the food. See ANATOMY, p. 189.

GASTROCNEMIUS, in anatomy. See ANATOMY, *Table of the Muſcles*.

GASTROMANCY, or GASTROMANTIA, a kind of divination practiſed among the ancients by means of words coming or ſeeming to come out of the belly. The word is Greek, γαςρομαντεια, compoſed of γαςηρ *belly* and μαντεια *divination*. There is another kind of divination called by the ſame name *gaſtromancy*, which is performed by means of glaſſes or other round tranſparent veſſels, within which certain figures appear by magic art. It is thus called, becauſe the figures appear as if within the belly of the veſſel.

GASTRORAPHY, in ſurgery, the operation of ſowing up wounds of the abdomen. See SURGERY.

GASTROTOMY, of γαςηρ, and τεμνω, *I cut*, the operation of cutting open the belly, otherwiſe called the *Cæſarian ſection*. See MIDWIFERY.

GATAKER (Thomas), a learned critic and divine, was born at London in 1574, and ſtudied at St. John's college, Cambridge. He was afterwards choſen preacher at Lincoln's Inn; which he quitted in 1611 for the rectory of Rotherhithe in Surry. In 1620 he made a tour through the Low Countries, and in 1624 publiſhed at London a book, intitled, Tranſubſtantiation declared by the Confeſſion of the Popiſh Writers to have no neceſſary Foundation in God's Word. He wrote likewiſe a defence of this diſcourſe. In 1642 he was appointed one of the aſſembly of divines, and was engaged with them in writing annotations upon the Bible. He died in July 1654, in the 80th year of his age. Beſides the above works, he publiſhed, 1. A Diſſertation upon the Style of the New Teſtament. 2. *De nomine tetragrammata*. 3. *De diphthongis, ſive bivocalibus*. 4. An Edition and Tranſlation of the Emperor Marcus Antoninus's Meditations. 5. A Collection of Sermons, in folio; and many other works. His piety and charity were very ex-

emplary, and his modefty fo great, that he declined all ecclefiaftical dignity and court-preferments. His extenfive learning was admired by Salmafius and other great men abroad; his houfe was a private feminary for young gentlemen of this nation, and many foreigners reforted to him to receive advice in their ftudies.

GATE, in architecture, a large door, leading or giving entrance into a city, town, caftle, palace, or other confiderable building. See ARCHITECTURE, p. 292. Thebes in Egypt was anciently known by the appellation *with a hundred gates*. In ancient Rome there was a triumphal gate, *porta triumphalis*. In modern Rome there is the *jubilee gate*, which is only opened in the year of a grand jubilee. The gates which were once very numerous in London, after having been converted into gaols or prifons, as Ludgate, Newgate, &c. were at length removed. The leffer or by-gates for foot paffengers are called *pofterns*. Gates through which coaches, &c. are to pafs fhould not be lefs than 7 feet broad, nor more than 12; the height to be $1\frac{1}{2}$ the breadth.

GATE, or GAIT, in the manege, called in French *train*, is ufed for the going or pace of a horfe.

GATE, in the military art, is made of ftrong planks with iron bars, to oppofe an enemy. Gates are generally made in the middle of the curtain, from whence they are feen, and defended by the two flanks of the baftions. They fhould be covered with a good ravelin, that they may not be feen or enfiladed by the enemy. Thefe gates, belonging to a fortified place, are paffages through the rampart, which may be fhut and opened by means of doors and a portcullis. They are either private or public. *Private* gates are thofe paffages by which the troops can go out of the town unfeen by the enemy, when they pafs to and from the relief of the duty in the outworks, or on any other occafion which is to be concealed from the befiegers. *Public* gates are thofe paffages through the middle of fuch curtains to which the great roads or public ways lead. The dimenfions of thefe are ufually about 13 or 14 feet high, and 9 or 10 feet wide, continued through the rampart, with proper receffes for foot paffengers to ftand in out of the way of wheel-carriages.

GATES *of Hell*. This expreffion is ufed in fcripture, to denote figuratively either the *grave* or the *powers of darknefs*, i. e. the devil and his angels. The Mahometans ufe the expreffion literally, and fuppofe that hell has feven gates. The firft is that where Muffulmans who incur the guilt of fin will be tormented. The fecond is for the Chriftians. The third is for the Jews. The fourth for the Sabians. The fifth for the Magians or worfhippers of fire. The fixth for Pagans and idolaters. And the feventh for hypocrites, who make an outward fhow of religion, but have none.

GATESHEAD, in the county of Durham, is as it were the fuburbs of Newcaftle, though it lies in another county, being divided by the river Tyne; over which there is a fine ftone-bridge, with an iron-gate in the middle, having the arms of Durham on one fide, and thofe of Newcaftle on the other, which is the boundary between the bifhoprick and Northumberland. The church is a fine building, with a very high tower, feen at a great diftance; and in the church-yard are feveral ancient monuments. There are few traces left of its ancient monaftery, except a ftone gateway, or rather a modern erection. The houfe covered two acres and a half of land. Here live the coal-pit men.

GATTON, a borough of Surry, which was formerly very large, but is now much reduced, and has neither market nor fair. It is 19 miles S. by W. of London. Lon. 0. 10. W. Lat. 51. 18. N.

GAUBIUS (Hieronymus David), a celebrated phyfician of Holland. He ftudied under the illuftrious Boerhaave, and became fo much the favourite of his profeffor, that he refigned the chemical chair in his favour. He taught at Leyden with great applaufe for 40 years. In the year 1775 he laid down his office, as being no longer able to fupport the fatigues of it. He was fucceeded by John David Hahn, then profeffor at Utrecht. His reputation was extended all over Europe by feveral valuable publications, particularly by his *Inftitutiones Pathologiæ Medicinalis* and his *Adverfaria*, which have contributed not a little to the improvement both of the theory and practice of medicine. He died at Leyden, 29th November 1780, in the 76th year of his age.

GAUDEN (Dr. Jofeph), fon of John Gauden vicar of Mayfield in Effex, was born there in 1605. At the commencement of the civil war, he was chaplain to Robert earl of Warwick; who taking part with the parliament againft the king, was followed by his chaplain. Upon the eftablifhment of the Prefbyterian model of church-government, he complied with the ruling powers, and was nominated one of the affembly of divines who met at Weftminfter in 1643, and took the covenant; yet, having offered fome fcruples and objections to it, his name was afterwards ftruck out of the lift. Nor did he efpoufe the parliament caufe any longer than they adhered to their firft avowed principles of reforming only, inftead of deftroying, monarchy and epifcopacy. In this fpirit he was one of thofe divines who figned a proteftation to the army againft the violent proceedings that affected the life of the king; and a few days after his execution publifhed the famous Εικων Βασιλικη, *A Portraiture of his Sacred Majefty in his Solitude and Sufferings*, which ran through 50 editions in the courfe of a year. Upon the return of Charles II. he was promoted to the fee of Exeter, and in 1662 was removed to Worcefter, much to his regret, having flattered himfelf with the hopes of a tranflation to Winchefter; and his death happened the fame year. He wrote many controverfial pieces fuited to the circumftances of the times and to his own views from them. The *Eikon Bafilike* above mentioned he publifhed as the king's private meditations, though on this point there has been a long controverfy. After the bifhop's death, his widow, in a letter to one of her fons, calls it *The Jewel*, and faid, her hufband had hoped to make a fortune by it; and that fhe had a letter of a very great man's which would decide that he had written it. This affertion, as the earl of Clarendon had predicted, was eagerly efpoufed by the anti-royalifts, in the view of difparaging Charles I. But it has been obferved that Gauden had too luxuriant an imagination, which betrayed him into a ranknefs of ftyle in the Afiatic way; and from thence, as bifhop Burnet argues with others, it may be certainly concluded, that not he, but the king himfelf, was the true author of the Εικων Βασιλικη; in which there is a noblenefs and juftnefs of thought, with a greatnefs of ftyle, that made it be looked on as the beft written book in the Englifh language.

GAVEL, or GABLE, among builders. See GABLE.

GAVEL, in law: tribute, toll, cuftom, or yearly revenue; of which we had in old time feveral kinds. See GABEL.

GAVEL-*Kind*, a tenure or cuftom belonging to lands in the county of Kent. The word is faid by Lambard to be compounded of three Saxon words, *gyfe*, *eal*, *kyn*, "*omnibus cognatione proximis data*." Verftegan calls it *gavel-kind*, quafi "give all kind," that is, to each child his part: and Taylor, in his hiftory of *gavelkind*, derives it from the Britifh *gavel*, i. e. a hold or tenure, and *cenned*, "*generatio* aut *familia*;" and fo *gavel cenned* might fignify *tenura generationis*. It is univerfally known what ftruggles the Kentifh men made to preferve their ancient liberties, and with how much fuccefs thofe ftruggles were attended. And as it is principally here that we meet with the cuftom of gavel-kind (though it was and is to be found in fome other parts of the kingdom), we may fairly conclude that this was a part of thefe liberties; agreeably to Mr. Selden's opinion

that gavel-kind, before the Norman conqueſt, was the general cuſtom of the realm. The diſtinguiſhing properties of this tenure are various: ſome of the principal are theſe. 1. The tenant is of age ſufficient to alienate his eſtate by feoffment at the age of 15. 2. The eſtate does not eſcheat in caſe of an attainder and execution for felony, their maxim being, "the father to the bough, the ſon to the plough." 3. In moſt places he had a power of deviſing lands by will, before the ſtatute for that purpoſe was made. 4. The lands deſcend, not to the eldeſt, youngeſt, or any one ſon only, but to all the ſons together; which was indeed anciently the moſt uſual courſe of deſcent all over England, though in particular places particular cuſtoms prevailed.

GAVELET, in law, an ancient and ſpecial ceſſavit uſed in Kent, where the cuſtom of gavel-kind continues, by which the tenant, if he withdraws his rent and ſervices due to the lord, forfeits his land and tenements. The proceſs of the gavelet is thus: The lord is firſt to ſeek by the ſteward of his court, from three weeks to three weeks, to find ſome diſtreſs upon the tenement, till the fourth court; and if at that time he find none, at this fourth court it is awarded, that he take the tenement in his hand in name of a diſtreſs, and keep it a year and a day without manuring; within which time, if the tenant pay his arrears, and make reaſonable amends for the with-holding, he ſhall have and enjoy his tenements as before: if he come not before the year and day be paſt, the lord is to go to the next county-court, with witneſſes of what had paſſed at his own court, and pronounce there his proceſs, to have further witneſſes; and then by the award of his own court, he ſhall enter and manure the tenement as his own: ſo that if the tenant deſired afterwards to have and hold it as before, he muſt agree with the lord, according to this old ſaying: "Has he not ſince any thing given, or any thing paid, then let him pay five pound for his were, e'er he become healder again." Other copies have the firſt part with ſome variation; "Let him nine times pay, and nine times repay."

Gavelet, in London, is a writ uſed in the huſtings, given to lords of rents in the city of London. Here the parties, tenant and demandant, appear by *ſcire facias*, to ſhow cauſe why the one ſhould not have his tenement again on payment of his rent, or the other recover the lands on default thereof.

GAUGE-point of a ſolid meaſure, the diameter of a circle whoſe area is equal to the ſolid content of the ſame meaſure.

GAUGER, a king's officer, who is appointed to examine all tuns, pipes, hogſheads, and barrels, of wine, beer, ale, oil, honey, &c. and give them a mark of allowance, before they are ſold in any place within the extent of his office.

GAUGING. See Geometry. An inſtrument uſed in gauging or meaſuring the contents of any veſſel is called a *Gauging Rod*. That uſually employed is the four-foot gauging-rod. It is commonly made of box, and conſiſts of four rules, each a foot long and about three-eighths of an inch ſquare, joined together by three braſs joints; by which means the rod is rendered four feet long when the four rules are quite opened, and but one foot when they are all folded together. On the firſt face of this rod, marked 4, (plate 36.), are placed two diagonal lines, one for beer and the other for wine: by means of which the content of any common veſſel in beer or wine gallons may be readily found, by putting the rod in at the bung-hole of the veſſel till it meets the interſection of the veſſel with the ſtaves oppoſite to the bung-hole. For diſtinction of this line, there is written thereon *beer and wine gallons*. On the ſecond face, 5, are a line of inches and the gauge-line; which is a line expreſſing the areas of circles, whoſe diameters are the correſpondent inches in ale-gallons. At the beginning is written *ale area*. On the third face, 6, are three ſcales of lines; the firſt, at the end of which is written *hogſhead*, is for finding how many gallons there are in a hogſhead when it is not full, lying with its axis parallel to the horizon. The ſecond line, at the end of which is written *B. L.* ſignifying a *butt lying*, is for the ſame uſe as that for the hogſhead. The third line is to find how much liquor is wanting to fill up a butt when it is ſtanding: at the end of it is written *B. S.* ſignifying a *butt ſtanding*. In the half of the fourth face of the gauging-rod, 7, there are three ſcales of lines, to find the wants in a firkin, kilderkin, and barrel, lying with their areas parallel to the horizon. They are diſtinguiſhed by *F. K. B.* ſignifying a *firkin, kilderkin,* and *barrel*, or the words at length.

Uſe of the diagonal lines on this rod. To find the content of a veſſel in beer or wine gallons, put the braſed end of the gauging-rod into the bung-hole of the caſk, with the diagonal lines upwards, and thruſt this braſed end to the meeting of the head and ſtaves; then with chalk make a mark at the middle of the bung-hole of the veſſel, and alſo on the diagonal lines of the rod, right againſt, over one another, when the braſed end is thruſt home to the head and ſtaves; then turn the gauging-rod to the other end of the veſſel, and thruſt the braſed end home to the end, as before. Laſtly, ſee if the mark made on the gauging-rod come even with the mark made on the bung-hole when the rod was thruſt to the other end; which if it be, the mark made on the diagonal lines will, on the ſame lines, ſhow the whole content of the caſk in beer or wine gallons.

If the mark made on the bung-hole be not right againſt that made on the rod when you put it the other way, then right againſt the mark made on the bung-hole make another on the diagonal lines; and the diviſion on the diagonal line between the two chalks will ſhow the veſſel's whole contents in beer or wine gallons. Thus, *e. g.* if the diagonal line of a veſſel be 28 inches four-tenths, its contents in beer gallons will be near 51, and in wine gallons 62.

If a veſſel be open, as a half-barrel, tun, or copper, and the meaſure from the middle on one ſide to the head and ſtaves be 38 inches, the diagonal line gives 122 beer-gallons; half of which, viz. 61, is the content of the open half tub.

If you have a large veſſel, as a tun or copper, and the diagonal line taken by a long rule proves 70 inches, the content of that veſſel may be found thus: Every inch at the beginning-end of the diagonal-line call ten inches. Thus ten inches becomes 100 inches; and every tenth of a gallon call 100 gallons; and every whole gallon call 1000 gallons. *Example.* At 44.8 inches on the diagonal beer-line is 200 gallons; ſo that 4 inches 48 parts, now called 44 inches 8-tenths, is juſt two-tenths of a gallon, now called 200 gallons: ſo alſo, if the diagonal line be 76 inches and 7-tenths, a cloſe caſk of ſuch diagonal will hold 1000 beer-gallons; but an open caſk but half ſo much, viz. 500 beer-gallons.

Uſe of the Gauge-*Line.* To find the content of any cylindrical veſſel in ale-gallons: ſeek the diameter of the veſſel in inches, and juſt againſt it on the gauge-line is the quantity of ale-gallons contained in one inch deep: this multiplied by the length of the cylinder will give its content in ale-gallons. For example, ſuppoſe the length of the veſſel 32.06, and the diameter of its baſe 25 inches, to find what is the content in ale-gallons? Right againſt 25 inches on the gauge-line is one gallon and 745 of a gallon; which multiplied by 32.06, the length, gives 55.9447 gallons for the content of the veſſel. The bung diameter of a hogſhead being 25 inches, the head diameter 22 inches, and the length 32.06 inches, to find the quantity of ale-gallons contained in it? Seek 25, the bung diameter, on the line of inches, and right againſt it on the gauge-line you will find 1.745: take one-third of it, which is .580, and ſet it down twice: ſeek 22 inches in the head diameter, and againſt it you will find on the gauge-line 1.356; one third of which added to twice .580 gives 1.6096; which multiplied by the

length 32.06, the product will be 51.603776, the content in ale-gallons. Note, this operation ſuppoſes that the aforeſaid hogſhead is in the figure of the middle fruſtum of a ſpheroid. The uſe of the lines on the two other faces of the rod is very eaſy; you need only put it downright into the bung-hole (if the veſſel you deſire to know the quantity of ale-gallons contained therein be lying) to the oppoſite ſtaves; and then where the ſurface of the liquor cuts any one of the lines appropriated to that veſſel will be the number of gallons contained in that veſſel.

GAUL, the name given by the Romans to the country that now forms the kingdom of France. The original inhabitants were deſcended from the Celtes or Gomerians, by whom the greateſt part of Europe was peopled; the name of *Galli* or *Gauls* being probably given them long after their ſettlement in that country. See GALLIA.

The ancient hiſtory of the Gauls is entirely wrapped up in obſcurity and darkneſs; all we know concerning them for a long time is, that they multiplied ſo faſt, that, their country being unable to contain them, they poured forth in vaſt multitudes into other countries, which they generally ſubdued, and ſettled themſelves in. It often happened, however, that theſe colonies were ſo moleſted by their neighbours, that they were obliged to ſend for aſſiſtance to their native country. This was always very eaſily obtained. The Gauls were, upon every occaſion, ready to ſend forth great numbers of new adventurers; and, as theſe ſpread deſolation wherever they came, the very name of *Gauls* proved terrible to moſt of the neighbouring nations. The earlieſt excurſion of theſe people of which we have any diſtinct account was into Italy under a famed leader named *Bellovesſus*, about 622 years before Chriſt. He croſſed the Rhone and the Alps, till then unattempted; defeated the Hetrurians, and ſeized upon that part of their country, ſince known by the names of *Lombardy* and *Piedmont*. The ſecond grand expedition was made by the Cœnomani, a people dwelling between the rivers Seine and Loire, under a general named *Elitonis*. They ſettled in thoſe parts of Italy now known by the names of *Breſciano*, *Cremoneſe*, *Mantuan*, *Carniola*, and *Venetian*. In a third excurſion, two other Gauliſh nations ſettled on both ſides of the river Po; and in a fourth, the Boii and Lingones ſettled in the country between Ravenna and Bologna. The time of theſe three laſt expeditions is uncertain.

The fifth expedition of the Gauls was more remarkable than any of the former, and happened about 200 years after that of Belloveſus. The Senones, ſettled between Paris and Meux, were invited into Italy by an Hetrurian lord, and ſettled themſelves in Umbria. Brennus their king laid ſiege to Cluſium, a city in alliance with Rome; and this produced a war with the Romans, in which the latter were at firſt defeated, and their city taken and burnt; but at length the whole army was cut off by Camillus, inſomuch that not a ſingle perſon eſcaped.

Some other expeditions the Gauls undertook againſt the Romans: in which, though they always proved unſucceſsful, by reaſon of their want of military diſcipline, yet their fierceneſs and courage made them ſo formidable to the republic, that, on the firſt news of their march, extraordinary levies of troops were made, ſacrifices and public ſupplications offered to the gods, and the law which granted an immunity from military ſervice to prieſts and old men was, for the time, aboliſhed.

Againſt the Greeks the expeditions of the Gauls were very little more ſucceſsful than againſt the Romans. The firſt of theſe we hear of was about 279 years before Chriſt, in the year after Pyrrhus had invaded Italy. At this time the Gauls, finding themſelves greatly overſtocked at home, ſent out three great colonies to conquer new countries for themſelves. One of theſe armies was commanded by *Brennus*, another by *Cerethrius*, and the third by *Belgius*. The firſt entered Pannonia, or Hungary; the ſecond Thrace; and the third marched into Illyricum and Macedonia. Here Belgius at firſt met with great ſucceſs, and enriched himſelf by plunder to ſuch a degree, that Brennus, envying him, reſolved to enter the ſame countries, in order to ſhare the ſpoil. In a ſhort time, however, Belgius met with ſuch a total defeat, that his army was almoſt entirely deſtroyed; upon which Brennus haſtened to the ſame place. His army at firſt conſiſted of 150,000 foot and 15,000 horſe: but two of his principal officers revolted, and carried off 20,000 men, with whom they marched into Thrace; where, having joined Cerethrius, they ſeized on Byzantium and the weſtern coaſt of Propontis, making the adjacent parts tributary to them. To retrieve this loſs, Brennus ſent for freſh ſupplies from Gaul; and having increaſed his army to 150,000 foot, and upwards of 60,000 horſe, he entered Macedonia, defeated the general who oppoſed him, and ravaged the whole country. He next marched towards the ſtraits of Thermopylæ, with a deſign to invade Greece, but was ſtopped by the forces ſent to defend that paſs againſt him. He paſſed the mountains, however, as Xerxes had formerly done; upon which the guards retired, to avoid being ſurrounded. Brennus then having ordered Acichorius, the next to him in command, to follow at a diſtance with part of his army, marched with the bulk of his forces to Delphi, in order to plunder the rich temple there. This event proved exceedingly unfortunate; a great number of his men were deſtroyed by a dreadful ſtorm of hail, thunder, and lightning; another part of his army was deſtroyed by an earthquake; and the remainder, ſome how or other, imagining themſelves attacked by the enemy, fought againſt each other the whole night, ſo that in the morning ſcarce one-half of them remained. The Greek forces then poured in upon them from all parts, and that in ſuch numbers, that, though Acichorius came up in due time with his forces, Brennus found himſelf unable to make head againſt the Greeks, and was defeated with great ſlaughter. He himſelf was deſperately wounded; and ſo diſheartened by his misfortune, that, having aſſembled all his chiefs, he adviſed them to kill all the wounded and diſabled, and to make the beſt retreat they could; after which he put an end to his own life. On this occaſion, it is ſaid that 20,000 of theſe unhappy people were executed by their own countrymen. Acichorius then ſet out with the remainder for Gaul; but, by being obliged to march through the country of their enemies, the calamities they met with by the way were ſo grievous, that not one of them reached their own country: A juſt judgment, ſay the Greek and Roman authors, for their ſacrilegious intentions againſt Delphi.

The Romans, having often felt the effects of the Gauliſh ferocity and courage, thought proper at laſt, in order to humble them, to invade their country. Their firſt ſucceſsful attempt was about 118 years before Chriſt, under the command of Quintus Marcius, ſurnamed *Rex*. He opened a way betwixt the Alps and the Pyrenees, which laid the foundation for conquering the whole country. This was a work of immenſe labour of itſelf, and rendered ſtill more difficult by the oppoſition of the Gauls, eſpecially thoſe called the Stæni, who lived at the foot of the Alps. Theſe people, finding themſelves overpowered by the conſular army, ſet fire to their houſes, killed their wives and children, and then threw themſelves into the flames. After this Marcius built the city of Narbonne, which became the capital of a province. His ſucceſſor Scaurus alſo conquered ſome Gauliſh nations; and, in order to facilitate the ſending troops from Italy into that country, he made ſeveral excellent roads between them, which before were almoſt impaſſable. Theſe ſucceſſes gave riſe to the invaſion of the CIMBRI and TEUTONES.

From this time the Gauls ceaſed to be formidable to the

Romans, and even ſeem to have been for ſome time on good terms with them. At laſt, however, the Helvetii kindled a war with the republic, which brought Cæſar over the Alps, and ended in the total ſubjection of the country. Orgetorix was the firſt cauſe of it, who had engaged a vaſt number of his countrymen to burn their towns and villages, and to go in ſearch of new conqueſts. Julius Cæſar, to whoſe lot the whole country of Gaul had fallen, made ſuch haſte to come and ſuppreſs them, that he was got to the Rhone in eight days; broke down the bridge of Geneva, and, in a few days more, finiſhed the famed wall between that city and mount Jura, now St. Claude, which extended ſeventeen miles in length, was fixteen feet high, fortified with towers and caſtles at proper diſtances, and a ditch that ran the whole length of it. If his own account of it may be relied upon, he did not ſet out till the beginning of April; and yet this huge work was finiſhed by the ides or 13th of the month: ſo that, ſubtracting the eight days he was a-coming, it muſt have been all done in about five days: a prodigious work, conſidering he had but one legion there, or even though the whole country had given him aſſiſtance. Whilſt this was doing, and the reinforcements he wanted were coming, he amuſed the Helvetii, who had ſent to demand a paſſage through the country of the Allobroges, till he had got his reinforcements, and then flatly refuſed it to them: whereupon a dreadful battle enſued, in which they loſt one hundred and thirty thouſand men, in ſpite of all their valour; beſides a number of priſoners, among whom were the wife and daughter of Orgetorix, the leader of this unfortunate expedition. The reſt ſubmitted, and begged they might be permitted to go and ſettle among the Ædui, from whom they originally ſprung; and, at the requeſt of theſe laſt, were permitted to go.

The Gauls were conſtantly in a ſtate of variance with one another; and Cæſar, who knew how to make the moſt of theſe inteſtine broils, ſoon became the protector of the oppreſſed, a terror to the oppreſſor, and the umpire of all their contentions. Among thoſe who applied to him for help were his allies the Ædui; againſt whom Arioviſtus, king of the Germans, joined with the Averni, who inhabited the banks of the Loire, had taken the country of the Sequani from them, and obliged them to ſend hoſtages to him. Cæſar forthwith ſent to demand the reſtitution of both, and, in an interview which he ſoon after obtained of that haughty and treacherous prince, was like to have fallen a ſacrifice to his perfidy; upon which he bent his whole power againſt him, forced him out of his ſtrong intrenchments, and gave him a total overthrow. Arioviſtus eſcaped with difficulty over the Rhine; but his two wives, and a daughter, with a great number of Germans of diſtinction, fell into the conqueror's hand. Cæſar, after this ſignal victory, put his army into winter quarters, whilſt he went over the Alps to make the neceſſary preparations for the next campaign. By this time all the Belgæ in general were ſo terrified at his ſucceſs, that they entered into a confederacy againſt the Romans as their common enemy. Of this, Labienus, who had been left in Gaul, ſent Cæſar notice; upon which he immediately left Rome, and made ſuch diſpatch, that he arrived upon their confines in about fifteen days. On his arrival the Rhemi ſubmitted to him; but the reſt, appointing Galba, king of the Sueſſones, general of all their forces, which amounted to one hundred and fifty thouſand men, marched directly againſt him. Cæſar, who had ſeized on the bridge of the Axona, now Aiſne, led his light horſe and infantry over it; and, whilſt the others were encumbered in croſſing that river, made ſuch a terrible ſlaughter of them, that the river was filled with their dead, inſomuch that their bodies ſerved for a bridge to thoſe who eſcaped. This new victory ſtruck ſuch terror into the reſt, that they diſperſed themſelves; immediately after which, the Sueſſones, Bellovaci, Ambiones, and ſome others, ſubmitted to him. The Nervii, indeed, joined with the Atrebates and Veromundui againſt them, and, having firſt ſecured their wives and children, made a vigorous reſiſtance for ſome time; but were at length defeated and the greateſt part of them ſlain. The reſt, with their wives and old men, ſurrendered themſelves, and were allowed to live in their own cities and towns as formerly. The Aduatici were next ſubdued, and, for their treachery to the conqueror, were ſold for ſlaves, to the number of fifty thouſand. Young Craſſus, the ſon of the triumvir, ſubdued likewiſe ſeven other nations, and took poſſeſſion of their cities; which not only completed the conqueſt of the Belgæ, but brought ſeveral nations from beyond the Rhine to ſubmit to the conqueror. The Veneti, or ancient inhabitants of Vannes in Brittany, who had been likewiſe obliged to ſend hoſtages to the conqueror, were, in the mean time, making great preparations by ſea and land to recover their liberty. Cæſar, then in Illyricum, was forced to equip a fleet on the Loire; and having given the command of it to Brutus, went and defeated them by land, as Brutus did by ſea; and having put their chief men to death, ſold the reſt for ſlaves. The Unelli, with Veridorix their chief, together with the Lexovii and Aulercii, were about the ſame time ſubdued by Sabinus, and the Aquitani by Craſſus, with the loſs of thirty thouſand men. There remained nothing but the countries of the Morini and Menapii to be conquered of all Gaul. Cæſar marched himſelf againſt them: but he found them ſo well intrenched in their inacceſſible fortreſſes, that he contented himſelf with burning and ravaging their country; and, having put his troops into winter-quarters, again paſſed over the Alps, to have a more watchful eye on ſome of his rivals there. He was, however, ſoon after obliged to come to defend his Gauliſh conqueſts againſt ſome nations of the Germans, who were coming to ſettle there, to the number of four hundred thouſand. Theſe he totally defeated, and then carried his conquering arms into Germany.

Upon his return into Gaul, he found it labouring under a great famine, which had cauſed a kind of univerſal revolt. Cotta and Sabinus, who were left in the country of the Eburones, now Liege, were betrayed into an ambuſh by Ambiorix, one of the Gauliſh chiefs, and had moſt of their men cut off. The Aduatici had fallen upon Q. Cicero, who was left there with one legion, and had reduced him to great ſtraits: at the ſame time Labienus, with his legion, was attacked by Indutiomarus, at the head of the Rheni and Senones, but had better luck than the reſt, and, by one bold ſally upon them, put them to flight, and killed their general. Cæſar acquired no ſmall credit by quelling all theſe revolts; but each victory loſt the lives of ſo many of his troops, that he was forced to have recourſe to Pompey for a freſh ſupply, who readily granted him two of his own legions to ſecure his Gauliſh conqueſts.

But it was not long before the Gauls, ever reſtleſs under a foreign yoke, raiſed up a new revolt, and obliged him to return thither. His fear leſt Pompey ſhould gain the affections of the Roman people had obliged him to ſtrip the Gauls of their gold and ſilver, to bribe them over to his intereſt; and this gave no ſmall handle to thoſe frequent revolts which happened during his abſence. He quickly, however, reduced the Nervii, Aduatici, Menapii, and Treviri, the laſt of whom had raiſed the revolt under the command of Ambiorix: but he found the flame ſpread much farther, even to the greateſt part of the Gauls, who had choſen Vercingetorix their generaliſſimo. Cæſar was forced to leave Inſubria, whither he had retired to watch the motions of Pompey, and, in the midſt of winter and ſnow, to repaſs the Alps into the province of Narbonne. Here he gathered his ſcattered troops with all poſſible ſpeed, and, in ſpite of the hard weather, beſieged and took Noviodunum, now Noyons, and defeated Vercingetorix, who was now come to

the relief of that place. He next took the city of Avaricum, now Bourges, one of the ſtrongeſt in Gaul, and which had a garriſon of forty thouſand men, of whom he made ſuch a dreadful ſlaughter, that hardly eight hundred eſcaped. Whilſt he was beſieging Gergovia, the capital of the Arverni, he was informed that the Nitiobriges or Agenois were in arms, and that the Ædui were ſending to Vercingetorix ten thouſand men, which they were to have ſent to reinforce Cæſar. Upon this news he left Fabius to carry on the ſiege, and marched againſt the Ædui. Theſe, upon his approach, ſubmitted, in appearance, and were pardoned; but, ſoon after, that whole nation roſe up in arms, and murdered all the Italian troops in their capital. Cæſar, at this, was in great ſtraits what meaſures to take; but reſolved at length to raiſe the ſiege of Gergovia, and at once attack the enemy's camp, which he did with ſome ſucceſs; but when he thought to have gone to Noviodunum, or Noyons, where his baggage, military cheſt, &c. were left, he heard that the Ædui had carried it off, and burnt the place. Labienus, juſtly thinking that Cæſar would want his aſſiſtance in the condition he now was, went to join him, and in his way defeated a Gauliſh general named *Camulogeno*, who came to oppoſe his march: but this did not hinder the revolt from ſpreading itſelf all over Celtic Gaul, whither Vercingetorix had ſent for freſh ſupplies, and, in the mean time, attacked Cæſar, but was defeated, and forced to retire to Aleſia, a ſtrong place, now Aliſe in Burgundy, as is ſuppoſed. Hither Cæſar haſtened, and beſieged him; and, having drawn a double circumvallation, with a deſign to ſtarve him in it, as he was likely to have done, upon that account refuſed all offers of a ſurrender from him. At length the long-expected reinforcement came, conſiſting of 160,000 men, under four generals: theſe made ſeveral fruitleſs attacks on Cæſar's trenches, but were defeated in three ſeveral battles, which at length obliged Vercingetorix to ſurrender at diſcretion. Cæſar uſed all his priſoners with great ſeverity except the Ædui and Arverni, by whoſe means he hoped to gain their nations, which were the moſt potent of Celtic Gaul: nor was he diſappointed; for both of them ſubmitted to him, and the former received him into the capital, where he ſpent the winter, after he put his army into winter-quarters. This campaign, as it proved one of the hardeſt he ever had, ſo he gained more glory by it than any Roman general had done before: yet could not at all by this procure from the ſervile ſenate, now wholly dedicated to his rival, a prolongation of his proconſulſhip; upon which he is reported to have laid his hand upon his ſword, and ſaid that that ſhould do it.

He was as good as his word; and the Gauls, upon their former ill ſucceſs, reſolving to have as many ſeparate armies as provinces, in order to embarraſs him the more, Cæſar and his generals Labienus and Fabius were forced to fight them one after another; which they did, however, with ſuch ſucceſs, that, notwithſtanding the hardneſs of the ſeaſon, they ſubdued the Bituriges, Carnuti, Rhemi, and Bellovaci, with their general Correus, by which he at once quieted all the Belgic provinces bordering on Celtic Gaul. The next who followed were the Treviri, the Eburones, and the Andes, under their general Dunmarus. The laſt place which held out againſt him was Uxellodunum; which was defended by the two laſt acting generals of the Gauls, Drapes the Senonian, and Luterius the Cadurcean. The place being ſtrong and well garriſoned, Cæſar was obliged to march thither from the fartheſt part of Belgic Gaul, and ſoon after reduced it for want of water. Here again he cauſed the right hands of all that were fit to bear arms to be cut off, to deter the reſt from revolting afreſh. Thus was the conqueſt of Gaul finiſhed, from the Alps and Pyrenees to the Rhine; all which vaſt tract was now reduced to a Roman province under the government of a prætor. During his ſeveral expeditions into Gaul, Cæſar is ſaid to have taken 800 cities, to have ſubdued 300 different nations, and to have defeated, in ſeveral battles, three millions of men, of whom one million were killed, and another taken priſoners.

The Gauls anciently were divided into a great number of different nations, which were continually at war with one another, and at variance among themſelves. Cæſar tells us, that not only all their cities, cantons, and diſtricts, but even almoſt all families were divided and torn by factions, and thus undoubtedly facilitated the conqueſt of the whole. The general character of all theſe people was an exceſſive ferocity and love of liberty. This laſt they carried to ſuch an extreme, that either on the appearance of ſervitude, or incapacity of action through old age, wounds, or chronic diſeaſes, they put an end to their own lives, or prevailed upon their friends to kill them. In cities, when they found themſelves ſo ſtraitly beſieged that they could hold out no longer, inſtead of thinking how to obtain honourable terms of capitulation, their chief care very often was to put their wives and children to death, and then to kill one another, to avoid being led into ſlavery. Their exceſſive love of liberty and contempt of death, according to Strabo, very much facilitated their conqueſt by Cæſar; for, pouring their numerous forces upon ſuch an experienced enemy as Cæſar, their want of conduct very ſoon proved the ruin of the whole.

The chief diverſion of the Gauls was hunting; and indeed, conſidering the vaſt foreſts with which their country abounded, and the multitude of wild beaſts which lodged in them, they were under an abſolute neceſſity to hunt and deſtroy them, to prevent the country from being rendered totally uninhabitable. Beſides this, however, they had alſo their hippodromes, horſe and chariot races, tilts and tournaments; at all of which the bards aſſiſted with their poems, ſongs, and muſical inſtruments. For an account of their religion, ſee the article Druid.

The Gauls were exceſſively fond of feaſting, in which they were very profuſe; as, like all other northern nations, they were great lovers of good eating and drinking. Their chief liquors were beer and wine. Their tables were very low. They ate but little bread, which was baked flat and hard, and eaſily broken in pieces, but devoured a great deal of fleſh, boiled, roaſted, or broiled; and this they did in a very ſlovenly manner, holding the piece in their hands, and tearing it with their teeth. What they could not part by this way, they cut with a little knife which hung at their girdle. When the company was numerous, the *Coryphee*, or chief of the feaſt, who was either one of the richeſt, or nobleſt, or braveſt, ſat in the middle, with the maſter of the houſe by his ſide; the reſt took their places next according to their rank, having their ſervants holding their ſhields behind them. Theſe feaſts ſeldom ended without bloodſhed; but, if by chance the feaſt proved a peaceable one, it was generally accompanied not only with muſic and ſongs, but likewiſe with dances, in which the dancers were armed cap-à-pee, and beat time with their ſwords upon their ſhields. On certain feſtivals they were wont to dreſs themſelves in the ſkins of beaſts, and in that attire accompany the proceſſions in honour of their deities or heroes. Others dreſſed themſelves in maſquerade habits, ſome of them very indecent, and played ſeveral antic and immodeſt tricks. This laſt cuſtom continued long after their converſion to Chriſtianity.

GAULTHERIA, in botany: a genus of the monogynia order, belonging to the decandria claſs of plants, and in the natural method ranking under the 18th order, *Bicornes*. The exterior calyx is diphyllous, the interior quinquefid, the corolla ovate; the nectarium conſiſts of ten ſubulated points. The capſule is quinquelocular, covered with the interior calyx formed in the ſhape of a berry.

GAUNT-bellied, in the manege, is ſaid of a horſe whoſe belly ſhrinks up towards his flanks.

GAUNTLET. See GANTLET.

GAUNTLOPE, pronounced *Gauntlet*, a military punishment for felony, or some other heinous offence. *In ships of war* it is executed in the following manner: The whole ship's crew are disposed in two rows, standing face to face on both sides of the deck, so as to form a lane whereby to go *forward* on one side, and return *aft* on the other; each person being furnished with a small twisted cord, called a *knittle*, having two or three knots upon it. The delinquent is then stripped naked above the waist, and ordered to pass forward between the two rows of men, and aft on the other side, a certain number of times, rarely exceeding three, during which every person gives him a stripe as he runs along. In his passage through this painful ordeal, he is sometimes tripped up, and very severely handled while incapable of proceeding. This punishment, which is called *running the gauntlet*, is seldom inflicted, except for such crimes as will naturally excite a general antipathy among the seamen; as, on some occasions, the culprit would pass without receiving a single blow; particularly in cases of mutiny and sedition, to the punishment of which our sailors seem to have a constitutional aversion. *In the land-service*, when a soldier is sentenced to run the gauntlope, the regiment is drawn out in two ranks facing each other; each soldier, having a switch in his hand, lashes the criminal as he runs along naked from the waist upwards. While he runs, the drums beat at each end of the ranks. Sometimes he runs three, five, or seven times, according to the nature of the offence. The major is on horseback, and takes care that each soldier does his duty.

GAVIES, or GAURS. See GABRES.

GAVOTTA, or GAVOTTE, is a kind of dance, the air of which has two brisk and lively strains in common time, each of which strains is twice played over. The first has usually four or eight bars, and the second contains eight, twelve, or more. The first begins with a minim, or two crotchets, or notes of equal value, and the hand rising, and ends with the fall of the hand upon the dominant or mediant of the mode, but never upon the final, unless it be a rondeau: and the last begins with the rise of the hand, and ends with the fall upon the final of the mode.

Tempi di GAVOTTA, is when only the time or movement of a gavotte is imitated, without any regard to the measure or number of bars or strains. Little airs are often found in sonatas, which have this phrase to regulate their motions.

GAURA, in botany; a genus of the monogynia order, belonging to the octandria class of plants, and in the natural method ranking under the 17th order, *Calycanthemæ*. The calyx is quadrifid and tubular, the corolla pentapetalous, with the petals rising upwards. The nut is inferior, monospermous, and quadrangular.

GAUZE, or GAWSE, in commerce, a very thin, slight, transparent kind of stuff, woven sometimes of silk, and sometimes only of thread. To warp the silk for making of gauze, they use a peculiar kind of mill, upon which the silk is wound: this mill is a wooden machine about six feet high, having an axis perpendicularly placed in the middle thereof, with six large wings, on which the silk is wound from off the bobbins by the axis turning round. When all the silk is on the mill, they use another instrument to wind it off again on two beams: this done, the silk is passed through as many little beads as there are threads of silk, and thus rolled on another beam to supply the loom. The gauze-loom is much like that of the common weavers, though it has several appendages peculiar thereto. See LOOM. There are figured gauzes, some with flowers of gold and silver on a silk ground: these last are chiefly brought from China.

GAY (John), a celebrated English poet, descended from an ancient family in Devonshire, was born at Exeter, and received his education at the free school of Barnstaple in that county, under the care of Mr. William Rayner. He was bred a mercer in the Strand; but having a small fortune independent of business, and considering the attendance on a shop as a degradation of those talents which he found himself possessed of, he quitted that occupation and applied himself to other views, and to the indulgence of his inclination for the muses. In 1712 we find him secretary, or rather domestic steward, to the duchess of Monmouth, in which station he continued till the beginning of the year 1714; at which time he accompanied the earl of Clarendon to Hanover, whither that nobleman was dispatched by Queen Anne. In the latter end of the same year, in consequence of the queen's death, he returned to England, where he lived in the highest estimation and intimacy of friendship with many persons of the first distinction both in rank and abilities. He was even particularly taken notice of by Queen Caroline, then princess of Wales, to whom he had the honour of reading in manuscript his tragedy of the *Captives*; and in 1726 dedicated his *Fables*, by permission, to the duke of Cumberland. From this countenance shown to him, and numberless promises made him of preferment, it was reasonable to suppose that he would have been genteelly provided for in some office suitable to his inclination and abilities. Instead of which, in 1727, he was offered the place of gentleman-usher to one of the youngest princesses; an office which, as he looked on it as rather an indignity to a man whose talents might have been so much better employed, he thought proper to refuse; and some pretty warm remonstrances were made on the occasion by his sincere friends and zealous patrons the duke and duchess of Queensberry, which terminated in those two noble personages withdrawing from court in disgust. Mr. Gay's dependencies on the promises of the great, and the disappointments he met with, he has figuratively described in his fable of the *Hare with many friends*. However, the very extraordinary success he met with from public encouragement made an ample amends, both with respect to satisfaction and emolument, for those private disappointments. For in the season of 1727-8 appeared his *Beggar's Opera*, the vast success of which was not only unprecedented, but almost incredible. It had an uninterrupted run in London of 63 nights in the first season, and was renewed in the ensuing one with equal approbation. It spread into all the great towns of England, was played in many places to the 30th and 40th time, and at Bath and Bristol 50; made its progress into Wales, Scotland, and Ireland, in which last place it was acted for 24 successive nights; and last of all it was performed at Minorca. Nor was the fame of it confined to the reading and representation alone, for the card-table and drawing-room shared with the theatre and closet in this respect; the ladies carried about the favourite songs of it engraven upon their fan-mounts, and screens and other pieces of furniture were decorated with the same. In short, the satire of this piece was so striking, so apparent, and so perfectly adapted to the taste of all degrees of people, that it overthrew the Italian opera, that Dagon of the nobility and gentry, which had so long seduced them to idolatry, and which Dennis, by the labours and outcries of a whole life, and many other writers by the force of reason and reflection, had in vain endeavoured to drive from the throne of public taste. The profits of this piece were so very great, both to the author and Mr. Rich the manager, that it gave rise to a quibble, which became frequent in the mouths of many, viz. *That it had made* Rich gay, *and* Gay rich; and it has been asserted, that the author's own advantages from it were not less than 2000l. In consequence of this success, Mr. Gay was induced to write a second part to it, which he intitled *Polly*. But the disgust subsisting between him and the court, together with the misrepresentations made of him as having been the author of some disaffected libels and seditious pamphlets, occasioned a prohibition and suppression of it to be sent from the

lord chamberlain, at the very time when every thing was in readinefs for the rehearfal of it. A very confiderable fum, however, accrued to him from the publication of it afterwards in quarto. Mr. Gay wrote feveral other pieces in the dramatic way, and many very valuable ones in verfe. Among the latter, his *Trivia*, or the *Art of walking the ftreets of London*, though his firft poetical attempt, is far from being the leaft confiderable, and is what recommended him to the efteem and friendfhip of Mr. Pope: but as, among his dramatic works, his *Beggar's Opera* did at firft, and perhaps ever will, ftand as an unrivalled mafter-piece, fo, among his poetical works, his *Fables* hold the fame rank of eftimation, the latter having been almoft as univerfally read as the former was reprefented, and both equally admired. Mr. Gay's difpofition was fweet and affable, his temper generous, and his converfation agreeable and entertaining. But he had one foible, too frequently incident to men of great literary abilities, and which fubjected him at times to inconveniencies which otherwife he needed not to have experienced, viz. an exceffive indolence, without any knowledge of economy. So that, though his emoluments were at fome periods of his life very confiderable, he was at others greatly ftraitened in his circumftances; nor could he prevail on himfelf to follow the advice of his friend Dean Swift, whom we find in many of his letters endeavouring to perfuade him to the purchafing of an annuity, as a referve for the exigencies that might attend on old age. Mr. Gay chofe rather to throw himfelf on patronage, than fecure to himfelf an independent competency by the means pointed out to him; fo that, after having undergone many viciffitudes of fortune, and being for fome time chiefly fupported by the liberality of the duke and duchefs of Queenfberry, he died at their houfe in Burlington-Gardens in December 1732. He was interred in Weftminfter-abbey, and a monument erected to his memory, at the expence of his aforementioned noble benefactors, with an infcription expreffive of their regards and his own deferts, and an epitaph in verfe by Mr. Pope.

GAZA (Theodore), a famous Greek in the 15th century, was born in 1398. His country being invaded by the Turks, he retired into Italy; where he at firft fupported himfelf by tranfcribing ancient authors, an employment the learned had frequent recourfe to before the invention of printing. His uncommon parts and learning foon recommended him to public notice, and particularly to cardinal Beffarion, who procured him a benefice in Calabria. He was one of thofe to whom the revival of polite literature in Italy was principally owing. He tranflated from the Greek into Latin, Ariftotle's Hiftory of Animals, Theophraftus on Plants, and Hippocrates's Aphorifms; and put into Greek, Scipio's Dream and Cicero's Treatife on Old Age. He wrote feveral other works in Greek and Latin, and died at Rome in 1475.

Gaza, an ancient and celebrated town of Paleftine, three miles from the fea, with a harbour called New Gaza. It is at prefent very fmall; but we may judge by the ruins that it was formerly a confiderable place. There is a caftle near it, where a bafhaw refides. It is 50 miles S. W. of Jerufalem. Lon. 34. 45. E. Lat. 31. 28. N.

GAZE-hound, or *Gaft hound*, one that makes more ufe of his fight than of his nofe. Such dogs are much ufed in the north of England: they are fitter in an open champaign country than in bufhy and woody places. If at any time a well-taught gaze-hound takes a wrong way, he will return upon a fignal and begin the chace afrefh. He is alfo excellent at fpying out the fatteft of a herd; and having feparated it from the reft, will never give over the purfuit till he has worried it to death.

GAZELLA, in zoology, a fpecies of Capra.

GAZETTE, a newfpaper, or printed account of the tranfactions of all the countries in the known world, in a loofe fheet or half-fheet. This name is with us confined to that paper of news publifhed by authority. The word is derived from *gazetta*, a Venetian coin, which was the ufual price of the firft newfpaper printed there, and which was afterwards given to the paper itfelf. The firft gazette in England was publifhed at Oxford, the court being there, in a folio half-fheet, November 7, 1665. On the removal of the court to London, the title was changed to the *London Gazette*. The Oxford gazette was publifhed on Tuefdays, the London on Saturdays: and thefe have continued to be the days of publication ever fince.

GAZNA, a city of Afia, once much celebrated, and the capital of a very extenfive empire, but which is now either entirely ruined, or become of fo little confideration that it is not taken notice of in our books of geography. This city was anciently an empory and fortrefs of Sableftan, not far from the confines of India. During the vaft and rapid conquefts of the Arabs, all this country had been reduced under their fubjection. On the decline of the power of the khalifs, however, the vaft empire eftablifhed by Mahomet and his fucceffors was divided into a number of independent principalities, moft of which were but of fhort duration. In the year of the Hegira 384, anfwering to the 994th of the Chriftian era, the city of Gazna, with fome part of the adjacent country, was governed by Mahmud Gazni, who became a great conqueror, and reduced under his fubjection a confiderable part of India, and moft of Perfia. This empire continued in the family of Mahmud Gazni for upwards of 200 years.

GECCO, in natural hiftory, a name given by the Indians to their terrible poifon which kills when mixed with the blood in ever fuch a fmall quantity. They fay that this gecco is a venomous froth or humour vomited out of the mouths of their moft poifonous ferpents; which they procure in this fatal ftrength, by hanging up the creatures by the tails, and whipping them to enrage them. They collect this in proper veffels as it falls; and, when they would ufe it, they either poifon a weapon with it, or, wounding any part of the flefh, introduce the fmalleft quantity imaginable into it; and this is faid to be immediate death.

GECKO. See the article Basiliscus.

GED (William), an ingenious though unfuccefsful artift, who was a goldfmith in Edinburgh, deferves to be recorded for his attempt to introduce an improvement in the art of printing. The invention, firft practifed by Ged in 1735, was fimply this. From any types of Greek or Roman, or any other character, he formed a plate for every page, or fheet, of a book, from which he printed, inftead of ufing a type for every letter, as is done in the common way. This was firft practifed, but on blocks of wood, by the Chinefe and Japanefe, and purfued in the firft effays of Cofter, the European inventor of the prefent art. "This improvement (fays James Ged the inventor's fon) is principally confiderable in three moft important articles, viz. expence, correctnefs, beauty and uniformity." But thefe improvements are controverted. In July 1729, William Ged entered into partnerfhip with William Fenner, a London ftationer, who was to have half the profits, in confideration of his advancing all the money requifite. To fupply this, Mr. John James, then an architect at Greenwich (who built Sir Gregory Page's houfe, Bloomfbury church, &c.) was taken into the fcheme; and afterwards his brother Mr. Thomas James, a letter-founder, and James Ged, the inventor's fon. In 1730 thefe partners applied to the univerfity of Cambridge for printing bibles and common prayer-books by blocks inftead of fingle types; and, in confequence, a leafe was fealed to them, April 23d, 1731. In their attempt they funk a large fum of money, and finifhed only two prayer-books; fo that it was forced to be relinquifhed, and the leafe was given up in 1738. Ged imputed his difap-

pointment to the villany of the preffmen and the ill treatment of his partners (which he fpecifies at large), particularly Fenner, whom John James and he were advifed to profecute, but declined it. He returned to Scotland in 1733, where he gave his friends a fpecimen of his performance, by an edition of Salluft. But being ftill unfuccefsful, and having failed in obtaining redrefs from Fenner, who died infolvent, he was preparing again to fet out for London, in order to join with his fon James as a printer there, when he died October 19, 1749. Thus ended his life and project; which, ingenious as it feems, is not likely to be revived, if, as Mr. Mores fuggefts, "it muft, had it at firft fucceeded, have foon funk under its own burden," for reafons needlefs here to recapitulate.

GEDDES (James), born of a refpectable family in Scotland in 1710, was educated for and practifed at the bar feveral years; but died of a confumption before he arrived at the age of 40. He publifhed *An effay on the compofition and manner of writing of the ancients*; and left behind him feveral other tracts.

GEHENNA, a fcripture term, which has given fome pain to the critics. It occurs in St. Matthew v. 22. 29. 30. x. 28. xviii. 9. xxiii. 15. 33. Mark ix. 43. 45. 47. Luke xii. 5. James iii. 6. The authors of the Louvain and Geneva verfions retain the word *gehenna* as it ftands in the Greek; the like does M. Simon: the Englifh tranflators render it by *hell* and *hell-fire*, and fo do the tranflators of Mons and father Bohours. The word is formed from the Hebrew *gehinnom*, i. e. "valley of Hinnom." In that valley, which was near Jerufalem, there was a place named *Tophet*, where fome Jews facrificed their children to Moloch, by making them pafs through the fire. King Jofias, to render this place for ever abominable, made a cloaca or common fewer thereof, where all the filth and carcafes in the city were caft. The Jews obferve farther, that there was a continual fire kept up there, to burn and confume thofe carcafes; for which reafon, as they had no proper term in their language to fignify *hell*, they made ufe of that of *gehenna* or *gehinnon*, to denote a fire unextinguifhable.

GELD, in the Englifh old cuftoms, a Saxon word fignifying *money* or *tribute*. It alfo denoted a compenfation for fome crime committed: hence *wergeld*, in their ancient laws, was ufed for the value of a man flain, and *orfgeld*, of a beaft.

GELDENHAUR (Gerard), in Latin *Geldenharius*, an hiftorian and Proteftant divine in the 16th century. He was a native of Nimeguen, and ftudied claffical learning at Deventer. He went through his courfe of philofophy at Louvaine, where he contracted a very ftrict friendfhip with feveral learned men, and particularly with Erafmus. He became reader and hiftorian to Charles of Auftria, and afterwards to Maximilian of Burgundy. At length he embraced the Proteftant religion, taught hiftory at Marpurg, and afterwards divinity, till his death in 1542. He wrote, 1. Hiftory of Holland. 2. Hiftory of the Low Countries. 3. Hiftory of the bifhops of Utrecht; and other works.

GELDING, the operation of caftrating any animal, particularly horfes. A colt may be gelded at nine or fifteen days old, if the tefticles have come down; in regard the fooner he is gelt the better it will be for his growth, fhape, and courage; though a horfe may be gelt at any age, if proper care is taken in performing the operation. The manner of doing it is ufually this: The beaft being caft down on fome foft place, the operator takes the tefticles between his foremoft and his great finger, and, flitting the fcrotum, preffes the ftones forth; then taking a pair of nippers made very fmooth either of fteel, box, or brafilwood, he claps the chord of the tefticle between them, a very little above where the ftones are fet on, and preffes them fo hard that the courfe of the blood through the artery is interrupted; then with a thin, drawing, cauterifing iron, he fears away the tefticle. This done, he takes a hard plafter made of rofin, wax, and turpentine, well diffolved together, and melts it on the feared part, till fuch time as he has laid a good thicknefs of it upon the cauterized edge. When this is done to one tefticle, the nippers are loofened, and the like is done to the other; and the two incifed edges of the fcrotum are brought clofe together, and kept in that fituation by pieces of fticking plafter. If the part inflames violently, the horfe fhould be bled, and a poultice of rye meal, linfeed meal, and water, fhould be applied. A confiderable improvement, however, on this operation would be to perform it exactly as in the human fubject, either applying a ftrong ligature round the chord of the tefticle, or taking up the blood veffels feparately: for the method commonly ufed is fometimes fatal to the horfe, owing to the violent inflammation brought on by the actual cautery.

The manner of gelding a hog is as follows: The operator, after having made two crofs flits or incifions on the midft of the ftones, preffes them out, and takes off the ftone. But another general method, yet fomewhat more difficult, is, firft to cut on the fide of one ftone, and after having drawn and cut it off, the operator puts in his fingers at the fame flit, and with a lancet cuts the fkin between the two ftones, and by that flit preffes out the other ftone; and thus there is but one incifion made in the cod. Boar pigs ought to be gelt about fix months old; yet they are commonly gelded about three weeks or a month old.

GELENHAUSEN, a fmall imperial town of Wetteravia in Germany, with a caftle built by the emperor Frederic I. E. lon. 8. 13. N. lat. 50. 20.

GELENIUS (Sigifmund), a learned and excellent man, born of a good family at Prague, about the year 1498. Erafmus, conceiving an efteem for him at Bafil, recommended him to John Frobenius as a corrector for his printing-houfe; which laborious charge he accepted, and had a great number of Hebrew, Greek, and Latin books to correct: he alfo tranflated many works himfelf from the Greek into Latin, and publifhed a dictionary in four languages, Greek, Latin, German, and Sclavonian. Profitable and honourable employments were offered him in other places; but nothing could tempt him to quit his peaceful fituation at Bafil. He died in 1555. All his tranflations are highly efteemed.

GELINOTTE, or GRUS, in ornithology. See TETRAO.

GELLERT (Chriftian), one of the fineft geniufes Germany has produced, was born at Hænichen, near Freyburg in Saxony, in 1715, and ftudied at Leipfic; at which univerfity he was for many years profeffor of philofophy and the belles lettres. He early diftinguifhed himfelf by his talent for poetry, and contracted a ftrict friendfhip with the moft learned and polite writers in Germany. All his works abound with fentiment, and bear the impreffion of the fweetnefs of his difpofition. The moft confiderable of them are his comedies, his fpiritual fongs, and moral poems, and particularly his facred odes, his fables, and his tales. He died in 1769, much lamented.

GELLI (John Baptift), an eminent Italian writer, was born of mean parents at Florence in the year 1498. He was bred a taylor, but had fuch an extraordinary genius, that he acquired feveral languages, and made an uncommon progrefs in the belles lettres; and, though he continued always to work at his trade, became acquainted with all the wits and learned men at Florence, and his merit was univerfally known. He was chofen a member of the academy there, and the city made him a burgefs. He acquired the higheft reputation by his works, which are, 1. *I Capricci del Bottaio*, quarto; which contains ten dialogues. 2. *La Circe*, octavo. This, which alfo contains ten dialogues, and treats of human nature, has been tranflated into Latin, French, and Englifh. 3. Differtations in Italian

on the poems of Dante and Petrarch. 4. The comedies of *La Sporta* and *La Errore*; and other works. He died in 1563.

GELLIBRAND (Henry), a laborious aſtronomer of the laſt century, was born in 1597. Though he was not without good views in the church, yet he became ſo enamoured with mathematical ſtudies, that on the death of his father he became a ſtudent at Oxford, contented himſelf with his private patrimony, and devoted himſelf ſolely to them. On the death of Mr. Gunter, he was recommended by Mr. Briggs to the truſtees of Greſham college, for the aſtronomical profeſſorſhip there; to which he was elected in 1627. His friend Mr. Briggs dying in 1630, before he had finiſhed his *Trigonometrica Britannica*, it was finiſhed by Gellibrand at his requeſt. He wrote ſeveral other things, chiefly tending to the improvement of navigation, and died in 1636.

GELLIUS (Aulus), a celebrated grammarian, who lived in the 2d century under Marcus Aurelius and ſome ſucceeding emperors. He wrote a collection of obſervations on authors, for the uſe of his children, and called it *Noctes Atticæ*, becauſe compoſed in the evenings of a winter he ſpent at Athens. The chief value of it is for preſerving many facts and monuments of antiquity not to be found elſewhere. Critics and grammarians have beſtowed much pains on this writer.

GELLY. See JELLY.

GELO, or GELON, a ſon of Dinomenes, who made himſelf abſolute at Syracuſe 484 years before the Chriſtian era. He conquered the Carthaginians at Himera, and made his oppreſſion popular by his great equity and moderation. He reigned ſeven years, and his death was univerſally lamented at Syracuſe. He was called the father of his people, and the patron of liberty, and honoured as a demigod. His brother Hiero ſucceeded him.

GEM, in natural hiſtory, a common name for all precious ſtones; of which there are two claſſes, the pellucid and ſemipellucid.

The bodies compoſing the claſs of pellucid gems are bright, elegant, and beautiful foſſils, naturally and eſſentially compound, ever found in ſmall detached maſſes, extremely hard, and of great luſtre.

The bodies compoſing the claſs of ſemipellucid gems are ſtones naturally and eſſentially compound, not inflammable nor ſoluble in water, found in detached maſſes, and compoſed of cryſtalline matter debaſed by earth: however, they are but ſlightly debaſed, and are of great beauty and brightneſs, of a moderate degree of tranſparency, and are uſually found in ſmall maſſes.

The knowledge of gems depends principally on obſerving their hardneſs and colour. For hardneſs they are commonly allowed to ſtand in the following order: The diamond the hardeſt of all; then the ruby, ſapphire, jacinth, emerald, amethyſt, garnet, carneol, chalcedony, onyx, jaſper, agate, porphyry, and marble. This difference, however, is not regular and conſtant, but frequently varies. Good cryſtals may be allowed to ſucceed the onyx; but the whole family of metallic glaſſy fluors ſeem to be ſtill ſofter. In point of colour, the diamond is valued for its tranſparency, the ruby for its purple, the ſapphire for its blue, the emerald for its green, the jacinth for its orange, the amethyſt carneol for its carnation, the onyx for its tawny, the jaſper, agate, and porphyry, for their vermilion, green, and variegated colours, and the garnet for its tranſparent blood-red.

All theſe gems are ſometimes found coloured and ſpotted, and ſometimes quite limpid and colourleſs. In this caſe the diamond-cutter or poliſher knows how to diſtinguiſh their different ſpecies by their different degrees of hardneſs upon the mill. For the cutting or poliſhing of gems, the fine powder of the fragments of thoſe that are next in degree of hardneſs is always required to grind away the ſofter; but as none of them are harder than the diamond, this can only be poliſhed by its own powder.

Cronſtedt obſerves of gems in general, that the colour of the ruby and emerald is ſaid to remain in the fire, while that of the topaz flies off: hence it is uſual to burn the topaz, and thence ſubſtitute it for the diamond. "Their colours (ſays our author) are commonly ſuppoſed to depend upon metallic vapours; but may they not more juſtly be ſuppoſed to ariſe from a phlogiſton united with a metallic or ſome other earth? Becauſe we find that metallic earths which are perfectly well calcined give no colour to any glaſs; and that the manganeſe, on the other hand, gives more colour than can be aſcribed to the ſmall quantity of metal which is to be extracted from it." M. Magellan is of opinion, that their colour is owing chiefly to the mixture of iron which enters their compoſition, but approves the ſentiment of Cronſtedt, that phlogiſton has a ſhare in their production, it being well known that the calces of iron, when dephlogiſticated, produce the red and yellow colours of marble; and, when phlogiſticated to a certain degree, produce the blue or green colours.

With regard to the texture of gems, M. Magellan obſerves, that all of them are foliated or laminated, and of various degrees of hardneſs. Whenever the edges of theſe laminæ are ſenſible to the eye, they have a fibrous appearance, and reflect various ſhades of colour, which change ſucceſſively according to their angular poſition to the eye. Theſe are called by the French *chatorantes*; and what is a blemiſh in their tranſparency often enhances their value on account of their ſcarcity. But when the ſubſtance of a gem is compoſed of a broken texture, conſiſting of various ſets of laminæ differently inclined to each other, it emits at the ſame time various irradiations of different colours, which ſucceed one another according to their angle of poſition. This kind of gems has obtained the name of *opals*, and are valued in proportion to the brilliancy, beauty, and variety of their colours. Their cryſtallization, no doubt, depends on the ſame cauſe which produces that of ſalts, earths, and metals, which is treated of under the article CRYSTALLIZATION: but, as to the particular configuration of each ſpecies of gem, we can hardly depend upon any individual form as a criterion to aſcertain each kind; and when we have attended with the utmoſt care to all that has been written on the ſubject, we are at laſt obliged to appeal to chemical analyſis, becauſe it very often aſſumes various forms. The following Table ſhows the component parts of gems according to the analyſis of Bergman and M. Achard; the letter B prefixed to each denoting Bergman's analyſis, and A that of Achard.

		Argil.	Silic.	Calc.	Iron.
Red oriental ruby, - -	B	40	39	9	10
Ditto, - -	A	37.5	42.5	9	11
Blue oriental ſapphire, -	B	58	35	5	2
Ditto, - - -	A	58	33	6	3
Yellow topaz from Saxony, -	B	46	39	8	6
Green oriental emerald, -	B	60	24	8	6
Ditto, - - -	A	60	23	10	7
Yellow-brown orient. hyacinth,	B	40	25	20	13
Ditto, - - -	A	42	22	20	16
Tourmalin from Ceylon, -	B	39	37	15	9
Ditto from Braſil, -	B	50	34	11	5
Ditto from Tyrol, - -	B	42	40	12	6
Garnet from Bohemia, -	A	30	48	11	10

The chryſophraſe from Koſeinitz in Sileſia was likewiſe analyſed by M. Achard, who found that it contained 456 grains of ſiliceous earth, 13 of calcareous, 6 of magneſia, 3 of copper,

and 2 of iron. "This (says M. Magellan) seems to be the only gem that contains no argillaceous earth."

Counterfeit GEMS. The art of imitating gems in glass is too considerable to be passed without notice. These gems are made of pastes, and are perhaps little inferior to the native stones, when carefully made and well polished, in brightness or transparence, though they want their hardness. The colour of all the counterfeit gems made of the several pastes may be made deeper or lighter, according to the work for which the stones are designed; and it is a necessary general rule, that small stones for rings, &c. require a deeper colour, and large ones a paler. Besides the colours made from manganese, verdegris, and zaffer, which are the ingredients commonly used, there are other very fine ones which care and skill may prepare. Very fine red may be made from gold, and one not much inferior to that from iron; a very fine green from brass or copper; a sky-colour from silver, and a much finer one from the granates of Bohemia, &c. The latest and most ingenious account of the different processes for making artificial gems is contained in a Memoir by M. Fontanieu of the Royal Academy of Sciences at Paris, from which we take the following remarks.

I. *Of the Bases.* Although the different calces of lead are all adapted to produce the same effect in vitrification, yet M. Fontanieu prefers lead in scales, and next to that minium, as being the most constantly pure. It is necessary to sift through a silk sieve the preparations of lead one wishes to make use of in the vitrification, in order to separate the grosser parts, as also the lead found in a metallic state when white lead in scales is employed.

The base of factitious gems is calx of lead and rock-crystal, or any other stone vitrifiable by the calces already mentioned. Pure sand, flint, and the transparent pebbles of rivers, are substances equally fit to make glass: but, as it is first necessary to break the masses of crystal, stones, or pebbles, into smaller parts, so by this operation particles of iron or copper are frequently introduced, and to these dust or greasy matters are also apt to adhere. Our author, therefore, begins by putting the pounded crystal or pebbles into a crucible, which he places in a degree of heat capable of making the mass red-hot; he then pours it into a wooden bowl filled with very clear water; and shaking the bowl from time to time, the small portions of coals furnished by the extraneous bodies swim on the surface of the water, and the vitrifiable earth, with the iron, &c. sinks to the bottom. He then decants the water, and, having dried the mass, he pounds it, sifts the powder through the finest silk sieve: he then digests the powder during four or five hours with marine acid, shaking the mixture every hour. After having decanted the marine acid from the vitrifiable earth, he washes the latter until the water no longer reddens the tincture of tournsol. This earth, being next dried, is passed through a silk sieve, and is then fit for use. Nitre, alkaline salt, and borax, are the three species of salts that enter with quartz and the several calces of lead into M. Fontanieu's vitrifications.

Much of the success in the art of making coloured stones depends on an accurate proportion of the substances made use of to form the crystal which serves as a base to the factitious stones. After having tried a great variety of receipts, our author found they might be reduced to the following:

1. Take two parts and a half of lead in scales, one part and a half of rock-crystal or prepared flints, half a part of nitre, as much borax, and a quarter part of glass of arsenic. These, being well pulverized and mixed together, are to be put into a Hessian crucible, and submitted to the fire. When the mixture is well melted, pour it into cold water: then melt it again a second and a third time; taking care, after each melting, to throw it into fresh cold water, and to separate from it the lead that may be revived. The same crucible should not be used a second time, because the glass of lead is apt to penetrate it in such a manner as to run the risk of losing the contents. We must also be careful to cover the crucible well, to prevent any coals getting into it, which would reduce the calx of lead, and spoil the composition.

2. Take two parts and a half of white cerus, one part of prepared flints, half a part of salt of tartar, and a quarter part of calcined borax: melt the mixture in a Hessian crucible, and then pour it into cold water: it is then to be melted again, and washed a second and a third time, the same precautions being observed as for the first base.

3. Take two parts minium, one part rock-crystal, half a part of nitre, and as much salt of tartar: this mixture being melted, must be treated as the former.

4. Take three parts of calcined borax, one part of prepared rock-crystal, and one part of salt of tartar; these, being well mixed and melted together, must be poured into warm water: the water being decanted and the mass dried, an equal quantity of minium must be added to it; it is then to be melted and washed several times, as directed above.

5. That called by our author the *Mayence base*, and which he considers as one of the finest crystalline compositions hitherto known, is thus composed: Take three parts of fixed alkali of tartar, one part of rock-crystal or flint pulverized: the mixture to be well baked together, and then left to cool. It is afterwards poured into a crucible of hot water to dissolve the fritt; the solution of the fritt is then received into a stone-ware pan, and aquafortis added gradually to the solution till it no longer effervesces: this water being decanted, the fritt must be washed in warm water till it has no longer any taste: the fritt is then dried, and mixed with one part and a half of fine cerus or white lead in scales; and this mixture must be well levigated with a little distilled water. To one part and a half of this powder dried, add an ounce of calcined borax: let the whole be well mixed in a marble mortar, then melted and poured into cold water, as the other bases already described. These fusions and lotions having been repeated, and the mixture dried and powdered, a 12th part of nitre must be added to it, and then melted for the last time, when a very fine crystal will be found in the crucible.

6. As a composition for furnishing very fine white stones: Take eight ounces of cerus, three ounces of rock-crystal pulverized, two ounces of borax finely powdered, and half a grain of manganese. Having melted and washed this mixture in the manner directed above, it will produce a very fine white crystal.

II. *Of the Colours.* The calces of metals, as already observed, are the substances employed to colour factitious gems; and on the preparation of these calces depends the vividness of their different hues.

α, From *Gold.*] To obtain the mineral purple, known by the name of *precipitate of Cassius*, M. Fontanieu employs the following different processes:

1. Dissolve some pure gold in aqua regia, prepared with three parts of precipitated nitrous acid and one part of marine acid; and, to hasten the dissolution, the matrass should be placed in a sand-bath. Into this solution pour a solution of tin in aqua regia. The mixture becomes turbid, and the gold is precipitated, with a portion of the tin, in the form of a reddish powder, which, after being washed and dried, is called *precipitate of Cassius.* The aqua regia employed to dissolve the tin is composed of five parts nitrous acid and one part of marine acid: to eight ounces of this aqua regia are added sixteen ounces of distilled water. Some leaves of Malacca tin, about the size and thickness of a sixpence, are then put into this diluted aqua regia, till it will dissolve no more of them: which operation, our author observes, requires commonly twelve or fourteen days; though it

might probably be haſtened by beating the tin ſtill thinner, and then rolling it into the form of a hollow cylinder, or turning it round into ſpiral convolutions, and thus expoſing a greater extent of ſurface to the action of the menſtruum. In order to prepare more readily the precipitate of Caſſius, M. Fontanieu puts into a large jug eight ounces of ſolution of tin, to which he adds four pints of diſtilled water: he afterwards pours into this metallic lye ſome ſolution of gold, drop by drop, taking care to ſtir the whole with a glaſs tube: when the mixture becomes of a deep purple colour, he ceaſes dropping the ſolution of gold; and in order to haſten the precipitation of the mineral purple, pours into the mixture a pint of freſh urine. Six or ſeven hours after, the precipitate is collected at the bottom of the veſſel: the fluid is then decanted; and the precipitate, waſhed once or twice, is dried till it becomes a brown powder.

2. Pour into a veſſel of fine tin with a thick bottom, four ounces of the ſolution of gold; three minutes after, add two pints of diſtilled water. Let this mixture ſtand in the tin veſſel during ſeven hours, taking care to ſtir it every hour with a glaſs tube; afterwards pour it into a conical glaſs jug, and add to it a pint of new urine: the mineral purple is ſoon precipitated, and then is to be waſhed and dried.

3. Diſtil, in a glaſs cornute placed in a bath of aſhes, ſome gold diſſolved in aqua regia, made with three parts nitrous and one part marine acid; when the acid is paſſed over and the gold contained in the cornute appears dry, leave the veſſel to cool, then pour into it ſome new aqua regia, and proceed to diſtil as before. Replace the aqua regia twice upon the gold, and diſtil the ſame. After theſe four operations, pour by little and little into the cornute ſome deliqueſced alkaline ſalt, which will occaſion a briſk effervescence: when this ceaſes, diſtil the mixture till it becomes dry, and then put ſome warm water into the cornute. Shake the whole, and pour it into a cucurbit, when a precipitate will deſcend, the colour of which is ſometimes brown and ſometimes yellow. After having waſhed this precipitate, dry it. Our author ſays this mineral purple was much ſuperior to the foregoing, ſince two grains of it only were ſufficient to an ounce of the baſe. And he adds, that he found a means of exalting the colour of the precipitate of Caſſius, by putting to it a ſixth part of its weight of glaſs of antimony finely powdered, and of nitre in the proportion of a dram to eight ounces of the baſe.

β, From *Silver*.] The calx of ſilver, being vitrified, produces a yellowiſh grey colour. This calx enters only into the compoſition of the yellow artificial diamond and the opal. M. Fontanieu introduces it into the baſe, in the form of luna cornea.

In order to prepare it, he directs us to diſſolve the ſilver in precipitated nitrous acid, and afterwards to pour into it a ſolution of ſea-ſalt: a white precipitate is obtained; which, being waſhed and dried, melts very readily in the fire, and is ſoon volatilized if not mixed with vitrifiable matters. To make the yellow diamond, 25 grains of this luna cornea are put to an ounce of the fourth baſe: the doſe of ſilver may be diminiſhed according to the ſhade of yellow that the artiſt wiſhes to procure.

γ, From *Copper*.] The calx of copper imparts to white glaſs the fineſt green colour; but, if this metal be not exactly in a ſtate of calx, it produces a browniſh red colour. *Mountain blue, verdigris*, and the reſidue of its diſtillation, are the different preparations of copper which our author employs to make the artificial emeralds.

, From *Iron*.] Although it has been aſſerted, that the calces of iron introduce a very fine tranſparent red colour into white glaſs, M. Fontanieu could only obtain from it a pale red a little opake. The calx of iron that he employed was in the proportion of the 20th part of the baſe.

There are ſeveral ways of preparing the calx of iron, by moſt people called *crocus Martis*. In general, it is neceſſary that this metal be ſo far deprived of its phlogiſton, that the magnet ceaſes to attract it: thus one may uſe the ſcales of iron found upon the bars of the furnaces, which ſerve to diſtil aquafortis. By digeſting filings of iron with diſtilled vinegar, then evaporating and replacing the vinegar 10 or 12 times upon theſe filings and drying them alternately, a calx of iron is obtained, which muſt be ſifted through a ſilk ſieve, and then calcined. The calx of iron thus obtained by the vinegar, our author ſays, only introduced into his baſes a green colour inclining to a yellow.

By the following proceſs, a calx of iron capable of the fineſt red colour is obtained: Let an ounce of iron filings be diſſolved in nitrous acid in a glaſs cornute, and diſtilled over a ſand-bath to dryneſs. After having replaced the acid on the dry calx, and re-diſtilled it a ſecond and a third time, it is then edulcorated with ſpirits of wine, and afterwards waſhed with diſtilled water.

ε, From the *Magnet*.] It is neceſſary to calcine the magnet before it be introduced into the vitrifications: having therefore torrified the magnet during two hours, it muſt be waſhed and dried. It is only employed in the compoſition of the opal.

ζ, From *Cobalt*.] The calx of cobalt is only proper to introduce a blue colour into glaſs; but this ſemimetal is rarely found free from iron and biſmuth, and therefore it is firſt neceſſary to ſeparate them from it. This is done by calcining the ore of cobalt in order to diſengage the arſenic: afterwards the calx muſt be diſtilled in a cornute with ſal ammoniac, and the iron and the biſmuth are found ſublimed with this ſalt. The diſtillation muſt be repeated with the ſal ammoniac till this ſalt is no longer coloured yellow. The cobalt which remains in the cornute is then calcined in a potſherd, and becomes a very pure calx; which being introduced into the baſe, in the proportion of a 900dth part, gives it a very fine blue colour, the intenſity of which may be increaſed at diſcretion by the addition of calx of cobalt. In order to prepare *black enamel* reſembling that which is called *black agate* of Iceland, melt together a pound and a half of one of the baſes, two ounces of the calx of cobalt, two ounces of calx of iron, prepared with vinegar, and two ounces of manganeſe.

η, From *Tin*.] The calx of tin is not vitrifiable alone, and, when deprived of phlogiſton, is of a white colour; it renders opake the glaſs with which it is melted, and forms white enamel. For this purpoſe, calcine the putty of tin, then waſh and dry it, and ſift it through a ſilk ſieve. Take ſix pounds of the ſecond baſe, the ſame quantity of the calcined putty of tin, and 48 grains of manganeſe.

θ, From *Antimony*.] Antimony is only ſuſceptible of vitrification when its calx contains phlogiſton, and then it produces a reddiſh or hyacinth-coloured glaſs; but if the antimony be in a ſtate of abſolute calx, ſuch as the diaphoretic antimony, then it is no longer vitrifiable, and may be ſubſtituted for calx of tin to make white enamel. M. Fontanieu introduces the glaſs of antimony in the compoſition of artificial topazes. For the *oriental topaz*, he takes 24 ounces of the firſt baſes and five drachms of the glaſs of antimony. To imitate the *topaz of Saxony*, he adds to each ounce of the baſe five grains of the glaſs of antimony. For the *topaz of Brazil*, he takes 24 ounces of the firſt baſe, one ounce 24 grains of glaſs of antimony, and 8 grains of the *precipitate of Caſſius*.

ι, From *Manganeſe*.] This mineral, employed in a ſmall quantity, renders the glaſs whiter; a larger quantity produces a very fine violet colour, and a ſtill larger doſe of it renders the glaſs black and opake.

There are two ways of preparing manganeſe. 1. The moſt

ſimple conſiſts in expoſing it to a red heat, and then quenching it with diſtilled vinegar; it is afterwards dried and powdered, in order to paſs it through a ſilk ſieve. 2. Haudiquer de Blancour deſcribes the ſecond manner of preparing the mangaueſe proper to furniſh a red colour, and names it *fuſible manganeſe.* Take of manganeſe of Piedmont one pound; torrify and pulverize it; then mix it with a pound of nitre, and calcine the mixture during 24 hours; afterwards waſh it repeatedly in warm water till the water of the lyes has no longer any taſte; dry the manganeſe, and mix with it an equal weight of ſal-ammoniac; levigate this mixture on a ſlab of porphyry with oil of vitriol, diluted with water to the ſtrength of vinegar. Dry the mixture, and introduce it into a cornute; diſtil by a graduated fire; and when the ſal ammoniac is ſublimed, weigh it, and add to the mixture an equal quantity. Then diſtil and ſublime as before, and repeat the operation ſix times, being careful at each time to mix the ſal ammoniac and the manganeſe upon the porphyry with diluted acid of vitriol.

At Tournhault in Bohemia, there is ſold a fuſible glaſs of a yellow colour, very like that of the topaz of Brazil, which, when expoſed to a degree of fire, in a cupel, ſufficient to redden it, becomes of a very fine ruby colour, more or leſs deep according to the degree of fire to which it has been expoſed. Our author aſſayed this glaſs, and found it to contain a great deal of lead, but was not able to diſcover any gold in it.

III. *Of the different degrees of Fire neceſſary for Factitious Gems.* Our author obſerves, that there are three degrees of heat very different in their energy. The fire kept up in the wind-furnaces in the laboratories of chemiſts is leſs active than that whoſe effect is accelerated by the means of bellows; and a fire ſupported by wood, and kept up during 60 hours without interruption, produces ſingular effects in vitrification, and renders the glaſs finer and leſs alterable.

When recourſe is had to the forge, in order to operate a vitrification, it is neceſſary to turn about the crucible from time to time, that the maſs may melt equally. Some coal alſo ſhould be replaced, in proportion as it conſumes towards the nozel of the bellows; for without this precaution, we ſhould run the riſk of cooling the crucible oppoſite to the flame, and probably of cracking it, when all the melted maſs running among the coals would be totally loſt. Though this is the readieſt way of melting, it ſhould not be employed out of choice; for the crucible often breaks, or coals get into it, and reduce the calx of lead to a metallic ſtate.

The wind-furnace is either ſquare or round. A ſmall cake of baked clay or brick, of the thickneſs of an inch, is placed upon the grate; and upon this cake is placed the crucible, ſurrounded with coals. The degree of heat produced by this furnace is much leſs than that of the forge: but, in order to ſucceed in the vitrification, M. Fontanieu recommends the uſe of a furnace deſcribed by Kunckel, which, with ſome neceſſary alterations, is repreſented in plate 37. The interior part of it is ſo diſpoſed, that we may place crucibles at three different heights; and the name of *chambers* is given to thoſe ſteps upon which the crucibles are placed. Fig. 1. is a plan of the kiln at the firſt chamber, and fig. 2. a plan of the kiln where the fire is placed. Fig. 3. exhibits the elevation; A the aſh-pit; B the door to put in the wood; C the door of the firſt chamber; D the floor of the ſecond chamber; E the third chamber; F the flue or chimney; GG, iron-hoops which ſurround the kiln to ſtrengthen it. Fig. 4. is a ſection of the kiln: H the aſh-pit with its air-hole; I the chamber for the fire with an air-hole; K the firſt chamber for the crucibles; L the ſecond chamber; M the dome; N the chimney; OO air-holes.

It is obvious, that the degree of heat cannot be equal in the ſaid three chambers. The chamber K is that where the heat is greateſt, afterwards in that of L, and laſtly in that of M. We ſhould begin by placing the crucibles according to their ſize, in theſe different chambers; by which means the beſt effect in vitrification is produced.

In order to conduct the fire well, only three billets of white wood ſhould be put into the furnace at a time for the firſt 20 hours, four billets at a time for the next 20 hours, and ſix billets for the laſt 20 hours; in all 60 hours. The furnace is then left to cool, care being taken to ſtop the air-holes with ſome lute; and, in about 48 hours after, when the kiln is quite cold, the crucible is to be withdrawn.

IV. *The Compoſitions.* For the *white diamond:* Take the baſe of Mayence. This cryſtal is very pure, and has no colours.

For the *yellow diamond:* To an ounce of the fourth baſe, add for colour 25 grains of luna cornea or 10 grains of glaſs of antimony.

For the *emerald:* 1. To 15 ounces of either of the baſes. add for colour one dram of mountain-blue and ſix grains of glaſs of antimony; or, 2. To an ounce of the ſecond baſe, add for colour 20 grains of glaſs of antimony and three grains of calx of cobalt.

For the *ſapphire:* To 24 ounces of the Mayence baſe, add for colour two drams 46 grains of the calx of cobalt.

For the *amethyſt:* To 24 ounces of the Mayence baſe, add for colour four drams of prepared manganeſe and four grains of precipitate of Caſſius.

For the *beril:* To 24 ounces of the third baſe, add for colour 96 grains of glaſs of antimony and four grains of calx of cobalt.

For the *black agate:* To 24 ounces of either of the baſes, add two ounces of the mixture directed above in par. 6.

For the *opal:* To an ounce of the third baſe, add for colour 10 grains of luna cornea, two grains of magnet, and 26 grains of abſorbent earth.

For the *oriental topaz:* To 24 ounces of the firſt or third baſe, add for colour five drams of glaſs of antimony.

For the *topaz of Saxony:* To 24 of the ſame baſe, add for colour ſix drachms of the glaſs of antimony.

For the *topaz of Braſil:* To 24 ounces of the ſecond or third baſe, add for colour one ounce 24 grains of the glaſs of antimony and eight grains of precipitate of Caſſius.

For the *hyacinth:* To 24 ounces of the baſe made with rock-cryſtal, add for colour two drams 48 grains of glaſs of antimony.

For the *oriental ruby:* 1. To 16 ounces of the Mayence baſe, add for colour a mixture of two drams 48 grains of the precipitate of Caſſius, the ſame quantity of calx of iron prepared in aqua fortis, the ſame of golden ſulphur of antimony and of fuſible manganeſe, with the addition of two ounces of mineral cryſtal; or, 2. To 20 ounces of the baſe made with flint, add half an ounce of fuſible manganeſe and two ounces of mineral cryſtal.

For the *balaſs ruby:* 1. To 16 ounces of the Mayence baſe, add the above colouring powder, but diminiſhed a fourth part; or, 2. To 20 ounces of the baſe made with flints, add the ſame colouring powder, but with a fourth leſs of the manganeſe.

The *factitious* gems are eaſily diſtinguiſhed from the *natural,* by their ſoftneſs and fuſibility; by their ſolubility in acids; by their cauſing only a ſingle refraction of the rays of light; and, in many caſes, by their ſpecific gravity, which exceeds 2.76 in all precious gems of the firſt order, as the diamond, ruby, ſapphire, &c.

Imitation of Antique GEMS. There has been at different times a method practiſed by particular perſons, of taking the impreſſions and figures of antique gems, with their engravings, in glaſs of the colour of the original gem. This has always been eſteemed a very valuable method, and greatly preferable to

the more ordinary ones of doing it on fealing-wax or brimftone: but, to the misfortune of the world, this art, being a fecret only in the hands of fome particular perfons who got their bread by it, died with them, and every new artift was obliged to re-invent the method; till at length Mr. Homberg, having found it in great perfection, gave the whole procefs to the world to be no more forgotten or loft; and fince that time it has been very commonly practifed in France, and fometimes in other places.

Mr Homberg was favoured in his attempts with all the engraved gems of the king's cabinet, and took fuch elegant impreffions, and made fuch exact refemblances of the originals, and that in glaffes fo artfully tinged to the colour of the gems themfelves, that the niceft judges were deceived in them, and often took them for the true antique ftones. Thefe counterfeit gems alfo ferve, as well as the original ones, to make more copies from afterwards: fo that there is no end of the numbers that may be made from one; and there is this farther advantage, that the copy may be eafily made perfect, though the original fhould not be fo, but fhould have fuftained fome damage from a blow or otherwife.

The great care in the operation is to take the impreffion of the gem in a very fine earth, and to prefs down upon this a piece of proper glafs, foftened or half melted at the fire, fo that the figures of the impreffion made in the earth may be nicely and perfectly expreffed upon the glafs. In general, the whole procefs much refembles that of the common founders. But, when it is brought to the trial, there is found a number of difficulties which were not to be forefeen, and which would not at all affect the common works of the founder. For his purpofe every earth will ferve that is fine enough to receive the impreffions, and tough enough not to crack in the drying: thefe all ferve for their ufe, becaufe the metals which they caft are of a nature incapable of mixing with earth, or receiving it into them, even if both are melted together, fo that the metal always eafily and perfectly feparates itfelf from the mould; but it is very difficult in thefe cafts of glafs. They are compofed of a matter which differs in nothing from that of the mould, but that it has been run into this form by the force of fire, and the other has not yet been fo run, but is on any occafion ready to be fo run, and will mix itfelf infeparably with the glafs in a large fire: confequently, if there be not great care ufed, as well in the choice of the glafs as in the manner of ufing it, when the whole is finifhed, there will be found great difficulty in the feparating the glafs from the mould; and often this cannot be done without wholly deftroying the impreffion.

All earths run more or lefs eafily in the fire as they are more or lefs mixed with faline particles in their natural formation. As all falts make earths run into glafs, and as it is neceffary to ufe an earth on this occafion for the making a mould, it being alfo neceffary, to the perfection of the experiment, that this earth fhould not melt or run, it is our bufinefs to fearch out for this purpofe fome earth which naturally contains very little falt. Of all the fpecies of earth which Mr. Homberg examined on this occafion, none proved fo much diverted of falts, or fo fit for the purpofe, as the common tripela, or Tripoli, ufed to polifh glafs and ftones. Of this earth there are two common kinds; the one reddifh, and compofed of feveral flakes or ftrata; the other yellowifh, and of a fimple ftructure. Thefe are both to be had in the fhops. The latter kind is from the Levant; the former is found in England, France, and many other places. This tripela muft be chofen foft and fmooth to the touch, and not mixed with fandy or other extraneous matter. The yellowifh kind is the beft of the two, and is commonly called *Venetian tripoli*. This receives the impreffions very beautifully, and never mixes with the glafs in the operation, which the red kind fometimes does. Mr. Homberg ufually employed both kinds at once in the following manner: Firft, powder a quantity of the red tripela in an iron mortar, and, fifting it through a fine fieve, fet it by for ufe; then fcrape with a knife a quantity of the yellow tripela into a fort of powder, and afterwards rub it till very fine in a glafs mortar with a glafs peftle. The finer this powder is, the finer will be the impreffion, and the more accurately perfect the caft. The artificer might naturally fuppofe, that the beft method to obtain a perfect fine powder of this earth, would be by wafhing it in water; but he muft be cautioned againft this. There is naturally in this yellowifh tripoli a fort of unctuofity, which, when it is formed into a mould, keeps its granules together, and gives the whole an uniform gloffy furface: now the wafhing the powder takes away this unctuofity; and, though it renders it much finer, it makes it leave a granulated furface, not this fmooth one, in the mould; and this muft render the furface of the caft lefs fmooth.

When the two tripelas are thus feparately powdered, the red kind muft be mixed with fo much water as will bring it to the confiftence of pafte, fo that it may be moulded like a lump of dough between the fingers: this pafte muft be put into a fmall crucible of a flat fhape, and about half an inch or a little more in depth, and of fuch a breadth at the furface as is a little more than that of the ftone whofe impreffion is to be taken. The crucible is to be nicely filled with this pafte lightly preffed down into it, and the furface of the pafte muft be ftrewed over with the fine powder of the yellow tripela not wetted. When this is done, the ftone of which the impreffion is to be taken muft be laid upon the furface, and preffed evenly down into the pafte with a finger and thumb, fo as to make it give a ftrong and perfect impreffion: the tripela is then to be preffed nicely even to its fides with the fingers, or with an ivory knife. The ftone muft be thus left a few moments, for the humidity of the pafte to moiften the dry powder of the yellow tripela which is ftrewed over it: then the ftone is to be carefully raifed by the point of a needle fixed in a handle of wood; and the crucible being then turned bottom upwards, it will fall out, and the impreffion will remain very beautifully on the tripela. If the fides of the cavity have been injured in the falling out of the ftone, they may be repaired; and the crucible muft then be fet, for the pafte to dry, in a place where it will not be incommoded by the duft.

The red tripoli, being the more common and the cheaper kind, is here made to fill the crucible only to fave the other, which alone is the fubftance fit for taking the impreffion. When the ftone is taken out, it muft be examined, to fee whether any thing be lodged in any part of the engraving, becaufe, if there be any of the tripela remaining, there will of courfe be fo much wanting in the impreffion. When the crucible and pafte are dry, a piece of glafs muft be chofen of a proper colour, and cut to a fize proper for the figure; this muft be laid over the mould, but in fuch a manner that it fhall not touch the figures, otherwife it would fpoil them. The crucible is then to be brought near the furnace by degrees, and gradually heated till it cannot be touched without burning the fingers; then it is to be placed in the furnace under a muffle furrounded with charcoal. Several of thefe fmall crucibles may be placed under one muffle; and, when they are properly difpofed, the aperture of the muffle fhould have a large piece of burning charcoal put to it, and then the operator is to watch the procefs, and fee when the glafs begins to look bright: this is the fignal of its being fit to receive the impreffion. The crucible is then to be taken out of the fire; and the hot glafs muft be preffed down upon the mould with an iron inftrument, to make it receive the regular impreffion: as foon as this is done, the crucible is to be fet by the fide of the furnace out of the way of the wind, that it may cool gradually without breaking. When it is cold, the glafs is to be taken out, and its edges fhould be grated round with pincers, in order

to prevent its flying afterwards; which is an accident that fometimes happens when this caution has been omitted, efpecially when the glafs is naturally tender. The different coloured glaffes are of different degrees of hardnefs, according to their compofition; but the hardeft to melt are always the beft for this purpofe, and this is known by a few trials.

If it be defired to copy a ftone in relief which is naturally in creux, or to take one in creux which is naturally in relief, there needs no more than to take an impreffion, firft in wax or fulphur, and to mould that upon the pafte of tripela inftead of the ftone itfelf: then proceeding in the manner before directed, the procefs will have the defired effect.

A more fimple and eafy method than the above is by taking the cafts in gypfum, or plafter of Paris as it is commonly called. For this purpofe, the gypfum muft be finely pulverized, and then mixed with clear water to the confiftence of thick cream. This is poured upon the face of the gem or feal of which the impreffion is wanted, and which muft be previoufly moiftened with oil to facilitate the feparation of the caft; and, in order to confine the liquid plafter, it is only neceffary to pin a flip of oiled paper round the fides of the feal by way of a cap or rim. When the plafter is dry, it is to be taken off, and fet before the mouth of the furnace, in order to free it entirely from moifture; when it is fit to be ufed as a matrix in the fame way as that formed with the tripoli earths. Only no crucible or other receptacle is at all neceffary; the cafts being formed like fo many fmall cakes half an inch thick, and thus put into the furnace with the bits of glafs upon them. The glafs, after coming to a proper heat, is preffed down upon the mould with an iron fpatula to receive the defired impreffion, the preffure requifite being more or lefs according to the fize of the ftone. This method has been long practifed very fuccefsfully, and with no fmall emolument, by that ingenious feal-engraver Mr. Deuchar of Edinburgh. The only refpect in which it is inferior to the other more operofe and expenfive methods confifts in the chance of air bubbles arifing in pouring on the plafter; which chance, however, is lefs in proportion to the finenefs of the gypfum employed. When air-bubbles do occur, the cafts may be laid afide, as it is fo eafy to replace them.

The application of paftes to multiply and preferve the impreffions of camaieux and intaglios is an object very interefting to artifts and to antiquaries, as well as to men of learning and tafte in the fine arts. This art, though only lately reftored in any degree of perfection, is of very confiderable antiquity. The great prices which the ancients paid for the elegant gems engraved by the celebrated Greek artifts could not but early fuggeft to them the idea of multiplying their numbers, by taking off their impreffions in wax, in fulphur, in plafter, or in clay; but more particularly in coloured glafs, or that vitrified fubftance commonly called *pafte*. As the impreffions on pafte are durable, and imitate the colours and brilliancy of the original ftones, they ferve the fame purpofes as the gems themfelves. This art was therefore practifed not only by the Greeks, but by all the nations who cultivated Grecian tafte.

Many of the fineft gems of antiquity are now loft, and their impreffions are to be found only on ancient paftes. Great, therefore, is the value of thefe paftes. Numerous collections of them have been formed by the curious. Inftances of this are found in the Florentine Mufeum, in Stofch's work on ancient gems with infcriptions, in Winckelmann's defcription of Stofch's cabinet, and in the noble collection of Mr. Charles Townley in London.

The art of taking impreffions of gems feems not to have been altogether loft even in the Gothic ages; for Heraclius, who probably lived in the ninth century, and wrote a book *De coloribus et artibus Romanorum*, teaches in very plain though not elegant terms how to make them. Indeed, fome of the few perfons who then poffeffed this art, taking advantage of the ignorance of the times, fold paftes for original gems. Thus the famous emerald of the abbey of Reichnaw near Conftance, although a prefent made by Charlemagne, is now found to be a piece of glafs; and thus the celebrated emerald vafe in the cathedral of Genoa is likewife found to be a pafte. The Genoefe got this vafe at the taking of Cefarea in the year 1101 as an equivalent for a large fum of money; nor was any impofition then fufpected, for in the year 1319 they pawned it for 1200 marcs of gold.

But this ingenious art, revived indeed in Italy in the time of Laurence of Medici and pope Leo X. was not cultivated in an extenfive manner till the beginning of the prefent century, when M. Homberg reftored it, as already mentioned. In this he is faid to have been greatly affifted and encouraged by the then duke of Orleans regent of France, who ufed to amufe himfelf with that celebrated chemift in taking off impreffions in pafte from the king of France's, from his own, and other collections of gems.

According to the French Encyclopedifts, M. Clachant the elder, an engraver of fome note, who died at Paris in 1781, learned this art from his royal highnefs, to whofe houfehold his father or he feems to have belonged. Mademoifelle Feloix next cultivated this art, and it is believed ftill carries it on. She had been taught by her father, who, in quality of garçon de chambre to the regent, had often affifted in the laboratory of his mafter, where he acquired this knowledge. Her collection confifts of 1800 articles. Baron Stofch, a Pruffian, who travelled over Europe in queft of original engraved ftones and impreffions of ancient gems for the elegant work which he publifhed and Picart engraved, was well acquainted with this art. He had taught it to his fervant Chriftian Dehn, who fettled at Rome, where he made and fold his well-known fulphur impreffions and paftes. He had collected 2500 articles. Dolce has arranged them in a fcientific order, and given a defcriptive catalogue of them.

It was chiefly from Dehn's collection that the tafte for fulphurs and paftes has become fo univerfal. They are great objects of ftudy, and often require much learning to explain them. They have unqueftionably ferved to extend and improve the art of engraving on ftones, and have been of infinite ufe to painters, to ftatuaries, and to other artifts, as well as to men of claffical learning and fine tafte.

It is very difficult to take off impreffions, and perfectly to imitate various coloured cameos. It cannot be properly done in wax, fulphur, plafter, or glafs of one colour only. The difficulties arifing from their fize and form, and from the various nature of the different forts of glafs which do not well unite into different ftrata, are very numerous: nor could the completeft fuccefs in this chemical and mechanical branch of the art produce a tolerable cameo. Impreffions or imitations, if unaffifted by the tool of the engraver, do not fucceed; becaufe the undercutting and deep work of moft of the originals require to be filled up with clay or wax, that the moulds may come off fafe without injuring them. Hence the impreffions from thefe moulds come off hard and deftitute of delicacy, fharpnefs, and precifion of outline, till the underworking of the moulder is cut away. But Mr. Reiffenftein at Rome, by his genius, perfeverance, and the affiftance of able artifts, has overcome thefe difficulties, and has had the fatisfaction of fucceeding, and producing variegated cameos which can hardly be diftinguifhed from the originals.

Mr. Lippart of Drefden, an ingenious glazier, and an enthufiaft in the fine arts, practifed this branch not unfuccefsfully; but not finding fufficient encouragement for his paftes of coloured glafs, or perhaps from local difficulties in making them

well and cheap, he abandoned this art. He ſubſtituted in its place impreſſions of fine white alabaſter or ſelenite plaſter. Such impreſſions, when carefully ſoaked in a ſolution of white Caſtile ſoap, then dried, and rubbed over with a ſoft bruſh, take a very agreeable poliſh. They ſhow the work perhaps to better advantage than red or white ſulphurs do; but they are not ſo durable, and are liable to be defaced by rubbing.

Of theſe impreſſions Mr. Lippart publiſhed three different collections, each of them containing 1000 articles; and to the merit of having increaſed the number of Mademoiſelle Feloix and Chriſtiano Dehn's collections, which are all inſerted in his, he added that of employing two learned Germans to arrange and deſcribe them. The firſt thouſand were arranged and deſcribed by the late profeſſor Chriſt at Leipſic, and the ſecond and third thouſand by profeſſor Heine at Goettingen. Nor did Mr. Lippart ſtop here: but, to make the ſtudy of antiquity more eaſy and acceptable to artiſts, he ſelected out of the whole collection of 3000 a ſmaller one of 2000 of the beſt and moſt inſtructive ſubjects, of which he himſelf drew up and publiſhed a deſcription in German.

But of all the artiſts and ingenious men who have taken impreſſions of engraved gems in ſulphur and in paſte, no one ſeems to have carried that art to ſuch perfection as Mr. James Taſſie, a native of Glaſgow, but who has reſided in London ſince the year 1766. His knowledge in various branches of the fine arts, particularly in that of drawing, naturally led him to it. The elegant portraits which he models in wax, and afterwards moulds and caſts in paſte, which entirely reſemble cameos, are well known to the curious.

Mr. Taſſie, profiting of all the former publications of this ſort, and by expence, induſtry, and acceſs to many cabinets in England and other kingdoms to which former artiſts had not obtained admiſſion, has now increaſed his collection of impreſſions of ancient and modern gems to the number of above 15,000 articles. It is the greateſt collection of this kind that ever exiſted, and ſerves for all the purpoſes of artiſts, antiquaries, ſcholars, men of taſte, and even philoſophers. The great demand for his paſtes was perhaps owing in the beginning to the London jewellers, who introduced them into faſhion by ſetting them in rings, ſeals, bracelets, necklaces, and other trinkets.

The reputation of this collection having reached the empreſs of Ruſſia, ſhe was pleaſed to order a complete ſet; which, being accordingly executed in the beſt and moſt durable manner, were arranged in elegant cabinets, and are now placed in the noble apartments of her imperial majeſty's ſuperb palace at Czarſko Zelo.

Mr. Taſſie, in executing this commiſſion, availed himſelf of all the advantages which the improved ſtate of chemiſtry, the various ornamental arts, and the knowledge of the age, ſeemed to afford. The impreſſions were taken in a beautiful white enamel compoſition, which is not ſubject to ſhrink or form air-bladders, which emits fire when ſtruck with ſteel, and takes a fine poliſh, and which ſhows every ſtroke and touch of the artiſt in higher perfection than any other ſubſtance. When the colours, mixed colours, and nature of the reſpective originals, could be aſcertained, they were imitated as completely as art can imitate them; inſomuch that many of the paſte intaglios and cameos in this collection are ſuch faithful imitations, that artiſts themſelves have owned they could hardly be diſtinguiſhed from the originals. And when the colour and nature of the gems could not be authenticated, the paſtes were executed in agreeable, and chiefly tranſparent, colours; conſtant attention being beſtowed to preſerve the outlines, extremities, attributes, and inſcriptions.

The arrangement of Mr. Raſpe, from whom this account is taken, is nearly the ſame with that of the late Abbé Winckelmann, in his deſcription of the gems which belonged to Baron Stoſch. But, as modern works were inſerted in this collection, he found it neceſſary to make a few alterations, and added ſome diviſions to thoſe of M. Winckelmann, as will appear from the following conſpectus, with which we ſhall conclude this detail:

I. *Ancient* Art and Engravings.

Egyptian. Hieroglyphics, ſacred animals, divinities, prieſts. Baſilidian, Gnoſtic, and other taliſmans, &c.

Oriental and barbarous ancient and modern engravings.

Greek and Roman originals, copies and imitations (the Etruſcan are claſſed with the Greek works). A, Mythology or fabulous age. Gods, inferior divinities, religious ceremonies. B, Heroic age before the ſiege of Troy. C, Siege of Troy. D, Hiſtoric age. Of Carthage, Greece, Rome, ſubjects unknown. E, Fabulous animals and chimeras. F, Vaſes and urns.

II. *Modern* Art and Engravings—A, Religious ſubjects. B, Portraits of kings and ſovereigns. C, Portraits of illuſtrious men in alphabetical order. D, Portraits unknown. E, Devices and emblems. F, Cyphers, arms, ſupporters, and medley of modern hiſtory.

GEMARA, or GHEMARA, the ſecond part of the TALMUD. The word גמרה, *gemara*, is commonly ſuppoſed to denote a ſupplement; but in ſtrictneſs it rather ſignifies complement, perfection: being formed of the Chaldee גמר, *gemar* or *ghemar*, "to finiſh, perfect, or complete any thing." The rabbins call the Pentateuch ſimply the *law*: the firſt part of the Talmud, which is only an explication of that law, or an application thereof to particular caſes, with the deciſions of the ancient rabbins thereon, they call the *Miſchna*, i. e. "ſecond law:" and the ſecond part, which is a more extenſive and ample explication of the ſame law, and a collection of deciſions of the rabbins poſterior to the Miſchan, they call *Gemara*, q. d. "perfection, completion, finiſhing;" becauſe they eſteem it the finiſhing of the law, or an explication beyond which there is nothing farther to be deſired.

The Gemara is uſually called ſimply *Talmud*, the common name of the whole work. In this ſenſe we ſay, there are two Gemaras or Talmuds, that of Jeruſalem and that of Babylon, though in ſtrictneſs the Gemara is only an explication of the Miſchna, given by the Jewiſh doctors in their ſchools; much as the commentaries of our ſchool-divines on St. Thomas, or the maſter of the ſentences, are an explication of the writings of thoſe authors. A commentary, Monſ. Tillemont obſerves, was written on the Miſchna by one Jochanan, whom the Jews place about the end of the ſecond century: but Fa. Morin proves, from the work itſelf, wherein mention is made of the Turks, that it was not written till the time of Heraclius, or about the year 620; and this is what is called the *Gemara* or *Talmud of Jeruſalem*, which the Jews do not uſe or eſteem much becauſe of its obſcurity.

They ſet a much greater value on the Gemara or Talmud of Babylon, begun by one Aſa; diſcontinued for 73 years, on occaſion of the wars with the Saracens and Perſians; and finiſhed by one Joſa about the cloſe of the ſeventh century. See TALMUD. Though the name Talmud, in its latitude, includes both the Miſchna and the two Gemaras, yet it is properly that of Aſa and Joſa alone which is meant under that name. This the Jews prize above all their other writings, and even ſet it on a level with ſcripture itſelf: in effect, they conceive it is the word of God, derived by tradition from Moſes, and preſerved without interruption to their time. R. Jehuda, and afterwards R. Johanan, R. Aſa, and R. Joſa, fearing the traditions ſhould be loſt in the diſperſion of the Jews, collected them into the Miſchna and the Gemara. See CARAITES and RABBINISTS.

GEMINI, in aſtronomy, the TWINS; a conſtellation or figur

of the zodiac, the third in order, representing Castor and Pollux; and it is marked thus, ♊. The stars in the sign Gemini, in Ptolemy's catalogue, are 25; in Tycho's, 25; in Hevelius's, 38; in the Britannic Catalogue, 85.

GEMINIANI, a celebrated musician and composer, was born at Lucca in the year 1680. He received his first instructions in music from Alessandro Scarlatti, and after that became a pupil of Carlo Ambrosio Lunati, surnamed *Il Gobbo*, a most celebrated performer on the violin; after which he became a disciple of Corelli, and under him finished his studies on that instrument. In the year 1714 he came to England, where in a short time he so recommended himself by his exquisite performance, that all who professed to love and understand music were captivated with hearing him. Many of the nobility laid claim to the honour of being his patrons; but he seemed chiefly to attach himself to Baron Kilmansegge, chamberlain to king George I. as elector of Hanover, and a favourite of that prince. In 1716 he published and dedicated to his patron 12 sonatas *a violino violone e cembalo*: the first six with fugues and double stops as they are vulgarly called; the last with airs of various measures, such as allemandes, courants, and jigs. This publication was so well relished by the baron, that he mentioned Geminiani to the king as an excellent performer; in consequence of which our musician had the honour to perform before his majesty, in concert with the celebrated Handel, who played on the harpsichord. But though Geminiani was exceedingly admired, yet he had not a talent at associating music with poetry, nor do we find that he ever became a public performer: he was therefore obliged to depend for his subsistence on the friendship of his patrons, and the profits which accrued to him from teaching. He had also the misfortune to be an enthusiast in painting; and the versatility of his temper was such, that, in order to gratify this passion, he not only suspended his studies, and neglected to exercise his talents, but involved himself in debt. In 1727 he was offered the place of master and composer of the state-music in Ireland; but this could not be conferred on a Catholic, and Geminiani refused to change his religion: upon which it was given to Matthew Dubourg, a young man who had been one of his pupils, and was a celebrated performer on the violin. Geminiani then set himself to compose parts to the *opera quinta* of Corelli; or, in other words, to make concertos of the first six of his solos. This work he completed, and, with the help of a subscription, at the head of which were the names of the royal family, published in 1726. In 1732 he published his *opera seconda*, which contains a celebrated minuet that goes by his name. He published many other pieces, the profits of which did not much mend his circumstances; but this perhaps was owing to his rambling disposition and enthusiastic fondness of painting. He was also an utter stranger to the business of an orchestra, and had no idea of the labour and pains necessary in the instruction of singers for the performance of music to which they were strangers. The consequence of this was, that a *concerto spirituale*, which he had advertised for his own benefit in 1748, failed in the performance. The audience, however, compassionated his distress, and sat very silent till the books were changed; when the performance was continued with compositions of the author's own, and which he executed in such a manner as was never forgot. The profits arising from this performance enabled him to take a journey to Paris, where he staid long enough to get plates engraven for a score of solos, and the parts of two operas of concertos. About the year 1755 he returned to England, and advertised them for sale. In 1761 Geminiani went over to Ireland, and was kindly entertained there by Mr. Matthew Dubourg, who had been his pupil, and was then master of the king's band in Ireland. This person through the course of his life had ever been disposed to render him friendly offices; and it was but a short time after Geminiani's arrival at Dublin that he was called upon to do him the last. It seems that Geminiani had spent many years in compiling an elaborate treatise on music, which he intended for publication; but soon after his arrival in Dublin, by the treachery of a female servant, who, it was said, was recommended to him for no other end than that she might steal it, it was conveyed away, and could not be recovered. The greatness of this loss, and his inability to repair it, made a deep impression on his mind, and, as is conjectured, hastened his end; at least he survived it but a short time, ending his days on the 17th of September 1762. The following list comprises the whole of his publications, except two or three articles of small account. Twelve solos for a violin, *opera prima*; six concertos in seven parts, *opera seconda*; six concertos in seven parts, *opera terza*; twelve solos for a violin, *opera quarta*; six solos for a violincello, *opera quinta*; the same made into solos for a violin; six concertos from his *opera quarta*; six concertos in eight parts, *opera settima*; rules for playing in taste; a treatise on good taste; the art of playing the violin; 12 sonatas from his first solos, *opera undecima*; Ripieno parts to ditto; lessons for the harpsichord; *Guida Armonica*; supplement to ditto; the art of accompaniment, two books; his first two operas of concertos in score; and the Enchanted Forest. Of his solos the *opera prima* is esteemed the best. Of his concertos some are excellent, others of them scarce pass the bounds of mediocrity. The sixth of the third opera not only surpasses all the rest, but, in the opinion of the best judges of harmony, is the finest instrumental composition extant.

GEMMA, or Bud, in botany; a compendium or epitome of a plant, seated upon the stem and branches, and covered with scales, in order to defend the tender rudiments inclosed, from cold and other external injuries, till, their parts being unfolded, they acquire strength, and render any further protection unnecessary. Buds, together with bulbs, which are a species of buds generally seated upon or near the root, constitute that part of the herb called by Linnæus *hybernacula*; that is, the winter-quarters of the future vegetable: a very proper appellation, as it is during that severe season that the tender rudiments are protected in the manner just mentioned. Plants, considered in analogy to animals, may properly enough be reckoned both viviparous and oviparous. Seeds are the vegetable eggs; buds, living fetuses, or infant-plants, which renew the species as certainly as the seed. Buds are placed at the extremity of the young shoots, and along the branches, being fixed by a short foot-stalk upon a kind of brackets, the remainder of the leaves, in the wings or angles of which the buds in question were formed the preceding year. They are sometimes placed single; sometimes two by two, and those either opposite or alternate; sometimes collected in greater numbers in whorls or rings.

With respect to their construction, buds are composed of several parts artificially arranged. Externally, we find a number of scales that are pretty hard, frequently armed with hairs, hollowed like a spoon, and placed over each other like tiles. These scales are fixed into the inner plates of the bark, of which they appear to be a prolongation. Their use is to defend the internal parts of the bud; which, being unfolded, will produce, some, flowers, leaves, and stipulæ; others, footstalks and scales. All these parts, while they remain in the bud, are tender, delicate, folded over each other, and covered with a thick clammy juice, which is sometimes resinous and odoriferous, as in the tacahamac-tree. This juice serves not only to defend the more tender parts of the embryo plant from cold, the assaults of insects, and other external injuries, but likewise from excessive perspiration, which, in its young and infant state, would be very destructive. It is conspicuous in the buds of horse-chesnut, poplar, and willow trees.

In general, we may distinguish three kinds of buds; that

containing the flower, that containing the leaves, and that containing both flower and leaves. The firft, termed *gemma florifera*, and by the French *bouton à fleur* or *à fruit*, contains the rudiments of one or feveral flowers, folded over each other, and furrounded with fcales. In feveral trees, this kind of bud is commonly found at the extremity of certain fmall branches, which are fhorter, rougher, and lefs garnifhed with leaves, than the reft. The external fcales of this fpecies of bud are harder than the internal; both are furnifhed with hairs, and in general more fwelled than thofe of the fecond fort. The bud containing the flower too is commonly thicker, fhorter, almoft fquare, lefs uniform, and lefs pointed; being generally terminated obtufely. It is called by Pliny *oculus gemmæ*, and is employed in that fpecies of grafting called *inoculation* or *budding*. The fecond fpecies of bud, viz. that containing the leaves, termed *gemma folifera*, and by the French *bouton à feuilles* or *à bois*, contains the rudiments of feveral leaves, which are varioufly folded over each other, and outwardly furrounded by fcales, from which the fmall ftipulæ that are feated at the foot of the young branches are chiefly produced. Thefe buds are commonly more pointed than the former fort. In the hazel-nut, however, they are perfectly round; and in horfe-chefnut, very thick. The third fort of bud is fmaller than either of the p eceding, and produces both flowers and leaves, though not always in the fame manner. Sometimes the flowers and leaves are unfolded at the fame time. This mode of the flower and leaf bud is termed by Linnæus *gemma folifera & florifera*. Sometimes the leaves proceed or emerge out of this kind of bud upon a fmall branch, which afterwards produces flowers. This mode of the flower and leaf bud is termed by Linnæus *gemma folifera-florifera*, and is the moft common bud of any. Such buds as produce branches adorned only with leaves are called *barren*; fuch as contain both leaves and flowers, *fertile*. From the bulk of the bud we may often with eafe foretel whether it contains leaves only, or leaves and flowers together, as in cherry and pear trees.

Neither the buds produced on or near the root, called by fome authors *turiones*, nor thofe produced on the trunk, and from the angles or wings of the leaves, contain, in ftrict propriety, an entire delineation of the plant; fince the roots are wanting, and in various buds, as we have feen, fhoots are contained with leaves only, and not with flowers: but as a branch may be confidered as a part fimilar to the whole plant, and, if planted, would in procefs of revegetation exhibit or produce roots and flowers, we may in general allow, that the bud contains the whole plant, or the principles of the whole plant, which may be unfolded *ad libitum*, and thus refembles the feed in containing a delineation of the future plant in embryo: for although the bud wants a radicle or plumula, of which the feed is poffeffed, yet it would undoubtedly form one if planted in the earth. But as the medullary part adhering to the bud is too tender, and by the abundance of juice flowing into it from the earth would be difpofed to putrefaction, the buds are not planted in the foil, but generally inferted within the bark of another tree; yet placed fo that the production of the marrow or pith adhering to them may be inferted into the pith of the branch in which the fiffure or cleft is made; by which means there is a large communication of juice. This propagation by gems or buds, called *inoculation*, is commonly practifed with the firft fort of buds above defcribed.

From the obvious ufes of the buds, we may collect the reafon why the fupreme Author of nature has granted this fort of protection to moft of the trees that are natives of cold climates, and, on the other hand, denied it to fuch as, enjoying a warm benign atmofphere, have not the tender parts of their embryo fhoots expofed to injuries and depredations from the feverities of the weather. Of this latter kind are the plants of the following lift, fome of them very large trees, others fmaller woody vegetables, of the fhrub and under-fhrub kind: Citron, orange, lemon, caffava, mock-orange, blad-apple, fhrubby fwallow-wort, alaternus, fhrubby geraniums, berry-bearing alder, Chrift's-thorn—Syrian mallow, baobab or Ethiopian fourgourd, jufticia, mild fena, the acacias and fenfitive plant, coral-tree, ftinking bean-trefoil, medicago, oleander, viburnum, fumach, ivy, tamarifk, heath, Barbadoes cherry, lavatera, rue, fhrubby night-fhades, Guinea henweed, cyprefs, lignum vitæ, and favine a fpecies of juniper.

On annual plants, whofe root as well as ftalk perifhes after a year, true buds are never produced: in their ftead, however, are protruded fmall branches, like a little feather, from the wings of the leaves, which wither without any farther expanfion if the plants climb and have no lateral branches; but if, either by their own nature or from abundance of fap, the plants become branched, the ramuli juft mentioned obtain an increafe fimilar to that of the whole plant. The fame appearance obtains in the trees of warm countries, fuch as thofe enumerated in the above lift, in which a plumula or fmall feather fends forth branches without a fcaly covering; as in fuch countries this tender part requires no defence or protection from cold. A fcaly covering then is peculiar to buds, as it protects the tender embryo inclofed from all external injuries. When we therefore fpeak of trees having buds that are naked or without fcales, our meaning is the fame as if we had faid that they have no buds at all. The buds that are to be unfolded the following year break forth from the evolved buds of the prefent year, in fuch a manner as to put on the appearance of fmall eminences in the wings or angles of the leaves. Thefe eminences or knots grow but little during the fummer, as in that feafon the fap is expended on the increafe of the parts of the plant: but in autumn, when the leaves begin to wither and fall off, the buds placed on the wings increafe, and the embryo-plant contained in the bud is fo expanded, that the leaves and flowers, the parts to be evolved the following year, are diftinctly vifible. Thus in horfe-chefnut the leaves, and in cornel tree the flowers, are each to be obferved in their refpective buds.

As each bud contains the rudiments of a plant, and would, if feparated from its parent vegetable, become every way fimilar to it, Linnæus, to fhow the wonderful fertility of nature, has made a calculation, by which it appears, that, in a trunk fcarce exceeding a fpan in breadth, 10,000 buds (that is, herbs) may be produced. What an infinite number then of plants might be raifed from a very large tree!

GEMMATIO, from *gemma*, "a bud;" a term ufed by Linnæus, expreffive of the form of the buds, their origin, and their contents. It includes both thofe properly called *buds*, and thofe which are feated at the roots, ftyled *bulbs*. Buds are originally formed either of the footftalks of the leaves, of ftipulæ, or of fcales of the bark. Their contents have been already difcovered, in the preceding article, to be either flowers, leaves, or both.

GEMONLE SCALÆ, or *Gradus*-GEMONII, among the Romans, was much the fame as gallows or gibbet in England. Some fay they were thus denominated from the perfon who raifed them: others, from the firft criminals that fuffered on them; and others, from the verb *gemo*, "I figh or groan." The *gradus gemonii*, according to Publius Victor or Sextus Rufus, was a place raifed on feveral fteps, from whence they precipitated their criminals; others reprefent it as a place whereon offenders were executed, and afterwards expofed to public view. The *gemoniæ fcalæ* were in the tenth region of the city, near the temple of Juno. Camillus firft appropriated the place to this ufe, in the year of Rome 358.

GENDARMES, or GENS D'ARMES, in the French armies, a denomination heretofore given to a felect body of horfe, on

account of their fucceeding the ancient gendarmes, who were thus called from their being completely clothed in armour. Thefe troops were commanded by captain-lieutenants, the king and the princes of the blood being their captains: the king's troop, befides a captain-lieutenant, had two fub-lieutenants, three enfigns, and three guidons.

Grand GENDARMES were a troop compofed of 250 gentlemen; the king himfelf was their captain, and one of the firft peers their captain-lieutenant, who had under him two lieutenants, three enfigns, three guidons, and other officers.

Small GENDARMES were the Scots gendarmes, the queen's, the dauphin's, the gendarmes of Anjou, Burgundy, the Englifh and Flemifh gendarmes, having each a captain-lieutenant, fub-lieutenant, enfign, guidon, and quarter-mafter.

Scots GENDARMES were originally inftituted by Charles VII. of France about the middle of the 5th century, and formed a part of his guard; in which ftation alfo they acted under other princes. It was their prerogative to take precedence of all the companies of the gendarmerie of France, and on particular occafions they even preceded the two companies of the king's moufquetaires. The fons of the Scottifh monarchs were the ufual captains of this company; and, after Mary's acceffion to the throne, its command belonged to them as a right. It was thence that James VI. made a claim of it for his fon prince Henry. This honour and its emoluments were alfo enjoyed by Charles I. and the next in command to this prince was Louis Stuart duke of Lennox. George Gordon marquis of Huntley fucceeded the duke of Lennox in the year 1624, and took the title of captain or commander in chief when Charles I. mounted the Englifh throne. It is not certain whether Charles II. was ever captain of this company; but it was conferred on his brother the duke of York, who was captain of the Scots gendarmes till the year 1667, when he refigned his commiffion into the hands of the French king. Since that time no native of Great Britain has enjoyed this command. All the different gendarmeries are now abolifhed, in confequence of the reforming fyftems that have lately taken place in France.

GENDER, among grammarians, a divifion of nouns or names to diftinguifh the two fexes. This was the original intention of gender: but afterwards other words, which had no proper relation either to the one fex or the other, had genders affigned them, rather out of caprice than reafon; which is at length eftablifhed by cuftom. Hence genders vary according to the languages, or even according to the words introduced from one language into another. Thus *arbor* in Latin is feminine, but *arbre* in French is mafculine; and *dens* in Latin is mafculine, but *dent* in French is feminine.

The *oriental* languages frequently neglect the ufe of genders, and the Perfian language has none at all. The Latins, Greeks, &c. generally content themfelves to exprefs the different genders by different terminations; as *bonus equus*, "a good horfe;" *bona equa*, "a good mare," &c. But in Englifh we frequently go further, and exprefs the difference of fex by different words: as boar, fow; boy, girl; buck, doe; bull, cow; cock, hen; dog, bitch, &c. We have only about 24 feminines, diftinguifhed from the males by the variation of the termination of the male into *efs*; of which number are abbot, abbefs; count, countefs; actor, actrefs; heir, heirefs; prince, princefs, &c. which is all that our language knows of any thing like genders. The *Greek* and *Latin*, befides the mafculine and feminine, have the neuter, common, and the doubtful gender; and likewife the epicene, or promifcuous, which, under one fingle gender and termination, includes both the kinds.

GENDRE (Louis le), an efteemed hiftorian, born at Roan. He became canon of Nôtre Dame at Paris, fubchanter of the fame church, and abbot of Nôtre Dame at Claire Fontaine in the diocefe of Chartres. He wrote a great number of works, the principal of which are: 1. The Manners and Cuftoms of the French in the different times of that monarchy. 2. An Hiftory of France, in three volumes folio, and in feven volumes duodecimo. 3. The Life of Cardinal d'Amboife. He died in 1733, aged 78.

GENDRE (Gilbert Charles le), marquis of St. Aubin, counfellor in the parliament of Paris, and afterwards mafter of requefts in the king's houfehold. He wrote feveral works, but is chiefly diftinguifhed by his *Trait de l'opinion*, 9 vols. 12mo; a curious performance, proving, by hiftoric examples, the empire of opinion over the works of art and fcience. He died at Paris in 1746, aged 59.

GENEALOGY, an enumeration of a feries of anceftors, or a fummary account of the relations and alliances of a perfon or family, both in a direct and collateral line. The word is Greek, γενεαλογια, which is formed of γενος, "race or lineage," and λογος, "difcourfe." In chapters and military orders, it is required that the candidates produce their genealogy, to fhow their family defcents. It is for the regulation of thefe matters that moft of the orders, that of the Bath in particular, have an officer appointed by the ftatutes, entitled *Genealogift*; who keeps a diftinct regifter of the pedigrees of the knights and their efquires. See *Knights of the* BATH.

GENEALOGICA ARBOR, or TREE *of Confanguinity*, fignifies a genealogy or lineage drawn out under the figure of a tree, with its root, ftock, branches, &c. The genealogical degrees are ufually reprefented in circles, ranged over, under, and befide each other. This the Greeks called *ftemmata*, a word fignifying crown, garland, or the like. See the articles CONSANGUINITY and DESCENT, and the plates there referred to.

GENEP, a ftrong town of Germany, in the circle of Weftphalia, fubject to the king of Pruffia. E. long. 4. 29. N. lat. 51. 42.

GENERAL, an appellation given to whatever belongs to a whole genus.

GENERAL *Affembly*. See ASSEMBLY.

GENERAL *Charge*, in law. See CHARGE *to enter Heir*.

GENERAL *Terms*, among logicians, thofe which are made the figns of general ideas. See LOGIC and METAPHYSICS.

GENERAL *Warrant*. See WARRANT.

GENERAL *of an Army*, in the art of war, he who commands in chief. See the article WAR, where his office and duties are fpoken of.

GENERAL *of the Artillery*. See ORDNANCE.

GENERAL *of Horfe*, and GENERAL *of Foot*, are pofts next under the general of the army; and thefe have upon all occafions an abfolute authority over all the horfe and foot in the army.

Adjutant-GENERAL, one who attends the general, affifts in council, and carries the general's orders to the army. He diftributes the daily orders to the majors of brigade. He is likewife charged with the general detail of the duty of the army. The majors of brigade fend every morning to the adjutant-general an exact return, by battalion and company, of the men of his brigade. In a day of battle the adjutant-general fees the infantry drawn up; after which, he places himfelf by the general, to receive any orders which may regard the corps of which he has the detail. In a fiege, he orders the number of workmen demanded, and figns the warrant for their payment. He receives the guards of the trenches at their rendezvous, and examines their condition; he gives and figns all orders for parties. He has an orderly ferjeant from each brigade of infantry in the line, to carry fuch orders as he may have occafion to fend from the general.

Lieutenant-GENERAL, is the next in command after the general; and provided he fhould die or be killed, the order is, that the oldeft lieutenant-general fhall take the command. This office is the firft military dignity after that of a general. One part

of their function is, to assist the general with their counsel: they ought, therefore, if possible, to possess the same qualities with the general himself; and the more, as they often command armies in chief. The number of lieutenant-generals have been multiplied of late in Europe, in proportion as the armies have become numerous. They serve, either in the field or in sieges, according to the dates of their commissions. In battle, the oldest commands the right wing of the army, the second the left wing, the third the centre; the fourth the right wing of the second line, the fifth the left wing, the sixth the centre—and so on. In sieges, the lieutenant-generals always command the right of the principal attack, and order what they judge proper for the advancement of the siege during the 24 hours they are in the trenches, except the attacks, which they are not to make without an order from the general-in-chief.

Lieutenant-GENERAL *of the Ordnance*. See ORDNANCE.

Lieutenant-GENERAL *of Artillery*, is, or ought to be, a very great mathematician and an able engineer, to know all the powers of artillery, to understand the attack and defence of fortified places in all its different branches, how to dispose of the artillery in the day of battle to the best advantage, to conduct its march and retreat, as also to be well acquainted with all the numerous apparatus belonging to the train, and to the laboratory, &c.

Major-GENERAL, the next officer to the lieutenant-general. His chief business is to receive orders from the general, or, in his absence, from the lieutenant-general of the day; which he is to distribute to the brigade-majors, with whom he is to regulate the guards, convoys, detachments, &c. On him the whole fatigue and detail of duty of the army rest. It is the major-general of the day who is charged with the encampment of the army, who places himself at the head of it when they march, who marks out the ground of the camp to the quarter-master-general, and who places the new guards for the safety of the camp. The day the army is to march, he dictates to the field-officers the order of the march, which he has received from the general, and on other days gives them the parole. In a fixed camp he is charged with the foraging, with reconnoitring the ground for it, and posting the escorts, &c. In sieges, if there are two separate attacks, the second belongs to him; but if there is but one, he takes, either from the right or left of the attack, that which the lieutenant-general has not chosen. When the army is under arms, he assists the lieutenant-general, whose orders he executes. If the army marches to an engagement, his post is at the head of the guards of the army, until they are near enough to the enemy to rejoin their different corps; after which he retires to his own proper post: for the major-generals are disposed in the order of battle as the lieutenant-generals are; to whom, however, they are subordinate for the command of their divisions. The major-general has one aid-de-camp, having additional pay for executing his orders.

GENERAL, is also used for a certain march, or beat of drum; being the first which gives notice, commonly in the morning early, for the infantry to be in readiness to march.

GENERAL is likewise an appellation by which officers in law, in the revenues, &c. are distinguished; as, *attorney-general, solicitor-general*, &c. *receiver-general, comptroller-general*, &c. See ATTORNEY, &c.

GENERAL is also used for the chief of an order of monks, or of all the houses and congregations established under the same rule. Thus we say, the General of the Franciscans, Cistertians, &c.

GENERALISSIMO, called also *captain-general*, and simply *General*, is an officer who commands all the military powers of a nation, who gives orders to all the other general officers, and receives no orders himself but from the king. Monf. Balzac observes, that the cardinal de Richelieu first coined this word, of his own absolute authority, upon his going to command the French army in Italy.

GENERATE, in music, is used to signify the operation of that mechanical power in nature which every sound has in producing one or more different sounds. Thus any given sound, however simple, produces along with itself its octave, and two other sounds extremely sharp, viz. its twelfth above, that is to say, the octave of its fifth; and the other the seventeenth above, or, in other words, the double octave of its third major. Whether we suppose this procreation of sounds to result from an aptitude in the texture and magnitude of certain particles in the air, for conveying to our ears vibrations that bear those proportions one to another, as being determined at once by the partial and total oscillations of any musical string; from whatever economy of nature we choose to trace it; the power of one sound thus to produce another when in action is said to *generate*. The same word is applied by Signior Tartini and his followers, to any two sounds which, simultaneously heard, produce a third.

GENERATED, or GENITED, is used by some mathematical writers for whatever is produced, either in arithmetic, by the multiplication, division, or extraction of roots; or in geometry, by the invention of the contents, areas, and sides; or of extreme and mean proportionals, without arithmetical addition and subtraction.

GENERATING LINE, or FIGURE, in geometry, is that which by its motion of revolution produces any other figure, plane or solid. See GENESIS.

GENERATION, in physiology, the act of procreating and producing a being similar to the parent. See MIDWIFERY.

GENERATION *of Fishes*. See COMPARATIVE *Anatomy*, p. 656; and ICHTHYOLOGY.

GENERATION *of Plants*. See BOTANY, p. 33.

GENERATION *of Insects*. See COMPARATIVE *Anatomy*, p. 658; and ENTOMOLOGY.

Parts of GENERATION. See ANATOMY, p. 208 and 209.

GENERATION, in mathematics, is used for formation or production. Thus we meet with the generation of equations, curves, solids, &c.

GENERATION, in theology. The Father is said by some divines to have produced his Word or Son from all eternity by way of generation; on which occasion the word *generation* raises a peculiar idea: that procession, which is really effected in the way of understanding, is called *generation*, because, in virtue thereof, the Word becomes like to him from whom he takes this original; or, as St. Paul expresses it, is the figure or image of his substance, *i. e.* of his being and nature. And hence it is, they say, that the second Person in the Trinity is called the Son.

GENERATION is also used, though somewhat improperly, for genealogy, or the series of children issued from the same stock. Thus the gospel of St. Matthew commences with the book of the generation of Jesus Christ, &c. The latter and more accurate translators, instead of *generation*, use the word *genealogy*.

GENERATION is also used to signify a people, race, or nation, especially in the literal translations of the scripture, where the word generally occurs wherever the Latin has *generatio*, and the Greek γενεσις. Thus, "A wicked and perverse generation seeketh a sign," &c. "One generation passeth away, and another cometh," &c.

GENERATION is also used in the sense of an age, or the ordinary period of man's life. Thus we say, "to the third and fourth generation." In this sense historians usually reckon a generation to be the space of 33 years or thereabouts. See AGE. Herodotus makes three generations in an hundred years;

which computation appears from the later authors of political arithmetic to be pretty juſt.

GENERATOR, in muſic, ſignifies the principal ſound or ſounds by which others are produced. Thus the loweſt C for the treble of the harpſichord, beſides its octave, will ſtrike an attentive ear with its twelfth above, or G in alt, and with its ſeventeenth above, or E in alt. The C, therefore, is called their *generator*, the G and E its products or harmonics. But in the approximation of chords, for G its octave below is ſubſtituted, which conſtitutes a fifth from the generator or loweſt C; and for E is likewiſe ſubſtituted its fifteenth below, which, with the abovementioned C, forms a third major. To the loweſt notes, therefore, exchanged for theſe in alt by ſubſtitution, the denominations of products or harmonics are likewiſe given, whilſt the C retains the name of their *generator*. But ſtill, according to the ſyſtem of Tartini, two notes in concord, which when ſounded produce a third, may be termed the *concurring generators* of that third. See *Generation Harmonique, par M. Rameau*; ſee alſo that delineation of Tartini's ſyſtem called *The power and principles of harmony*.

GENERIC NAME, in natural hiſtory, the word uſed to ſignify all the ſpecies of natural bodies which agree in certain eſſential and peculiar characters, and therefore all of the ſame family or kind; ſo that the word uſed as the generical name equally expreſſes every one of them, and ſome other words expreſſive of the peculiar qualities or figures of each are added, in order to denote them ſingly, and make up what is called the ſpecific name. See BOTANY, ZOOLOGY, &c.

GENESIS, the firſt book of the Old Teſtament, containing the hiſtory of the creation and the lives of the firſt patriarchs. The book of Geneſis ſtands at the head of the Pentateuch. Its author is held to be Moſes: it contains the relation of 2369 years, viz. from the beginning of the world to the death of Joſeph. The Jews are forbidden to read the beginning of Geneſis and the beginning of Ezekiel before 30 years of age. The Hebrews called this book *Bereſchith*, becauſe it begins with that word, which in their language ſignifies *in principio*, or "in the beginning." The Greeks gave it the name *Geneſis*, Γενεσις, *q. d.* production, generation, becauſe it begins with the hiſtory of the production or generation of all beings. This book, beſides the hiſtory of the creation, contains an account of the original innocence and fall of man; the propagation of mankind; the riſe of religion; the general defection and corruption of the world; the deluge; the reſtoration of the world; the diviſion and peopling of the earth; and the hiſtory of the firſt patriarchs to the death of Joſeph. It was eaſy for Moſes to be ſatisfied of the truth of what he delivers in this book, becauſe it came down to him through a few hands: for from Adam to Noah there was one man, viz. Methuſelah, who lived ſo long as to ſee them both: in like manner Shem converſed with Noah and Abraham; Iſaac with Abraham and Joſeph, from whom the records of this book might eaſily be conveyed to Moſes by Amram, who was contemporary with Joſeph.

GENESIS, in geometry, denotes the formation of a line, plane, or ſolid, by the motion or flux of a point, line, or ſurface. See FLUXIONS. The geneſis or formation, *e. gr.* of a globe or ſphere is conceived by ſuppoſing a ſemicircle to revolve upon a right line, drawn from one extreme thereof to the other, called its axis, or axis of circumvolution: the motion or revolution of that ſemicircle is the geneſis of the ſphere, &c. In the geneſis of figures, &c. the line or ſurface that moves is called the *deſcribent*; and the line round which, or according to which, the revolution or motion is made, the *dirigent*.

GENET, GENNET, or *Jennet*, in the manege, denotes a ſmall-ſized well-proportioned Spaniſh horſe. To ride *à la genette* is to ride after the Spaniſh faſhion, ſo ſhort that the ſpurs bear upon the horſe's flank.

GENETHLIA, in antiquity, a ſolemnity kept in memory of ſome perſon deceaſed.

GENETHLIACI, in aſtrology, perſons who erect horoſcopes, or pretend to foretel what ſhall befall a man by means of the ſtars which preſided at his nativity. The word is formed of the Greek γενεθλη, "origin, generation, nativity." The ancients called them *Chaldæi*, and by the general name *mathematici*: accordingly, the ſeveral civil and canon laws which we find made againſt the mathematicians only reſpect the *genethliaci* or aſtrologers. They were expelled Rome by a formal decree of the ſenate, and yet found ſo much protection from the credulity of the people, that they remained therein unmoleſted. Hence an ancient author ſpeaks of them as *hominum genus, quod in civitate noſtra ſemper & vetabitur & retinebitur*.

GENETTE, in zoology. See VIVERRA.

GENEVA, an ancient, large, and populous town, capital of a republic of the ſame name, near the confines of France and Swiſſerland. It is ſeated on the moſt narrow part of the lake of the ſame name, where the Rhone iſſues in two large narrow channels, which ſoon after unite. This river divides the city into two unequal parts. Geneva, which lies partly in the plain on the borders of the lake, and partly on a gentle aſcent, is irregularly built. It is the moſt populous town of Swiſſerland, containing 24,000 ſouls. The reformation, firſt preached at Geneva by William Farel, a native of Gap, and Peter Viret of Orbe, owed its final reception and eſtabliſhment here to the celebrated John Calvin. The treaty of alliance which Geneva contracted with Bern and Friburg in 1526 may be conſidered as the true era of its liberty and independence; for, not long after, the dukes of Savoy were deprived of the authority which they poſſeſſed over this city, the biſhop was expelled, a republican form of government eſtabliſhed, and the reformation introduced. In 1584 Geneva concluded a treaty of perpetual alliance with Zurich and Bern, by which it is allied with the Swiſs cantons. It is governed by a ſenate, or little council of 25; of which four are annually choſen ſyndics, who are the chief magiſtrates. Thus far the government is ariſtocratic. But there is alſo a great council, and a general council or aſſembly of the people; the latter amounting to about 1500, who name half the members of the great council, as the ſenate does the other half. This is the democratic part of the government. During the greater part of the laſt century to the year 1789, the hiſtory of Geneva contains little more than a narrative of conteſts between the ariſtocratic and the popular parties, the hiſtory of which would require a volume to relate. It may ſuffice to obſerve here, that the years 1768, 1782, and 1789, were diſtinguiſhed by great revolutions; and that, by the laſt, the conſtitution was wiſely modelled into a mean between the too popular form eſtabliſhed in 1768 and the too ariſtocratical form eſtabliſhed in 1782. The houſes of Geneva are lofty, and many that ſtand in the trading part of the city have arcades of wood, which are raiſed even to the upper ſtories. Theſe arcades, ſupported by pillars, give a gloomy appearance to the ſtreet, but are uſeful to the inhabitants in protecting them from the ſun and rain. Playing at cards, or drinking at public-houſes, is not permitted; but they exerciſe their militia, play at bowls, and have other diverſions on Sunday: where, however, the duties of the day, during the hours appropriated to divine ſervice, are obſerved with the moſt reſpectful decorum. The citizens of both ſexes are remarkably well inſtructed, and "it is not uncommon," ſays Dr. Moore, "to find mechanics, in the intervals of their labour, amuſing themſelves with the works of Locke, Monteſquieu, Newton, and other productions of the ſame kind." Geneva is 40 miles N. E. of Chamberry, and 135 N. W. of Turin. E. lon. 6. 5. N. lat. 46. 12.

Lake of GENEVA, a magnificent expanſe of water, in Swiſ-

ſerland, which, from one extremity of it at the city of Geneva to the other at the town of Villenenve, extends 54 miles in length; and its breadth in its wideſt part is 12. It is in the ſhape of a creſcent, of which Swiſſerland forms the concave, and Savoy the convex part. Savoy affords a rude and awful boundary of aſpiring Alps, craggy, and covered with the ice of ages. From Geneva to the environs of Lauſanne, the country ſlopes, for a conſiderable way, to the margin of the lake, and is enriched with all the varieties that nature can beſtow. The long ridge of the Jura, fertile in paſturage, and varied with woods, backs the beautiful tract. Near Lauſanne the banks riſe conſiderably, and form a charming terrace. A few miles beyond that town is a rapid deſcent. Near Vevay begins a plain, which is continued far beyond the end of the lake, but contracted, by the approach of the mountains toward the water; the colour of which is extremely beautiful, clear, and at a diſtance ſeems of a lovely blue. The depth is various; the greateſt yet found by ſounding is 160 fathoms. Like all inland lakes, incloſed within high mountains, it is ſubject to ſudden ſtorms. Among the birds which frequent this lake, are the *tippet grebes* (Pennant's Brit. Zool. vol. ii. N 222.), which appear in December, and retire in February. Their ſkins are an elegant article of luxury, and ſell for 12 or 14s each. Theſe birds are obliged to breed in other places, this lake being almoſt totally deſtitute of reeds and ruſhes, in which they form their floating neſt. The river Rhone runs through the whole extent of this lake, from its E. to its S. W. extremity.

Geneva, or *Gin*, among diſtillers, an ordinary malt ſpirit diſtilled a ſecond time, with the addition of ſome juniper berries. Originally the berries were added to the malt in the grinding; ſo that the ſpirit thus obtained was flavoured with the berries from the firſt, and exceeded all that could be made by any other method. At preſent they leave out the berries entirely, and give their ſpirits a flavour by diſtilling them with a proper quantity of oil of turpentine; which, though it nearly reſembles the flavour of juniper-berries, has few of their valuable qualities.

GENEVIEVE (fathers or religious of), the name of a congregation of regular canons of the order of St. Auguſtine, eſtabliſhed in France. The congregation of St. Genevieve is a reform of the Auguſtine canons. It was begun by St. Charles Faure in the abbey of St. Vincent de Senlis, of which he was a member in the year 1618. In the year 1634 the abbey was made elective; and a general chapter, compoſed of the ſuperiors of 15 houſes who had now received the reform, choſe F. Faure coadjutor of the abbey of St. Genevieve, and general of the whole congregation. Such were its beginnings. It has ſince increaſed very much, and it now conſiſts of above a hundred monaſteries; in ſome whereof the religious are employed in the adminiſtration of the pariſhes and hoſpitals, and in others in the celebration of divine ſervice, and the inſtruction of eccleſiaſtics in ſeminaries for the purpoſe. The congregation takes its name from the abbey of St. Genevieve, which is the chief of the order, and whoſe abbot is the general thereof. The abbey itſelf took its name from St. Genevieve, the patroneſs of the city of Paris, who died in the year 512. Five years after her death, Clovis erected the church of St. Genevieve, under the name and invocation of St. Peter, where her relics are ſtill, or were till lately, preferved, her ſhrine viſited, and her image carried with great proceſſions and ceremonies upon extraordinary occaſions, as when ſome great favour is to be entreated of heaven.

GENIAL, an epithet given by the Pagans to certain gods who were ſuppoſed to preſide over generation. The *genial gods*, ſays Feſtus, were earth, air, fire, and water. The twelve ſigns, together with the ſun and moon, were ſometimes alſo ranked in the number.

GENII, a ſort of intermediate beings, by the Mahometans believed to exiſt, between men and angels. They are of a groſſer fabric than the latter, but much more active and powerful than the former. Some of them are good, others bad, and they are capable of future ſalvation or damnation like men. The Orientals pretend that theſe genii inhabited the world many thouſand years before the creation of Adam, under the reigns of ſeveral princes, who all bore the common name of Solomon: that, falling at length into an almoſt general corruption, Eblis was ſent to drive them into a remote part of the earth, there to be confined; and that ſome of that generation ſtill remaining, were by Tamurath, one of the ancient kings of Perſia, forced to retreat into the famous mountain of *Kaf*; of whoſe ſucceſſions and wars they have many fabulous and romantic ſtories. They alſo made ſeveral ranks and degrees among this kind of beings (if they are not rather different ſpecies); ſome being abſolutely called *Jin*; ſome *Peri*, or fairies; ſome *Div*, or giants; and others *Tacwins*, or fates.

GENIOGLOSSI, in anatomy. See Anatomy, *Table of the Muſcles*.

GENIOHYOIDÆUS, in anatomy. *Ibid.*

GENIOSTOMA, in botany; a genus of the monogynia order, belonging to the pentandria claſs of plants. The calyx is a turbinated quinquefid perianthium; the corolla monopetalous and tubular; the ſtamina five ſhort filaments; the antheræ oblong; the ſeeds very numerous and ſubangulated, placed on a filiform receptacle.

GENIPPA, in botany; a genus of the monogynia order, belonging to the pentandria claſs of plants, and in the natural method ranking under the 30th order, *Contortæ*. The corolla is wheel-ſhaped; the ſtigma club-ſhaped; the berry bilocular; the ſeeds neſtling in a carnous heart-ſhaped ſubſtance.

GENISTA, broom, or dyers-weed; a genus of the decandria order, belonging to the diadelphia claſs of plants, and in the natural method ranking under the 32d order, *Papilionaceæ*. The calyx is bilabiate, the upper lip bidented, the under one tridentate; the vexillum is oblong and reflexed, or turned back from the piſtil and ſtamina. There are ſeveral ſpecies, of which the moſt remarkable are the cytiſo-geniſta, or common broom, and the tinctoria, or dyers-weed. The firſt is too well known to need deſcription. Its young flowers are ſometimes preſerved as pickles; and the plant, when burnt, affords a tolerably pure alkaline ſalt. Dr. Mead relates the caſe of a dropſical patient that was cured by taking half a pint of a decoction of green broom tops, with a ſpoonful of whole white muſtard ſeed, every morning and evening. The patient had been tapped three times, and tried the uſual remedies before. The ſeeds, or an infuſion of them, drank freely, have been known to produce ſimilar happy effects; but theſe are to be expected in very few inſtances. Cows, horſes, and ſheep, refuſe the plant. 2. The tinctoria is alſo a native of Britain. It riſes with ſhrubby ſtalks three feet high, garniſhed with ſpear-ſhaped leaves placed alternate, and terminated by ſeveral ſpikes of yellow flowers, ſucceeded by pods. The branches of the plant are uſed by dyers for giving a yellow colour; from whence it is called *dyers-broom*, *green-wood*, *wood-waxen*, or *dyers-weed*. A dram and an half of the powdered ſeeds operates as a mild purgative. A decoction of the plant is diuretic, and, like the former, has proved ſerviceable in dropſical caſes. Horſes, cows, goats, and ſheep, eat it.

GENITAL, an appellation given to whatever belongs to the parts of generation. See Anatomy, p. 208.

GENITES, among the Hebrews, thoſe deſcended from Abraham without any mixture of foreign blood. The Greeks diſtinguiſhed by the name of *genites* ſuch of the Jews as were ſprung from parents who, during the Babyloniſh captivity, had not allied with any gentile family.

GENITIVE, in grammar, the ſecond caſe of the declenſion of nouns. The relation of one thing conſidered as belonging in ſome manner to another has occaſioned a peculiar termination of nouns called the *genitive caſe*; but in the vulgar tongues they make uſe of a ſign to expreſs the relation of this caſe. In Engliſh they prefix the particle *of*, in French *de* or *du*, &c. though in ſtrictneſs there are no caſes in either of theſe languages; inaſmuch as they do not expreſs the different relations of things by different terminations, but by additional prepoſitions, which is otherwiſe in the Latin. See GRAMMAR.

GENIUS, a good or evil ſpirit or dæmon, whom the ancients ſuppoſed ſet over each perſon, to direct his birth, accompany him in life, and to be his guard. See DÆMON. Among the Romans, Feſtus obſerves, the name *genius* was given to "the god who had the power of doing all things," *deum qui vim obtineret rerum omnium gerendarum*; which Voſſius, *de Idol.* rather chooſes to read *genendarum*, "who has the power of producing all things," by reaſon Cenſorinus frequently uſes *gerere* for *gignere*. Accordingly St. Auguſtin, *de Civitat. Dei*, relates, from Varro, that the genius was a god who had the power of generating all things, and preſided over them when produced. Feſtus adds, that Aufuſtius ſpake of the genius as the Son of God, and the Father of men, who gave them life. Others, however, repreſented the genius as the peculiar or tutelary god of each place: and it is certain the laſt is the moſt uſual meaning of the word. The ancients had their *genii* of nations, of cities, of provinces, &c. Nothing is more common than the following inſcription on medals—GENIUS POPULI ROM. "the genius of the Roman people;" or GENIO POP. ROM. "to the genius of the Roman people." In this ſenſe, *genius* and *lar* were the ſame thing; as, in effect, Cenſorinus and Apulius affirm they were. See LARES and PENATES.

The Platoniſts and other eaſtern philoſophers ſuppoſed the *genii* to inhabit the vaſt region or extent of air between earth and heaven. They were a ſort of intermediate powers, who did the office of mediators between gods and men. They were the interpreters and agents of the gods, communicated the will of the deities to men, and the prayers and vows of men to the gods. As it was unbecoming the majeſty of the gods to enter into ſuch trifling concerns, this became the lot of the *genii*, whoſe nature was a mean between the two, who derived immortality from the one and paſſions from the other, and who had a body framed of an aërial matter. Moſt of the philoſophers, however, held that the genii of particular men were born with them, and died; and Plutarch attributes the ceaſing of oracles partly to the death of the genii. See ORACLE.

The heathens, who conſidered the genii as the guardians of particular perſons, believed that they rejoiced and were afflicted at all the good and ill fortune that befel their wards. They never, or very rarely, appeared to them, and then only in favour of ſome perſon of extraordinary virtue or dignity. They likewiſe held a great difference between the genii of different men, and that ſome were much more powerful than others: on which principle it was, that a wizard in *Appian* bids Anthony keep at a diſtance from Octavius, by reaſon Anthony's genius was inferior to and ſtood in awe of that of Octavius. There were alſo evil genii, who took a pleaſure in perſecuting men and bringing them evil tidings: ſuch was that in *Paterculus*, &c. which appeared to Brutus the night before the battle of Philippi. Theſe were alſo called *larvæ* and *lemures*. See LARVÆ and LEMURES.

GENIUS, in matters of literature, &c. a natural talent or diſpoſition to do one thing more than another, or the aptitude a man has received from nature to perform well and eaſily that which others can do but indifferently and with a great deal of pains. To know the bent of nature is of great importance. Men uſually come into the world with a genius determined not only to a certain art, but to certain parts of that art, in which alone they are capable of ſucceſs. If they quit their ſphere, they fall even below mediocrity in their profeſſion. Art and induſtry add much to natural endowments, but cannot ſupply them where they are wanting. Every thing depends on genius. A painter often pleaſes without obſerving rules, whilſt another diſpleaſes though he obſerves them, becauſe he has not the happineſs of being born with a genius for painting.

A man born with a genius for commanding an army, and capable of becoming a great general by the help of experience, is one whoſe organical conformation is ſuch, that his valour is no obſtruction to his preſence of mind, and his preſence of mind cauſes no abatement of his valour. Such a diſpoſition of mind cannot be acquired by art: it can be poſſeſſed only by a perſon who has brought it with him into the world. What has been ſaid of theſe two arts may be equally applied to all other profeſſions. The adminiſtration of great concerns, the art of putting people to thoſe employments for which they are naturally formed, the ſtudy of phyſic, and even gaming itſelf, all require a genius. Nature has thought fit to make a diſtribution of her talents among men, in order to render them neceſſary to one another, the wants of men being the very firſt link of ſociety: ſhe has therefore pitched upon particular perſons, to give them aptitude to perform rightly ſome things which ſhe has rendered impoſſible to others; and the latter have a greater facility granted them for other things, which facility has been refuſed to the former. Nature, indeed, has made an unequal diſtribution of her bleſſings among her children; yet ſhe has diſinherited none; and a man diveſted of all kinds of abilities is as great a phenomenon as an univerſal genius.

From the diverſity of genius, the difference of inclination ariſes in men, whom nature has had the precaution of leading to the employments for which ſhe deſigns them, with more or leſs impetuoſity in proportion to the greater or leſſer number of obſtacles they have to ſurmount in order to render themſelves capable of anſwering this vocation. Thus the inclinations of men are ſo very different, becauſe they follow the ſame mover, that is, the impulſe of their genius. This, as with the painter, is what renders one poet pleaſing even when he treſpaſſes againſt rules, while others are diſagreeable, notwithſtanding their ſtrict regularity.

The genius of theſe arts, according to the abbé du Bos, conſiſts in a happy arrangement of the organs of the brain; in a juſt conformation of each of theſe organs; as alſo in the quality of the blood, which diſpoſes it to ferment, during exerciſe, ſo as to furniſh plenty of ſpirits to the ſprings employed in the functions of the imagination. Here he ſuppoſes that the compoſer's blood is heated, for that painters and poets cannot invent in cool blood; nay, that it is evident they muſt be rapt into a kind of enthuſiaſm when they produce their ideas. Ariſtotle mentions a poet who never wrote ſo well as when his poetic fury hurried him into a kind of phrenſy. The admirable pictures we have in Taſſo of Armida and Clorinda were drawn at the expence of a diſpoſition he had to real madneſs, into which he fell before he died. "Do you imagine (ſays Cicero), that Pacuvius wrote in cold blood? No, it was impoſſible. He muſt have been inſpired with a kind of fury, to be able to write ſuch admirable verſes."

GENOA, a city of Italy, capital of a republic of the ſame name. It is very ancient and large, being about ſix miles in circumference, built like an amphitheatre, and full of magnificent churches and palaces; whence it has the name of Genoa the Proud. It is very populous, and one of the moſt trading places in Italy. They have great manufactures of velvet, ſilk, and cloth; and the banking buſineſs is a very profitable article of commerce. The nobility here do not ſcruple to engage in the manufactures or trade. Genoa is an archbiſhop's ſee, has an academy, a good

harbour, and lofty walls. There is a large aqueduct, which fupplies a great number of fountains with water in all parts of the city. The houfes are well-built, and are five or fix ftories high. The government is ariftocratic, none but the nobility having any fhare in it. Thefe are of two forts, the old and the new, whence there are 80 perfons chofen, who make the great council, in which their fovereignty refides. Befide thefe, there is a fenate, compofed of the doge and 12 fenators, who have the adminiftration of affairs. The doge continues in his office but two years. The harbour is very confiderable, and, to preferve it, they have built a mole 560 paces in length, 13 in breadth, and 15 feet above the level of the water. Genoa was bombarded by the French in 1684, and was taken by the Auftrians in 1746. The oppreffion of the inhabitants was fuch, that the latter fuddenly rofe and expelled their conquerors, who again befieged the city the next year, but without effect. The ordinary revenue of this republic is 200,000l. a year, and there is a bank which is fupported by public duties. They generally keep two or three years provifion of corn, wine, and oil in their magazines, which they fell to the people in fcarce times. Genoa is 62 miles S. E. of Turin, and 225 N. W. of Rome. E. lon. 8. 41. N. lat. 44. 25.

GENSING, or GINSENG. See PANAX.

GENTIANA, GENTIAN, in botany; a genus of the digynia order, belonging to the pentandria clafs of plants, and in the natural method ranking under the 20th order, *Rotaceæ*. The corolla is monopetalous, the capfule bivalved and unilocular; there are two longitudinal receptacles. The moft remarkable fpecies are the following:

1. The *lutea*, or common gentian of the fhops. This is a native of the mountainous parts of Germany; from whence the roots, the only part ufed in medicine, are brought to this country. They have a yellowifh-brown colour, and a very bitter tafte. The lower leaves are of an oblong oval fhape, a little pointed at the end, ftiff, of a yellowifh green, and have five large veins on the back of each. The ftalk rifes four or five feet high, garnifhed with leaves growing by pairs at each joint, almoft embracing the ftalk at their bafe. They are of the fame form with the lower, but diminifh gradually in their fize to the top. The flowers come out in whorls at the joints on the upper part of the ftalks, ftanding on fhort foot-ftalks, whofe origin is in the wings of the leaves. They are of a pale yellow colour. The roots of this plant are very frequently ufed in medicine as ftomachic bitters. In tafte they are lefs exceptionable than moft of the fubftances of this clafs. Infufions of gentian-root flavoured with orange-peel are fufficiently grateful. Some years ago a poifonous root was difcovered among the gentian brought to London, the ufe of which occafioned violent diforders, and in fome cafes death. This root is eafily diftinguifhed from the gentian, by its being internally of a white colour, and void of bitternefs.

2. The *centaureum*, or leffer centaury of the fhops, is a native of many parts of Britain. It grows on dry paftures; and its height is commonly proportioned to the goodnefs of the foil, as in rich foils it will grow to the height of a foot, but in poor ones not above three or four inches. It is an annual plant, with upright branching ftalks, garnifhed with fmall leaves, placed by pairs. The flowers grow in form of an umbel at the top of the ftalk, and are of a bright purple colour. They come out in July, and the feed ripens in autumn. The plant cannot be cultivated in gardens. The tops are an ufeful aperient bitter, in which view they have been often ufed in the practice of medicine.

GENTILE, in matters of religion, a Pagan, or worfhipper of falfe gods.

The origin of this word is deduced from the Jews, who called all thofe who were not of their name גוים *gojim*, i. e. *gentes*, which, in the Greek tranflations of the Old Teftament, is rendered τα εθνα; in which fenfe it frequently occurs in the New Teftament; as in Matth. vi. 32. "All thefe things the nations or Gentiles feek." Whence the Latin church alfo ufed *gentes* in the fame fenfe as our *Gentiles*, efpecially in the New Teftament. But the word *gentes* foon got another fignification, and no longer meant all fuch as were not Jews, but thofe only who were neither Jews nor Chriftians, but followed the fuperftitions of the Greeks and Romans, &c. In this fenfe it continued among the Chriftian writers, till their manner of fpeech, together with their religion, was publicly and by authority received in the empire; when *gentiles*, from *gentes*, came into ufe: and then both words had two fignifications, viz. in treatifes or laws concerning religion, they fignified Pagans, neither Jews nor Chriftians; and, in civil affairs, they were ufed for all fuch as were not Romans.

GENTILE, in the Roman law and hiftory, a name which fometimes expreffes what the Romans otherwife called *barbarians*, whether they were allies of Rome or not: but this word was ufed in a more particular fenfe for all ftrangers and foreigners not fubject to the Roman empire.

GENTILESCHI (Horatio), an Italian painter, was born at Pifa in 1563. After having made himfelf famous at Florence, Rome, Genoa, and other parts of Italy, he removed to Savoy; from whence he went to France, and at laft, upon the invitation of Charles I. came over to England. He was well received by that king, who appointed him lodgings in his court, together with a confiderable falary, and employed him in his palace at Greenwich, and other public places. The moft remarkable of his performances in England were the cielings of Greenwich and York-houfe. He did alfo a Madona, a Magdalen, and Lot with his two daughters, for king Charles; all which he performed admirably well. After the death of the king, when his collection was expofed to fale, nine pictures of Gentilefchi were fold for 600l. and are now faid to be the ornaments of the hall of Marlborough-houfe. His moft efteemed piece abroad was the portico of cardinal Bentivoglio's palace at Rome. He made feveral attempts in face-painting, but with little fuccefs; his talent lying altogether in hiftories, with figures as big as the life. He was much in favour with the duke of Buckingham, and many others of the nobility. After 12 years continuance in England, he died there at 84 years of age, and was buried in the Queen's chapel at Somerfet-houfe. His print is among the heads of Vandyke, he having been drawn by that great mafter. He left behind him a daughter, *Artemifia Gentilefchi*, who was but little inferior to her father in hiftory-painting, and excelled him in portraits.

GENTILIS (Albericus), profeffor of civil law at Oxford, an Italian by birth. He had quitted Italy with his father on account of religion. He wrote feveral works; three books, in particular, *De jure belli*, which have not been unferviceable to Grotius. He died at London in 1608.

GENTILIS (Scipio), brother to the former, and as celebrated a civilian as he; forfook his native country, that he might openly profefs the Proteftant religion. He was counfellor of the city of Nuremberg, and profeffor of law with uncommon reputation. He was a great humanift; and in his lectures, as well as books, mixed the flowers of polite learning with the thorns of the law. He died in 1616.

GENTLEMAN, a term applied in our days indifcriminately to every man of an appearance and behaviour above the lower orders of the people. Originally under this denomination were comprehended all above the rank of yeomen (fee COMMONALTY), whereby noblemen were truly called *gentlemen*. A gentleman, in an heraldic fenfe, is one who, without any title, bears a coat of arms, or whofe anceftors have been freemen: and by the coat that a gentleman giveth, he is known to be, or not to be, defcended from thofe of his name that lived many hundred

years before. The word is formed of the French *gentilhomme*, or rather of *gentil*, " fine, faſhionable, or becoming," and the Saxon *man*, q. d. *honeſtus*, or *honeſto loco natus*. The ſame ſignification has the Italian *gentilhuomo*, and the Spaniſh *hidalgo*, or *hijo dalgo*, that is, the ſon of ſomebody, or of a perſon of note. If we go farther back, we ſhall find *gentleman* originally derived from the Latin *gentilis homo*; which was uſed among the Romans for a race of noble perſons of the ſame name, born of free or ingenuous parents, and whoſe anceſtors had never been ſlaves or put to death by law. Thus Cicero in his *Topics*, " *Gentiles ſunt, qui inter ſe eodem ſunt nomine, ab ingenuis oriundi, quorum majorum nemo ſervitutem ſervivit, qui capite non ſunt diminuti*, &c. Some hold that it was formed from *gentile*, i. e. pagan; and that the ancient Franks, who conquered Gaul, which was then converted to Chriſtianity, were called *gentiles* by the natives, as being yet heathens. Others relate, that towards the declenſion of the Roman empire, as recorded by Ammianus Marcellinus, there were two companies of brave ſoldiers, the one called *gentilium*, and the other *ſcutariorum*; and that it was hence we derive the names *gentleman* and *eſquire*. See Esquire. This ſentiment is confirmed by Paſquire, who ſuppoſes the appellation *gentiles* and *ecuyers* to have been tranſmitted to us from the Roman ſoldiery; it being to the *gentiles* and *ſcutarii*, who were the braveſt of the ſoldiery, that the principal benefices and portions of lands were aſſigned. See Benefice. The Gauls obſerving, that, during the empire of the Romans, the *ſcutarii* and *gentiles* had the beſt tenements or appointments of all the ſoldiers on the frontiers of the provinces, became inſenſibly accuſtomed to apply the ſame names *gentilhommes* and *ecuyers* to ſuch as they found their kings gave the beſt proviſions or appointments to.

Gentleman *Uſher of the Black Rod*. See Rod.

Gentlemen *of the Chapel*, officers whoſe duty and attendance is in the royal chapel, being in number 32. Twelve of them are prieſts; the other 20, commonly called *clerks of the chapel*, aſſiſt in the performance of divine ſervice. One of the firſt 12 is choſen for chaplain of the houſehold, whoſe office is to read prayers every morning to the houſehold ſervants, to viſit the ſick, examine and prepare communicants, and adminiſter the ſacrament. One of the 20 clerks, well verſed in muſic, is choſen firſt organiſt, who is maſter of the children, to inſtruct them in muſic, and whatever elſe is neceſſary for the ſervice of the chapel; a ſecond is likewiſe an organiſt; a third a lutaniſt; and a fourth a violiſt. There are likewiſe three vergers, ſo called from the ſilver rods they carry in their hands; being a ſerjeant, a yeoman, and groom of the veſtry: the firſt attends the dean and ſub-dean, and finds ſurplices and other neceſſaries for the chapel; the ſecond has the whole care of the chapel, keeps the pews, and ſeats the nobility and gentry; the groom has his attendance within the chapel-door, and looks after it.

GENTOOS, in modern hiſtory, according to the common acceptation of the term, denote the profeſſors of the religion of the bramins or brachmans, who inhabit the country called *Hindoſtan*, in the Eaſt Indies, from the word *ſtan*, a " region," and *hind* or *hindoo*; which Feriſhteh, as we learn from colonel Dow's tranſlation of his hiſtory, ſuppoſes to have been a ſon of Ham the ſon of Noah. It is obſerved, however, that Hindoo is not the name by which the inhabitants originally ſtyled themſelves; but according to the idiom of the *ſchanſcrit* which they uſe, *jumbodeep*, from *jumboo*, a " jackall," an animal common in their country, and *deep*, a large portion of land ſurrounded by the ſea; or *bhertekhunt*, from *khunt*, i. e. " a continent," and *bherrhut*, the name of one of the firſt Indian rajahs. It is alſo to be obſerved, that they have aſſumed the name of *Hindoos* only ſince the æra of the Tartar government, to diſtinguiſh themſelves from their conquerors the Muſſulmen. The term *Gentoo* or *Gent*, in the Shanſcrit dialect, denotes *animal* in general and in its more confined ſenſe *mankind*, and is never appropriated particularly to ſuch as follow the doctrines of Brhima. Theſe are divided into four great tribes, each of which has its own ſeparate appellation; but they have no common or collective term that comprehends the whole nation under the idea affixed by the Europeans to the word *Gentoo*. Mr. Halhed, in the preface to his tranſlation of the Code of Gentoo Laws, conjectures, that the Portugueſe, on their firſt arrival in India, hearing the word frequently in the mouths of the natives as applied to mankind in general, might adopt it for the domeſtic appellation of the Indians themſelves, or perhaps their bigotry might force from the word *Gentoo* a fanciful alluſion to Gentile or Pagan. The Hindoos, or Gentoos, vie with the Chineſe as to the antiquity of their nation. They reckon the duration of the world by four jogues, or diſtinct ages: the firſt is the Suttee jogue, or age of purity, which is ſaid to have laſted about 3,200,000 years; during which the life of man was 100,000 years, and his ſtature 21 cubits: the ſecond, the Tirtah jogue, or the age in which one-third of mankind were reprobate; which conſiſted of 2,400,000 years, when men lived to the age of 10,000 years: the third, the Dwaper jogue, in which half of the human race became depraved; which endured to 600,000 years, when men's lives were reduced to 1000 years: and fourthly, the Collee jogue, in which all mankind were corrupted, or rather diminiſhed, which the word *collee* imports. This is the preſent era, which they ſuppoſe will ſubſiſt for 400,000 years, of which near 5000 are already paſt; and man's life in this period is limited to 100 years. It is ſuppoſed by many authors, that moſt of the Gentoo *ſhaſters*, or ſcriptures, were compoſed about the beginning of the Collee jogue: but an objection occurs againſt this ſuppoſition, viz. that the ſhaſters take no notice of the deluge; to which the bramins reply, that all their ſcriptures were written before the time of Noah, and the deluge never extended to Hindoſtan. Nevertheleſs, it appears from the ſhaſters themſelves, that they claim a much higher antiquity than this; inſtances of which are recited by Mr. Halhed.

The doctrine of tranſmigration is one of the diſtinguiſhing tenets of the Gentoos. With regard to this ſubject, it is their opinion, according to Mr. Holwell, that thoſe ſouls which have attained to a certain degree of purity, either by the innocence of their manners or the ſeverity of their mortifications, are removed to regions of happineſs proportioned to their reſpective merits; but that thoſe who cannot ſo far ſurmount the prevalence of bad example, and the powerful degeneracy of the times, as to deſerve ſuch a promotion, are condemned to undergo continual puniſhment in the animation of ſucceſſive animal forms, until, at the ſtated period, another renovation of the four jogues ſhall commence, upon the diſſolution of the preſent. They imagine ſix different ſpheres above this earth; the higheſt of which, called *ſuttee*, is the reſidence of Brhima and his particular favourites. This ſphere is alſo the habitation of thoſe men who never uttered a falſehood, and of thoſe women who have voluntarily burned themſelves with their huſbands; the propriety of which practice is expreſsly enjoined in the code of the Gentoo laws. This code, printed by the Eaſt India Company in 1776, is a very curious collection of Hindoo juriſprudence, which was ſelected by the moſt experienced pundits or lawyers from curious originals in the Shanſcrit language, who were employed for this purpoſe from May 1773 to February 1775; afterwards tranſlated into the Perſian idiom, and then into the Engliſh language by Mr. Halhed.

The ſeveral inſtitutes contained in this collection are interwoven with the religion of the Gentoos, and revered as of the higheſt authority. The curious reader will diſcover an aſtoniſhing ſimilarity between the inſtitutes of this code and many

of the ordinances of the Jewiſh law; between the character of the bramins or prieſts, and the Levites; and between the ceremony of the ſcape-goat under the Moſaic diſpenſation, and a Gentoo ceremony called the *aſhummed jug*, in which a horſe anſwers the purpoſe of the goat. Many obſolete cuſtoms and uſages alluded to in many parts of the Old Teſtament may alſo receive illuſtration from the inſtitutes of this code. It appears from the code, that the bramins, who are the prieſts and legiſlators of the country, have reſigned all the ſecular and executive power into the hands of another caſt or tribe; and no bramin has been properly capable of the magiſtracy ſince the time of the ſuttee jogue. The only privilege of importance which they have appropriated to themſelves is an exemption from all capital puniſhment: they may be degraded, branded, impriſoned for life, or ſent into perpetual exile; but it is every where expreſsly ordained, that a bramin ſhall not be put to death on any account whatſoever.

We have already obſerved, that the Hindoos are divided into four great and original tribes, which, according to the Gentoo theology, proceeded from the four different members of Brhima, the ſuppoſed immediate agent of the creation under the ſpirit of the Almighty. Theſe tribes are, the Bramins, which proceeded from his mouth, and whoſe office is to pray, read, and inſtruct; the Chehteree, which proceed from his arms, whoſe office is to draw the bow, to fight, and to govern; the Bice, proceeding from the belly or thighs, who are to provide the neceſſaries of life by agriculture and traffic; and the Sooder, from the feet, which are ordained to labour, ſerve, and travel.

Few Chriſtians, ſays the tranſlator of the Gentoo code, have expreſſed themſelves with a more becoming reverence of the grand and impartial deſigns of Providence in all its works, or with a more extenſive charity towards all their fellow-creatures of every profeſſion, than the Gentoos. It is indeed an article of faith among the bramins, that God's all merciful power would not have permitted ſuch a number of different religions, if he had not found a pleaſure in beholding their varieties.

GENUFLEXION (of *genu*, "knee," and *flecto* "I bend,"), the act of bowing or bending the knee, or rather of kneeling down. The Jeſuit Roſweyd, in his Onomaſticon, ſhows that genuflexion or kneeling has been a very ancient cuſtom in the church, and even under the Old Teſtament diſpenſation; and that this practice was obſerved throughout all the year, excepting on Sundays, and during the time from Eaſter to Whitſuntide, when kneeling was forbid by the council of Nice. Others have ſhown, that the cuſtom of not kneeling on Sundays had obtained from the time of the apoſtles, as appears from St. Irenæus and Tertullian; and the Ethiopic church, ſcrupulouſly attached to the ancient ceremonies, ſtill retains that of not kneeling at divine ſervice. The Ruſſians eſteem it an indecent poſture to worſhip God on the knees. The Jews likewiſe uſually prayed ſtanding. Roſweyd gives the reaſons of the prohibition of genuflexion on Sundays, &c. from St. Baſil, Anaſtaſius, St. Juſtin, &c. Baronius is of opinion, that genuflexion was not eſtabliſhed in the year of Chriſt 58, from that paſſage in Acts xx. 36. where St. Paul is expreſsly mentioned to kneel down at prayer; but Saurin ſhows that nothing can be thence concluded. The ſame author remarks alſo, that the primitive Chriſtians carried the practice of genuflexion ſo far, that ſome of them had worn cavities in the floor where they prayed: and St. Jerome relates of St. James, that he had contracted a hardneſs on his knees equal to that on the knee of a camel.

GENUS, among metaphyſicians and logicians, denotes a number of beings which agree in certain general properties common to them all: ſo that a genus is nothing elſe but an abſtract idea, expreſſed by ſome general name or term. See Logic and Metaphysics.

Genus, is alſo uſed for a character or manner applicable to every thing of a certain nature or condition: in which ſenſe it ſerves to make capital diviſions in various ſciences, as medicine, natural hiſtory, &c.

Genus, in rhetoric. Authors diſtinguiſh the art of rhetoric, as alſo orations or diſcourſes produced thereby, into three genera or kinds, demonſtrative, deliberative, and judiciary. To the demonſtrative kind belong panegyrics, genethliacons, epithalamiums, funeral harangues, &c. To the deliberative kind belong perſuaſions, diſſuaſions, commendations, &c. To the judiciary kind belong defences and accuſations.

Genus, in natural hiſtory, a ſubdiviſion of any claſs or order of natural beings, whether of the animal, vegetable, or mineral kingdoms, all agreeing in certain common characters. See Botany and Zoology.

Genus, in muſic, by the ancients called *genus melodiæ*, is a certain manner of dividing and ſubdividing the principles of melody; that is, the conſonant and diſſonant intervals into their concinnous parts. The moderns conſidering the octave as the moſt perfect of intervals, and that whereon all the concords depend in the preſent theory of muſic, the diviſion of that interval is conſidered as containing the true diviſion of the whole ſcale. But the ancients went to work ſomewhat differently: the diateſſaron, or fourth, was the leaſt interval which they admitted as concord; and therefore they ſought firſt how that might be moſt conveniently divided; from whence they conſtituted the diapente and diapaſon. The diateſſaron being thus, as it were, the root and foundation of the ſcale, what they called the *genera* or kinds, aroſe from its various diviſions; and hence they defined the *genus modulandi* to be the manner of dividing the tetrachord and diſpoſing its four ſounds as to ſucceſſion. The genera of muſic were three, the enharmonic, chromatic, and diatonic. The two firſt were variouſly ſubdivided: and even the laſt, though that is commonly reckoned to be without any ſpecies, yet different authors have propoſed different diviſions under that name, without giving any particular names to the ſpecies as was done to the other two. For the characters, &c. of theſe ſeveral genera, ſee Enharmonic, Chromatic, and Diatonic.

GEOCENTRIC, in aſtronomy, is applied to a planet or its orbit, to denote it concentric with the earth, or as having the earth for its centre, or the ſame centre with the earth.

GEOFFRÆA, in botany; a genus of the decandria order, belonging to the diadelphia claſs of plants, and in the natural method ranking under the 32d order, *Papilionaceæ*. See plate 36. The calyx is quinquefid, the fruit an oval plum, the kernel compreſſed. There is only one ſpecies, viz. the inermis, or cabbage-bark tree, which is a native of Braſil and Jamaica. The wood of this tree is uſed in building; but it is chiefly valued for its bark, which is adminiſtered as an anthelmintic medicine. From this medical property it is alſo called the *worm-bark tree*. This bark is of a grey colour externally, but black and furrowed on the inſide. It has a mucilaginous and ſweetiſh taſte, and a diſagreeable ſmell. It is given in caſe of worms, in form of powder, decoction, ſyrup, and extract. The decoction is preferred, and is made by ſlowly boiling an ounce of the freſh dried bark in a quart of water, till it aſſume the colour of Madeira wine. This, ſweetened, is the ſyrup; evaporated, it forms an extract. It commonly produces ſome ſickneſs and purging; ſometimes violent effects, as vomiting, delirium, and fever. Theſe laſt are ſaid to be owing to an over-doſe, or to drinking cold water, and are relieved by the uſe of warm water, caſtor oil, or a vegetable acid. It ſhould always be begun in ſmall doſes. But when properly and cautiouſly adminiſtered, it is ſaid to operate as a very powerful anthelmintic, particularly for the expulſion of the lumbrici, which are a very common

caufe of difeafe in the Weft India iflands; and there it is very frequently employed: but it has, we believe, been but little ufed in Britain.

GEOFFREY of MONMOUTH, bifhop of St. Afaph, called by our ancient biographers *Gallofridus Monumetenfis*. Leland conjectures that he was educated in a Benedictine convent at Monmouth, where he was born, and that he became a monk of that order. Bale, and after him Pits, call him archdeacon of Monmouth; and it is generally afferted that he was made bifhop of St. Afaph in the year 1151 or 1152, in the reign of king Stephen. His hiftory was probably finifhed after the year 1138. It contains a fabulous account of Britifh kings, from the Trojan Brutus to the reign of Cadwallader in the year 690. But Geoffrey, whatever cenfure he may deferve for his credulity, was not the inventor of the ftories he relates. It is a tranflation from a manufcript written in the Britifh language, and brought to England from Armorica by his friend Gualter, archdeacon of Oxford. But the achievements of king Arthur, Merlin's prophecies, many fpeeches and letters, were chiefly his own addition. In excufe for this hiftorian, Mr. Wharton judicioufly obferves, that fabulous hiftories were then the fafhion, and popular traditions a recommendation to his book.

GEOFFROY (Stephen Francis), a celebrated phyfician, botanift, and chemift, born at Paris in 1672. After having finifhed his ftudies, he travelled into England, Holland, and Italy. In 1704 he received the degree of doctor of phyfic at Paris, and at length became profeffor of chemiftry, and phyfician of the Royal College. He was a member of the Royal Society of London, and of the Academy of Sciences. He wrote, 1. Several very curious Thefes in Latin, which were afterwards tranflated into French. 2. An excellent treatife, intitled *Tractatus de Materia Medica, five de Medicamentorum fimplicium hiftoria, virtute, delectu, et ufu.* He died at Paris in 1731.

GEOGRAPHICAL MILE, the fame with the fea-mile; being one minute, or the 60th part of a degree of a great circle on the earth's furface.

GEOGRAPHY,

THE fcience that teaches and explains the nature and properties of the earth, as to its figure, place, magnitude, motions, celeftial appearances, &c. with the various lines, real or imaginary, on its furface. Geography is diftinguifhed from cofmography, as a part from the whole; this latter confidering the whole vifible world, both heaven and earth. And from topography and chorography it is diftinguifhed, as the whole from a part.

Golnitz confiders geography as either exterior or interior: but Varenius more juftly divides it into general and fpecial, or univerfal and particular. *General* or *Univerfal* GEOGRAPHY, is that which confiders the earth in general, without any regard to particular countries, or the affections common to the whole globe: as its figure, magnitude, motion, land, fea, &c. *Special* or *Particular* GEOGRAPHY, is that which contemplates the conftitution of the feveral particular regions, or countries, their bounds, figure, climate, feafons, weather, inhabitants, arts, cuftoms, language, &c.

SECT. I. *Hiftory of Geography.*

The ftudy and practice of geography muft have commenced at very early ages of the world. By the accounts we have remaining, it feems this fcience was in ufe among the Babylonians and Egyptians, from whom it paffed to the Greeks firft of any Europeans, and from thefe fucceffively to the Romans, the Arabians, and the weftern nations of Europe. Herodotus fays the Greeks firft learned the pole, the gnomon, and the 12 divifions of the day, from the Babylonians. But Pliny and Diogenes Laertius affert, that Thales of Miletus, in the 6th century before Chrift, firft found out the paffage of the fun from tropic to tropic, and, it is faid, was the author of two books, the one on the tropic, and the other on the equinox; both probably determined by means of the gnomon; whence he was led to the difcovery of the four feafons of the year, which are determined by the equinoxes and folftices; all which, however, it is likely he learned of the Egyptians, as well as his divifion of the year into 365 days. This it is faid was invented by the fecond Mercury, furnamed Trifmegiftus, who, according to Eufebius, lived about 50 years after the Exodus. Pliny exprefsly fays, that this difcovery was made by obferving when the fhadow returned to its marks; a clear proof that it was done by the gnomon. It is farther faid, that Thales conftructed a globe, and reprefented the land and fea upon a table of brafs. Farther, that Anaximander, a difciple of Thales, firft drew the figure of the earth upon a globe; and that Hecate, Democritus, Eudoxus, and others, formed geographical maps, and brought them into common ufe in Greece.

Meton and Euctemon obferved the fummer folftice at Athens, on the 27th of June, 432 years before Chrift, by watching narrowly the fhadow of the gnomon, with the defign of fixing the beginning of their cycle of 19 years.

Timocharis and Ariftillus, who began their obfervations about 295 B. C., it feems firft attempted to fix the latitudes and longitudes of the fixed ftars, by confidering their diftances from the equator, &c. One of their obfervations gave rife to the difcovery of the preceffion of the equinoxes, which was firft remarked by Hipparchus about 150 years after; who alfo made ufe of their method, for delineating the parallels of latitude and the meridians on the furface of the earth; thus laying the foundation of this fcience as it now appears.

The latitudes and longitudes, thus introduced by Hipparchus, were not, however, much attended to till Ptolemy's time. Strabo, Vitruvius, and Pliny, have all of them entered into a minute geographical defcription of the fituation of places, according to the length of the fhadows of the gnomon, without noticing the longitudes and latitudes.

Maps at firft were little more than rude outlines, and topographical fketches of different countries. The earlieft on record were thofe of Sefoftris, mentioned by Euftathius, who fays that "this Egyptian king, having traverfed great part of the earth, recorded his march in maps, and gave copies of them not only to the Egyptians but to the Scythians, to their great aftonifhment." Some have imagined, with much probability, that the Jews made a map of the Holy Land, when they gave the different portions to the nine tribes at Shiloh: for Jofhua tells us that they were fent to walk through the land, and that they *defcribed it in feven parts in a book*; and Jofephus relates that, when Jofhua fent out people from the different tribes to meafure the land, he gave them, as companions, perfons well fkilled in geometry, who could not be miftaken in the truth.

The firft Grecian map on record was that of Anaximander, mentioned by Strabo, lib. 1, p. 7, fuppofed to be the one referred to by Hipparchus under the defignation of the *ancient map*. Herodotus minutely defcribes a map made by Ariftagoras, tyrant of Miletus, which will ferve to give fome idea of the maps of thofe times. He relates, that Ariftagoras fhowed it to Cleomenes, king of Sparta, to induce him to attack the king of Perfia at Sufa, in order to reftore the Ionians to their ancient liberty. It was traced upon brafs or copper, and feems to have been a mere itinerary, containing the route through the inter-

mediate countries which were to be traverfed in that march, with the rivers Halys, the Euphrates, and Tigris, which Herodotus mentions as neceffary to be croffed in that expedition. It contained one ftraight line called the *Royal Road* or *Highway*, which took in all the ftations or places of encampment from Sardis to Sufa, being 111 in the whole journey, and containing 13,500 ftadia, or 1687½ Roman miles of 5000 feet each.

Thefe itinerary maps of the places of encampment were indifpenfably neceffary in all armies and marches; and indeed war and navigation feem to be the two grand caufes of the improvements both in geography and aftronomy. Athenæus quotes Bæton as author of a work intitled *The encampment of Alexander's march*, and likewife Amyntas to the fame purpofe. Pliny obferves that Diognetus and Bæton were the furveyors of Alexander's marches, and then quotes the exact number of miles according to their menfuration; which he afterwards confirms by the letters of Alexander himfelf. The fame author alfo remarks, that a copy of this great monarch's furveys was given by Xenocles, his treafurer, to Patrocles the geographer, who was admiral of the fleets of Seleucus and Antiochus. His book on geography is often quoted both by Strabo and Pliny; and it feems that this author furnifhed Eratofthenes with the principal materials for conftructing his map of the oriental part of the world.

Eratofthenes firft attempted to reduce geography to a regular fyftem, and introduced a regular parallel of latitude, which began at the ftraits of Gibraltar, paffed eaftwards through the ifle of Rhodes, and fo on to the mountains of India, noting all the intermediate places through which it paffed. In drawing this line, he was not regulated by the fame latitude, but by obferving where the longeft day was 14 hours and a half, which Hipparchus afterwards determined was the latitude of 36 degrees.

This firft parallel through Rhodes was ever after confidered with a degree of preference, in conftructing all the ancient maps; and the longitude of the then known world was often attempted to be meafured in ftadia and miles, according to the extent of that line, by many fucceeding geographers.

Eratofthenes foon after attempted not only to draw other parallels of latitude, but alfo to trace a meridian at right angles to thefe, paffing through Rhodes and Alexandria down to Syene and Meroe; and at length he undertook the arduous tafk of determining the circumference of the globe, by an actual meafurement of a fegment of one of its great circles. To find the magnitude of the earth is indeed a problem which has engaged the attention of aftronomers and geographers ever fince the fpherical figure of it was known. It feems Anaximander was the firft among the Greeks who wrote upon this fubject. Archytas of Tarentum, a Pythagorean, famous for his fkill in mathematics and mechanics, alfo made fome attempts in this way; and Dr. Long conjectures that thefe are the authors of the moft ancient opinion that the circumference of the earth is 400,000 ftadia: and Archimedes makes mention of the ancients who eftimated the circumference of the earth at only 30,000 ftadia.

As to the methods of meafuring the circumference of the earth, it would feem, from what Ariftotle fays in his treatife De Cœlo, that they were much the fame as thofe ufed by the moderns, deficient only in the accuracy of the inftruments. That philofopher there fays, that different ftars pafs through our zenith, according as our fituation is more or lefs northerly; and that in the fouthern parts of the earth ftars come above our horizon, which are no longer vifible if we go northward. Hence it appears that there are two ways of meafuring the circumference of the earth; one by obferving ftars which pafs through the zenith of one place, and do not pafs through that of another; the other, by obferving fome ftars which come above the horizon of one place, and are obferved at the fame time to be in the horizon of another. The former of thefe methods, which is the beft, was followed by Eratofthenes at Alexandria in Egypt 250 years before Chrift. He knew that, at the fummer folftice, the fun was vertical to the inhabitants of Syene, a town on the confines of Ethiopia, under the tropic of cancer, where they had a well made to obferve it, at the bottom of which the rays of the fun fell perpendicularly the day of the fummer folftice: he obferved, by the fhadow of a wire fet perpendicularly in an hemifpherical bafon, how far the fun was on that day at noon diftant from the zenith of Alexandria; when he found that diftance was equal to the 50th part of a great circle in the heavens. Then, fuppofing Syene and Alexandria under the fame meridian, he inferred that the diftance between them was the 50th part of a great circle upon the earth; and this diftance being by meafure 5000 ftadia, he concluded that the whole circumference of the earth was 250,000 ftadia. But as this number divided by 360 would give 694⁴⁄₉ ftadia to a degree, either Eratofthenes himfelf or fome of his followers affigned the round number 700 ftadia to a degree; which, multiplied by 360, makes the circumference of the earth 252,000 ftadia: whence both thefe meafures are given by different authors as that of Eratofthenes.

In the time of Pompey the Great, Pofidonius determined the meafure of the circumference of the earth by the fecond method above hinted by Ariftotle, viz. the horizontal obfervations. Knowing that the ftar called Canopus was but juft vifible in the horizon of Rhodes, and at Alexandria finding its meridian height was the 48th part of a great circle in the heavens, or 7½ degrees, anfwering to the like quantity of a circle on the earth: then, fuppofing thefe two places under the fame meridian, and the diftance between them 5000 ftadia, the circumference of the earth will be 240,000 ftadia, which is the firft meafure of Pofidonius. But, according to Strabo, Pofidonius made the meafure of the earth to be 180,000 ftadia, at the rate of 500 ftadia to a degree. The reafon of this difference is thought to be, that Eratofthenes meafured the diftance between Rhodes and Alexandria, and found it only 3750 ftadia: taking this for a 48th part of the earth's circumference, which is the meafure of Pofidonius, the whole circumference will be 180,000 ftadia. This meafure was received by Marinus of Tyre, and is ufually afcribed to Ptolomy. But this meafurement is fubject to great uncertainty, both on account of the great refraction of the ftars near the horizon, the difficulty of meafuring the diftance at fea between Rhodes and Alexandria, and by fuppofing thofe places under the fame meridian, when they are really very different.

Several geographers afterwards made ufe of the different heights of the pole in diftant places under the fame meridian, to find the dimenfions of the earth. About the year 800, the khalif Almamun had the diftance meafured between two places that were 2 degrees afunder, and under the fame meridian in the plains of Sinjar near the Red Sea: and the refult was, that the degree at one time was found equal to 56 miles, and at another 56¼ or 56⅔ miles.

The next attempt to find out the circumference of the earth was in 1525 by Fernelius, a learned philofopher of France. For this purpofe, he took the height of the pole at Paris, going from thence directly northwards, till he came to the place where the height of the pole was one degree more than at that city. The length of the way was meafured by the number of revolutions made by one of the wheels of his carriage; and, after proper allowances for the declivities and turnings of the road, he concluded that 68 Italian miles were equal to a degree on the earth.

According to thefe methods, many other meafurements of the earth's circumference have fince that time been made, with much

greater accuracy; a particular account of which is given under the articles Latitude and Longitude.

Though the maps of Eratoſthenes were the beſt of his time, they were yet very imperfect and inaccurate. They contained little more than the ſtates of Greece, and the dominions of the ſucceſſors of Alexander, digeſted according to the ſurveys above mentioned. He had indeed ſeen, and has quoted, the voyages of Pythias into the great Atlantic ocean, which gave him ſome faint idea of the weſtern parts of Europe; but ſo imperfect, that they could not be realized into the outlines of a chart. Strabo ſays he was very ignorant of Gaul, Spain, Germany, and Britain; and he was equally ignorant of Italy, the coaſts of the Adriatic, Pontus, and all the countries towards the north.

Such was the ſtate of geography, and the nature of the maps, before the time of Hipparchus. He made a cloſer connection between geography and aſtronomy, by determining the latitudes and longitudes from celeſtial obſervations.

War has uſually been the occaſion of making or improving the maps of countries; and accordingly geography made great advances from the progreſs of the Roman arms. In all the provinces occupied by that people, camps were every where conſtructed at proper intervals, and good roads made for communication between them; and thus civilization and ſurveying were carried on according to ſyſtem, through the whole extent of that large empire. Every new war produced a new ſurvey and itinerary of the countries where the ſcenes of action paſſed; ſo that the materials of geography were accumulated by every additional conqueſt. Polybius ſays, that at the beginning of the ſecond Punic war, when Hannibal was preparing his expedition againſt Rome, the countries through which he was to paſs were carefully meaſured by the Romans. And Julius Cæſar cauſed a general ſurvey of the Roman empire to be made, by a decree of the ſenate. Three ſurveyors had this taſk aſſigned them, which they completed in 25 years. The Roman itineraries that are ſtill extant alſo ſhow what care and pains they had been at in making ſurveys in all the different provinces of their empire; and Pliny has filled the 3d, 4th, and 5th books of his Natural Hiſtory with the geographical diſtances that were thus meaſured. Other maps are alſo ſtill preſerved, known by the name of the Pentingerian Tables, publiſhed by Welſer and Bertius, which gave a good ſpecimen of what Vegetius calls the *Itinera Picta*, for the better direction of their armies in their march.

The Roman empire had been enlarged to its greateſt extent, and all its provinces well known and ſurveyed, when Ptolomy, about 150 years after Chriſt, compoſed his ſyſtem of geography. The chief materials he employed in compoſing this work were, the proportions of the gnomon to its ſhadow, taken by different aſtronomers at the times of the equinoxes and ſolſtices; calculations founded on the length of the longeſt days; the meaſured or computed diſtances of the principal roads contained in their ſurveys and itineraries; and the various reports of travellers and navigators. All theſe were compared together, and digeſted into one uniform body or ſyſtem; and afterwards were tranſlated by him into a new mathematical language, expreſſing the different degrees of latitude and longitude, after the invention of Hipparchus, which had been neglected for 250 years.

Ptolomy's ſyſtem of geography, notwithſtanding it was ſtill very imperfect, continued in vogue till the laſt three or four centuries, within which time the great improvements in aſtronomy, the many diſcoveries of new countries by voyagers, and the progreſs of war and arms, have contributed to bring it to a very conſiderable degree of perfection; the particulars of which will be found treated under their reſpective articles in this work.

Among the moderns, the chief authors on the ſubject of geography are Johannes de Sacroboſco, or John Hallifax, who wrote a treatiſe on the ſphere; Sebaſtian Munſter, in his Coſmographia Univerſalis, in 1559; Clavius, on the ſphere of Sacroboſco; Piccioli's Geographia et Hydrographia Reformata; Weigelius's Speculum Terræ; De Chales's Geography, in his Mundus Mathematicus; Cellarius's Geography; Cluverius's Introductio in Univerſam Geographiam; Leibnecht's Elementa Geographiæ Generalis; Stevenius's Compendium Geographicum; Wolfius's Geographia, in his Elementa Matheſeos; Buſching's New Syſtem of Geography; Gordon's, Salmon's, and Guthrie's Grammars; and, above all, Varenius's Geographia Generalis, with Jurin's additions, the moſt ſcientific and ſyſtematical of any geographical work.

Sect. II. *Principles and Practice of Geography.*

The fundamental principles of geography are, the ſpherical figure of the earth, its rotation on its axis, its revolution round the ſun, and the poſition of the axis or line round which it revolves with regard to the celeſtial luminaries. That the earth and ſea taken together conſtitute one vaſt ſphere is demonſtrable by the following arguments. 1. To people at ſea the land diſappears, though near enough to be viſible were it not for the intervening convexity of the water. 2. The higher the eye is placed, the more extenſive is the proſpect; whence it is common for ſailors to climb up to the tops of the maſts to diſcover land or ſhips at a diſtance. But this would give them no advantage, were it not for the convexity of the earth; for upon an infinitely extended plane objects would be viſible at the ſame diſtance whether the eye were high or low, nor would any of them vaniſh till the angle under which they appeared became too ſmall to be perceived. 3. To people on ſhore, the maſt of a ſhip at ſea appears before the hull: but were the earth an infinite plane, not the higheſt objects, but the biggeſt, would be longeſt viſible; and the maſt of a ſhip would diſappear, by reaſon of the ſmallneſs of its angle, long before the hull did ſo. 4. The convexity of any piece of ſtill water of a mile or two extent may be perceived by the eye. A little boat, for inſtance, may be perceived by a man who is any height above the water; but, if he ſtoop down and lay his eye near the ſurface, he will find that the fluid appears to riſe and intercept the view of the boat entirely. 5. The earth has been often ſailed round, as by Magellan, Drake, Dampier, Anſon, Cook, and many other navigators; which demonſtrates that the ſurface of the ocean is ſpherical; and that the land is very little different may eaſily be proved from the ſmall elevation of any part of it above the ſurface of the water. The mouths of rivers which run 1000 miles are not more than one mile below their ſources, and the higheſt mountains are not quite four miles of perpendicular height: ſo that, though ſome parts of the land are elevated into hills, and others depreſſed into valleys, the whole may ſtill be accounted ſpherical. 6. An undeniable and indeed ocular demonſtration of the ſpherical figure of the earth is taken from the round figure of its ſhadow which falls upon the moon in time of eclipſes. As various ſides of the earth are turned towards the ſun during the time of different phenomena of this kind, and the ſhadow in all caſes appears circular, it is impoſſible to ſuppoſe the figure of the earth to be any other than ſpherical. The inequalities of its ſurface have no effect upon the earth's ſhadow on the moon; for as the diameter of the terraqueous globe is very little leſs than 8000 miles, and the height of the higheſt mountains on earth not quite four, we cannot account the latter any more than the 2000th part of the former; ſo that the mountains bear no more proportion to the bulk of the earth, than grains of duſt bear to that of a common globe.

A great many of the terreſtrial phenomena depend upon the globular figure of the earth, and the poſition of its axis with regard to the ſun; particularly the riſing and ſetting of the ce-

leſtial luminaries, the length of the days and nights, &c. A general explanation of theſe is given under the article Astronomy; but ſtill it belongs to geography to take notice of the difference betwixt the ſame phenomena in different parts of the earth. Thus, though the ſun riſes and ſets all over the world, the circumſtances of his doing ſo are very different in different countries. The moſt remarkable of theſe circumſtances is the duration of the light, not only of the ſun himſelf, but of the twilight before he riſes and after he ſets. In the equatorial regions, for inſtance, darkneſs comes on very ſoon after ſunſet; becauſe the convexity of the earth comes quickly in between the eye of the obſerver and the luminary, the motion of the earth being much more rapid there than any where elſe. In our climate the twilight always continues two hours or thereabouts, and during the ſummer ſeaſon it continues in a conſiderable degree during the whole night. In countries farther to the northward or ſouthward, the twilight becomes brighter and brighter as we approach the poles, until at laſt the ſun does not appear to touch the horizon, but goes in a circle at ſome diſtance above it for many days ſucceſſively. In like manner, during the winter, the ſame luminary ſinks lower and lower, until at laſt he does not appear at all; and there is only a dim twinkling of twilight for an hour or two in the middle of the day. By reaſon of the refraction of the atmoſphere, however, the time of darkneſs, even in the moſt inhoſpitable climates, is always leſs than that of light; and ſo remarkable is the effect of this property, that in the year 1682, when ſome Dutch navigators wintered in Nova Zembla, the ſun was viſible to them 16 days before he could have been ſeen above the horizon had there been no atmoſphere, or had it not been endowed with any ſuch power. The reaſon of all this is, that in the northern and ſouthern regions only a ſmall part of the convexity of the globe is interpoſed betwixt us and the ſun for many days, and in the high latitudes none at all. In the warmer climates the ſun has often a beautiful appearance at riſing and ſetting, by reaſon of the refraction of his light through the vapours which are copiouſly raiſed in thoſe parts. In the colder regions, halos, parhelia, aurora borealis, and other meteors, are frequent; the two former owing to the great quantity of vapour continually flying from the warm regions of the equator to the colder ones of the poles. The aurora borealis is owing to the electrical matter imbibed by the earth from the ſun in the warm climates, and going off through the upper regions of the atmoſphere to the place from whence it came. In the high northern latitudes, thunder and lightning are unknown, or but ſeldom heard of; but the more terrible phenomena of earthquakes, volcanoes, &c. are by no means unfrequent. Theſe, however, ſeem only to affect iſlands and the maritime parts of the continent.

Notwithſtanding the ſeeming inequality in the diſtribution of light and darkneſs, however, it is certain, that throughout the whole world there is nearly an equal proportion of light diffuſed on every part, abſtracting from what is abſorbed by clouds, vapours, and the atmoſphere itſelf. The equatorial regions have indeed the moſt intenſe light during the day, but the nights are long and dark; while, on the other hand, in the northerly and ſoutherly parts, though the ſun ſhines leſs powerfully, yet the length of time that he appears above the horizon, with the greater duration of the twilight, makes up for the ſeeming deficiency.

Were the earth a perfect plane, the ſun would appear to be vertical in every part of it: for, in compariſon with the immenſe magnitude of that luminary, the diameter of this globe itſelf is but very ſmall: and as the ſun, were he near to us, would do much more than cover the whole earth, ſo, though he were removed to any diſtance, the whole diameter of the latter would make no difference in the apparent angle of his altitude. By means of the globular figure of the earth alſo, along with the great diſparity between the diameters of the two bodies, ſome advantage is given to the day over the night: for thus the ſun, being immenſely the larger of the two, ſhines upon more than one half of the earth; whence the unenlightened part has a ſhorter way to go before it again receives the benefit of his rays. This difference is greater in the inferior planets Venus and Mercury than the earth.

To the globular figure of the earth likewiſe is owing the long moon-light which the inhabitants of the polar regions enjoy, the general reaſon of which is given under the article Astronomy, ſect. vi. The ſame thing likewiſe occaſions the appearance and diſappearance of certain ſtars at ſome ſeaſons of the year in ſome countries; for, were the earth flat, they would all be viſible in every part of the world at the ſame time. Hence moſt probably has ariſen the opinion of the influence of certain ſtars upon the weather and other ſublunary matters. In ſhort, on the globular figure of the earth depends the whole preſent appearance of nature around us; and were the ſhape of the planet we inhabit to be altered to any other, beſides the *real* differences which would of conſequence take place, the *apparent* ones would be ſo great that we cannot form any idea of the face which nature would then preſent to us.

In geography the circles which the ſun apparently deſcribes in the heavens are ſuppoſed to be extended as far as the earth, and marked on its ſurface; and in like manner we may imagine as many circles as we pleaſe to be deſcribed on the earth, and their planes to be extended to the celeſtial ſphere, till they mark concentric ones on the heavens. The moſt remarkable of thoſe ſuppoſed by geographers to be deſcribed in this manner are the following:

1. *The Horizon.* This is properly a double circle, one of the horizons being called the *ſenſible*, and the other the *rational*. The former comprehends only that ſpace which we can ſee around us upon any part of the earth, and which is very different according to the difference of our ſituation. The other, called the *rational*, is a circle parallel to the former, and, paſſing through the centre of the earth, ſuppoſed to be continued as far as the celeſtial ſphere itſelf. To the eyes of ſpectators, there is always a vaſt difference between the ſenſible and rational horizons; but, by reaſon of the immenſe diſparity betwixt the ſize of the earth and celeſtial ſphere, planes of both circles may be conſidered as coincident. Hence in geography, when the horizon or plane of the horizon is ſpoken of, the rational is always underſtood, when nothing is ſaid to the contrary. In conſequence of the round figure of the earth, every part has a different horizon. The poles of the horizon, that is, the points directly above the head, and oppoſite to the feet of the obſerver, are called the *zenith* and *nadir*.

2. A great circle deſcribed upon the ſphere of the heaven, and paſſing through the two vertical points, is called a *vertical circle*, or an azimuth; and of theſe we may ſuppoſe as many as we pleaſe all round the horizon. Sometimes they are alſo called *ſecondaries* of the horizon; and in general any great circle drawn through the poles of another is called its *ſecondary*. In geography every circle obtains the epithet of *great* whoſe plane paſſes through the centre of the earth; in other caſes they are called *leſſer circles*. The altitudes of the heavenly bodies are meaſured by an arch of the azimuth or vertical circle intercepted between the horizon and the body itſelf. The moſt accurate method of taking them, with regard to the ſun and moon, is for two perſons to make their obſervations at the ſame time; one of them to obſerve the altitude of the upper limb, the other of the lower limb of the luminary; the mean betwixt theſe two giving the true height of the centre. The ſame thing may alſo be done accurately by one obſerver, having the apparent diameter of the luminary given. For, having found the height of the upper edge of the limb by the quadrant, take from it half

his diameter, the remainder is the height of his centre; or having found the altitude of his lower edge, add to it half the diameter, and the sum is the height of the centre as before. When the observations are made with a large instrument, it will be convenient to use a sextant, or sixth part of a circle, rather than a quadrant, as being less unwieldy.

3. *Almucantars* are circles supposed to be drawn upon the sphere parallel to the horizon, and grow less and less as they approach the vertical points, where they entirely vanish. The apparent distances betwixt any two celestial bodies are measured by supposing arches of great circles drawn through them, and then finding how many degrees, minutes, &c. of these circles are intercepted between them. The apparent diameter of the sun's disk is found by a circle of distance drawn through the centre of it; and the number of minutes continued between the two opposite points of that part of the circle which passes through the centre is the measure of the apparent diameter. The apparent diameter of the sun may be found by two observers, one taking the altitude of the upper, and the other of the lower edge of the limb; the difference betwixt the two being the diameter required; or,

4. Sometimes the visible horizon is considered only with regard to the objects which are upon the earth itself; in which case we may define it to be a lesser circle on the surface of the earth, comprehending all such objects as are at once visible to us; and the higher the eye, the more is the *visible horizon* extended. It is most accurately observed, however, on the sea, on account of the absence of those inequalities which at land render the circle irregular; and for this reason it is called sometimes the horizon of the sea; and may be observed by looking through the sights of a quadrant at the most distant part of the sea then visible. In making this observation, the visual rays AD and AE, plate 38. fig. 1. will, by reason of the spherical surface of the sea, always point a little below the true sensible horizon SS, and consequently below the rational horizon which is parallel to it, and supposed to be coincident with it. The quadrant shows the depression of the horizon of the sea below the true horizon; and it is obvious from the figure, that the higher the eye is, the greater must this depression be. The depression of the horizon of the sea, however, is not always the same, even though there be no variation in the height of the eye. The difference indeed is but small, amounting only to a few seconds, and is owing to a difference in the atmosphere, which sometimes refracts more than at others. Without refraction, the visual ray would be AE, and in that case E is the most distant point which could be seen; but by refraction, the ray FG, coming from the point G, may be seen at F, so as to go on from thence in the line FA; and then the view is extended as far as G, and the depression of the horizon of the sea is in the line AF, which points higher than AE, but extends the view farther. From an inspection of the figure it is evident, that, if the refraction were greater, the view would be extended still farther, as to M; though the depression of the horizon of the sea would then be less, as is shown by the line ALM: whence also it appears, that, by reason of the difference of refraction in the air, our horizon is sometimes more extensive than at others.

5. The *equator* is a great circle upon the earth, every part of which is equally distant from the poles or extremities of the imaginary line on which the earth revolves. In the sea-language it is usually called the *line*, and when people sail over it they are said to cross the line.

6. The *meridian* of any place is a great circle on the earth drawn through that place and both poles of the earth. It cuts the horizon at right angles, marking upon it the true north and south points; dividing also the globe into two hemispheres, called the *eastern* and *western* from their relative situation to that place and to one another. The poles divide the meridians into two semicircles, one of which is drawn through the place to which the meridian belongs, the other through that point of the earth which is opposite to the place. By the meridian of a place, geographers and astronomers often mean that semicircle which passes through the place, and which may therefore be called the *geographical meridian*. All places lying under this semicircle are said to have the same meridian; the semicircle opposite to this is called the *opposite meridian*. The meridians are thus immoveably fixed to the earth as much as the places themselves on its surface, and are carried along with it in its diurnal rotation. When the geographical meridian of any place is, by the rotation of the earth, brought to point at the sun, it is noon or mid-day at that place; in which case, were the plane of the circle extended, it would pass through the middle of the luminary's disk. Supposing the plane of the meridians to be extended to the sphere of the fixed stars, in that case, when by the rotation of the earth the meridian comes to any point in the heavens, then, from the apparent motion of the heavens, that point is said to come to the meridian. The rotation of the earth is from west to east; whence the celestial bodies appear to move the contrary way. East and west, however, are terms merely relative, since a place may be west from one part of the earth, and east from another; but the true *east and west points* from any place are those where its horizon cuts the equator.

7. All places lying under the same meridian are said to have the same *longitude*, and those which lie under different meridians to have different longitudes; the difference of longitude being reckoned eastward or westward on the equator. Thus, if the meridian of any place cuts the equator in a point 15 degrees distant from one another, we say there is a difference of 15° longitude betwixt these two places. Geographers usually pitch upon the meridian of some remarkable place for the first meridian, and reckon the longitude of all others by the distance of their meridians from that which they have pitched upon as the first; measuring sometimes eastward on the equator all round the globe, or sometimes only one-half east and the other west; according to which last measurement, no place can have more than 180° longitude either east or west. By the ancient Greek geographers, the first meridian was placed in *Hera* or *Junonia*, one of the *Fortunate Islands*, as they were then called; which is supposed to be the present island of Teneriffe, one of the Canaries. These islands, being the most westerly part of the earth then known, were on that account made the seat of the first meridian, the longitude of all other places being counted eastward from them. The Arabians, ambitious of having the first meridian taken from them, fixed it at the most westerly part of the continent of Africa. Some later geographers placed the first meridian in the island of Corvo, one of the Azores; because at that time the magnetic needle on the island just mentioned pointed due north without any variation; and it was not then known that the needle itself was subject to variation, as has since been discovered. Bleau replaced the first meridian in the isle of Teneriffe; and, to ascertain the place more exactly, caused it to pass through the famous mountain of that island, called the *peak* from *el-pico*, "a bird's-beak." Among modern geographers, indeed, it is now become customary for each to make the first meridian pass through the capital of his own country; a practice, however, which is certainly improper, as it is thus impossible for the geographers of one nation to understand the maps of another without a troublesome calculation, which answers no purpose. By the British geographers the royal observatory at Greenwich is accounted the place of the first meridian.

8. If we suppose 12 great circles, one of which is the meridian to a given place, to intersect each other at the poles of the earth, and divide the equator into 24 equal parts, these are the *hour-circles* of that place. These are by the poles divided into

24 ſemicircles, correſponding to the 24 hours of the day and night. The diſtance betwixt each two of theſe ſemicircles is 15°, being the 24th part of 360; and, by the rotation of the earth, each ſucceeding ſemicircle points at the ſun one hour after the preceding; ſo that in 24 hours all the ſemicircles point ſucceſſively at the ſun. Hence it appears, that ſuch as have their meridian 15° eaſt from any other have likewiſe noon one hour ſooner, and the contrary; and in like manner every other hour of the natural day is an hour ſooner at the one place than at the other. Hence, from any inſtantaneous appearance in the heavens obſerved at two diſtant places, the difference of longitude may be found, if the hour of the day be known at each place. Thus the beginning of an eclipſe of the moon, when the luminary firſt touches the ſhadow of the earth, is an inſtantaneous appearance, as alſo the end of an eclipſe of this kind, when the moon leaves the ſhadow of the earth viſible to all the inhabitants on that ſide of the globe. If therefore we find, that at any place an eclipſe of the moon begins an hour ſooner than at another, we conclude that there is a difference of 15° of longitude between the two places. Hence alſo, were a man to travel or ſail round the earth from weſt to eaſt, he will reckon one day more to have paſſed than they do who ſtay at the place from whence he ſet out; ſo that their Monday will be his Tueſday, &c. On the other hand, if he ſails weſtward, he will reckon a day leſs, or be one day in the week later, than thoſe he leaves behind.

9. The equator divides the earth into two hemiſpheres called the *northern* and *ſouthern*: all places lying under the equator are ſaid to have no latitude; and all others to have north or ſouth latitude according to their ſituation with reſpect to the equator. The *latitude* itſelf is the diſtance from the equator meaſured upon the meridian, in degrees, minutes, and ſeconds. The complement of latitude is the difference between the latitude itſelf and 90°, or as much as the place itſelf is diſtant from the pole; and this complement is always equal to the elevation of the equator above the horizon of the place. The elevation of the pole of any place is equal to the latitude itſelf.

An inhabitant of the earth who lives at either of the poles has always one of the celeſtial poles in his zenith and the other in his nadir, the equator coinciding with the horizon: hence all the celeſtial parallels are alſo parallel to the horizon; whence the perſon is ſaid to live in a *parallel ſphere*, or to have a parallel horizon.

Thoſe who live under the equator have both poles in the horizon, all the celeſtial parallels cutting the horizon at right angles; whence they are ſaid to live in a *right ſphere*, or to have a right horizon.

Laſtly, thoſe who live between either of the poles and the equator, are ſaid to live in an *oblique ſphere*, or to have an oblique horizon; becauſe the celeſtial equator cuts his horizon obliquely, and all the parallels in the celeſtial ſphere have their planes oblique to that of the horizon. In this ſphere ſome of the parallels interſect the horizon at oblique angles, ſome are entirely above it, and ſome entirely below it; all of them, however, ſo ſituated, that they would obliquely interſect the plane of the horizon extended.

The largeſt parallel which appears entire above the horizon of any place in north latitude is called by the ancient aſtronomers the *arctic circle* of that place: within this circle, *i. e.* between it and the arctic pole, are comprehended all the ſtars which never ſet in that place, but are carried perpetually round the horizon in circles parallel to the equator. The largeſt parallel which is hid entire below the horizon of any place in north latitude was called the *antarctic circle* of that place by the ancients. This circle comprehends all the ſtars which never riſe in that place, but are carried perpetually round below the horizon in circles parallel to the equator. In a parallel ſphere, however, the equator may be conſidered as both *arctic* and *antarctic* circle; for, being coincident with the horizon, all the parallels on one ſide are entirely above it, and thoſe on the other entirely below it. In an oblique ſphere, the nearer any place is to either of the poles, the larger are the arctic and antarctic circles, as being nearer to the celeſtial equator, which is a great circle. In a right ſphere, the arctic and antarctic circles have no place, becauſe no parallel appears either entirely above or below it. By the arctic and antarctic circles, however, modern geographers in general underſtand two fixed circles at the diſtance of $23\frac{1}{2}$ degrees from the pole. Theſe are ſuppoſed to be deſcribed by the poles of the ecliptic, and mark out the ſpace all round the globe where the ſun appears to touch the horizon at midnight in the ſummer time, and to be entirely ſunk below it in the winter. Theſe are alſo called the *polar circles*. By the ancients the arctic circle was called *maximus ſemper apparentium*, and *circulus perpetuæ apparitionis*; the antarctic circle, on the other hand, being named *maximus ſemper occultorum*, and *circulus perpetuæ occultationis*.

According to the different poſitions of the globe with regard to the ſun, the celeſtial bodies will exhibit different phenomena to the inhabitants. Thus, in a *parallel ſphere*, they will appear to move in circles round the horizon; in a right ſphere, they would appear to riſe and ſet as at preſent, but always in circles cutting the horizon at right angles; but, in an oblique ſphere, the angle varies according to the degree of obliquity, and the poſition of the axis of the ſphere with regard to the ſun. Hence we eaſily perceive the reaſon of the ſun's continual change of place in the heavens: but though it is certain that this change takes place every moment, the vaſt diſtance of the luminary renders it imperceptible for ſome time, unleſs to very nice aſtronomical obſervers. Hence we may generally ſuppoſe the place of the ſun to be the ſame for a day or two together, though in a conſiderable number of days it becomes exceedingly obvious to every body. When he appears in the celeſtial equator, his motion appears for ſome time to be in the plane of that circle, though it is certain that his place there is only for a ſingle moment; and in like manner, when he comes to any other point of the heavens, his apparent diurnal motion is in a parallel drawn throughout. Twice a-year he is in the equator, and then the days and nights are nearly equal all over the earth. This happens in the months of March and September; after which the ſun proceeding either northward or ſouth, according to the ſeaſon of the year and the poſition of the obſerver, the days become longer or ſhorter than the nights, and ſummer or winter comes on, as is fully explained under the article Astronomy. The receſſion of the ſun from the equator either northward or ſouthward is called his *declination*, and is either north or ſouth according to the ſeaſon of the year; and when this declination is at its greateſt height, he is then ſaid to be in the tropic, becauſe he begins to turn back (the word *tropic* being derived from the Greek τρεπω, *verto*). The ſpace between the two tropics, called the *torrid zone*, extends for no leſs than 47 degrees of latitude all round the globe; and throughout the whole of that ſpace the ſun is vertical to ſome of the inhabitants twice a-year, but to thoſe who live directly under the tropics only once. Throughout the whole torrid zone alſo there is little difference between the length of the days and nights. The ancient geographers found themſelves conſiderably embarraſſed in their attempts to fix the northern tropic; for though they took a very proper method, namely, to obſerve the moſt northerly place where objects had no ſhadow on a certain day, yet they found that on the ſame day no ſhadow was caſt for a ſpace of no leſs than 300 ſtadia. The reaſon of this was, the apparent diameter of the ſun; which, being about half a degree, ſeemed to extend himſelf over as much of the ſurface of the earth, and to be vertical every where within that ſpace.

When the ſun is in or near the equator, he ſeems to change

his place in the heavens moſt rapidly; ſo that about the equinoxes one may very eaſily perceive the difference in a day or two: but, as he approaches the tropics, this apparent change becomes gradually ſlower; ſo that for a number of days he ſcarce ſeems to move at all. The reaſon of this may eaſily be underſtood from any map on which the ecliptic is delineated: for, by drawing lines through every degree of it parallel to the equator, we ſhall perceive them gradually approach nearer and nearer each other, until at laſt, when we approach the point of contact betwixt the ecliptic and tropic, they can for ſeveral degrees ſcarce be diſtinguiſhed at all.

From an obſervation of the diverſity in the length of the days and nights, the riſing and ſetting of the ſun, with the other phenomena already mentioned, the ancient geographers divided the ſurface of the earth into certain diſtricts, which they called *climates*; and, inſtead of the method of deſcribing the ſituation of places by their latitude and longitude as we do now, they contented themſelves with mentioning the climate in which they were ſituated. When more accuracy was required, they mentioned alſo the beginning, middle, and ending of the climates. This diſtinction, however, was certainly very vague and inaccurate: for the only method they had of determining the difference was by the length of the day; and a climate, according to them, was ſuch a ſpace as had the day in its moſt northerly part half an hour longer than in the moſt ſoutherly. For the beginning of their firſt climate, they took that parallel under which the day is twelve hours and three quarters long; thoſe parts of the world which lie nearer the equator not being ſuppoſed to be in any climate, either becauſe in a looſe ſenſe they may be conſidered as in a right ſphere, or becauſe they were unknown, or thought to be uninhabitable by reaſon of the heat. The northern climates were generally ſuppoſed to be ſeven; which muſt have an equal number of ſouthern climates correſponding with them. The names of the northern climates, according to the ancients, were as follow: 1. Meroe. 2. Syene in Egypt. 3. Alexandria in Egypt. 4. Rhodes. 5. Rome; or, according to others, a parallel drawn through the Helleſpont. 6. The parallel paſſing through the mouth of the river Boriſthenes. 7. The Riphean mountains. Each of theſe places was ſuppoſed to be in the middle of the climate; and as the ſouthern parts of the globe were then very little known, the climates to the ſouthward of the equator were then ſuppoſed to be as far diſtant from that circle as the northern ones; in conſequence of which they took their names from the latter.

A parallel was ſaid to paſs through the middle of a climate when the day under that parallel is a quarter of an hour longer than that which paſſes through the moſt ſoutherly part. Hence it does not divide the ſpace into two equal parts; but that part next the equator will always be the larger of the two, becauſe the farther we recede from that circle, the leſs increaſe of latitude will be ſufficient to lengthen the day a quarter of an hour. Thus in every climate there are three parallels; one marking the beginning, the ſecond the middle, and the third the ending of the climate; the ending of one being always the beginning of another. Some of the ancients divided the earth by theſe parallels; others, by a parallel, did not mean a mere line, but a ſpace of ſome breadth: and hence the parallel may be underſtood as the ſame with half a climate.

This method of dividing the ſurface of the earth into climates, though now very much diſuſed, has been adopted by ſeveral modern geographers. Some of theſe begin their climates at the equator, reckoning them by the increaſe of half an hour in the length of the day northward. Thus they go on till they come to the polar circles, where the longeſt day is 24 hours: betwixt theſe and the poles they count the climates by the increaſe of a natural day in the length of time that the ſun continues above the horizon, until they come to one where the longeſt day is 15 of ours, or half a month; and from this to the pole they count by the increaſe of half months or whole months, the climates ending at the poles where the days are ſix months long. The climates betwixt the equator and the polar circles are called *hour-climates*, and thoſe between the polar circles and the poles are called *month-climates*. In common language, however, we take the word *climate* in a very different ſenſe; ſo that, when two countries are ſaid to be in different climates, we underſtand only that the temperature of the air, ſeaſons, &c. are different.

From the difference in the length and poſitions of the ſhadows of terreſtrial ſubſtances, ancient geographers have given different terms to the inhabitants of certain places of the earth; the reaſon of which will be eaſily underſtood from the following conſiderations: 1. Since the ſun in his apparent annual revolution never removes farther from the equator than $23\frac{1}{2}$ degrees, it follows, that none of thoſe who live without that ſpace, or beyond the tropics, can have the luminary vertical to them at any ſeaſon of the year. 2. All who live between the tropics have the ſun vertical twice a year, though not all at the ſame time. Thus, to thoſe who live directly under the equator, he is directly vertical in March and September at the time of the equinox. If a place is in 10° north latitude, the ſun is vertical when he has 10° north declination, and ſo of every other place. 3. All who live between the tropics have the ſun at noon ſometimes north and ſometimes ſouth of them. Thus they who live in a place ſituated in 20° north latitude have the ſun at noon to the northward when he has more than 20 degrees north declination, and to the ſouthward when he has leſs. 4. Such of the inhabitants of the earth as live without the tropics, if in the northern hemiſphere, have the ſun at noon to the ſouthward of them, but to the northward if in the ſouthern hemiſphere. 5. When the ſun is in the zenith of any place, the ſhadow of a man or any upright object falls directly upon the place where they ſtand, and conſequently is inviſible; whence the inhabitants of ſuch places were called *Aſcii*, or without ſhadows. Thoſe who live between the tropics, and have the ſun ſometimes to the north and ſometimes to the ſouth of them, have of conſequence their ſhadows projecting north at ſome ſeaſons of the year and ſouth at others; when they were called *Araphiſcii*, or having two kinds of ſhadows. They who live without the tropics have their noon ſhadows always the ſame way, and are therefore called *Heteroſcii*, that is, having only one kind of ſhadow. If they are in north latitude, the ſhadows are always turned towards the north, and, if in the ſouthern hemiſphere, towards the ſouth. When a place is ſo far diſtant from the equator that the days are 24 hours long or longer, the inhabitants were called *Periſcii*, becauſe their ſhadows turn round them.

Names have likewiſe been impoſed upon the inhabitants of different parts of the earth from the parallels of latitude under which they live, and their ſituation with regard to one another. Thus, when two places are ſo near each other that the inhabitants have only one horizon, or at leaſt that there is no perceptible difference between them, the inhabitants were called *Synœci*, that is, near neighbours; the ſeaſons, days, nights, &c. in both places being perfectly alike. Thoſe who lived at diſtant places, but under the ſame parallel, were called *Periœci*, that is, living in the ſame circle. Thoſe who are on the ſame ſide of the equator have the ſeaſons of the year at the ſame time; but, if on different ſides, the ſummer ſeaſon of the one is the winter of the other: ſee the article ASTRONOMY, page 391. Some writers, however, by the name of *Periœci* diſtinguiſh thoſe who live under oppoſite points of the ſame parallel, where the noon of one is the midnight of the other. When two places lie under parallels equally diſtant from the equator, but in oppoſite hemiſpheres, the inhabitants were called *Antœci*.

Theſe have a ſimilar increaſe of days and nights, and ſimilar ſeaſons, but in oppoſite months of the year. According to ſome, the Antæci were ſuch as lived under the ſame geographical meridian, and had day and night at the ſame time. If two places are in parallels equally diſtant from the equator, and in oppoſite meridians, the inhabitants were called *Antichthones* with reſpect to one another, that is, lying on oppoſite ſides of the earth; or *Antipodes*, that is, having their feet oppoſite to one another. When two perſons are Antipodes, the zenith of the one is the nadir of the other. They have a like elevation of the pole, but it is of different poles: they have alſo days and nights alike, and ſimilar ſeaſons of the year; but they have oppoſite hours of the day and night, as well as ſeaſons of the year. Thus, when it is mid-day with us, it is midnight with our Antipodes; when it is ſummer with us, it is winter with them, &c.

From the various appearances of the ſun, and the effects of his light and heat upon different parts of the earth, the diviſion of it into *zones* has ariſen. Theſe are five in number. 1. The torrid zone, lying between the two tropics for a ſpace of 47° of latitude. This is divided into two equal parts by the equator; and the inhabitants have the ſun vertical to them twice a year, excepting only thoſe who dwell under the tropics, to whom he is vertical only once, as has already been explained. 2. The two temperate zones lie between the polar circles and the tropics, containing a ſpace of 43° of latitude. And, 3. The two frigid zones lie between the polar circles and the poles. In theſe laſt the longeſt day is never below 24 hours, in the temperate zones it is never quite ſo much, and in the torrid zone it is never above 14. The zones are named from the degree of heat they were ſuppoſed to be ſubjected to. The torrid zone was ſuppoſed by the ancients to be uninhabitable by reaſon of its heat; but this is now found to be a miſtake, and many parts of the temperate zones are more intolerable in this reſpect than the torrid zone itſelf. Towards the polar circles alſo theſe zones are intolerably cold during the winter ſeaſon. Only a ſmall part of the northern frigid zone, and none of the ſouthern, is inhabited. Some geographers reckoned ſix zones, dividing the torrid zone into two by the equator.

When any parts of the heaven or earth are ſaid to be on the *right* or *left*, we are to underſtand the expreſſion differently according to the poſition of the perſon who makes uſe of it; becauſe, according to that, his face is ſuppoſed to be turned towards a certain quarter. A geographer is ſuppoſed to ſtand with his face to the north, becauſe the northern part of the world is beſt known. An aſtronomer looks towards the ſouth, to obſerve the celeſtial bodies as they come to the meridian. The ancient augurs, in obſerving the flight of birds, looked towards the eaſt; while the poets look towards the *Fortunate Iſles*. In books of geography, therefore, by the right hand we muſt underſtand the eaſt; in thoſe of aſtronomy, the weſt; in ſuch as relate to augury, the ſouth; and in the writings of poets, the north.

Under the article ASTRONOMY, page 397, the method of drawing a *meridian line* is fully explained; the knowledge of which is abſolutely neceſſary both for geographers and aſtronomers. To what is mentioned there we ſhall only add further, that the time for drawing a line of this kind is when the ſun is nearly at the ſummer ſolſtice; becauſe the difference of declination is then ſcarce perceptible for ſeveral days, and, in the few hours requiſite for the operation, may be totally diſregarded. The winter ſolſtice would do equally well, were it not that the ſun is then ſo low in the heavens, that a difference in the refraction might cauſe a conſiderable error in the reſult. The motion of the luminary above the horizon is likewiſe ſo oblique, that he changes his vertical faſter than his altitude, which is inconvenient in an operation where we are to determine the vertical by the altitude. A clear day muſt be choſen for the purpoſe; and the ground on which the ſhadow falls ought to be white, that the ſhadow may be better defined. The ſtile ought not to be too high, becauſe then the top of the ſhadow will be indiſtinct; neither ought it to terminate in a point, for the ſame reaſon. Dr. Long recommends the top of it to be about an eighth of an inch thick. Having drawn a meridian line upon one plane, we may draw one upon another by the following method: Hang a thread with a plummet exactly over the ſouth end of the meridian line given, and another on the plane on which the meridian line is to be drawn. Let one perſon obſerve at noon the moment when the ſhadow of the firſt thread falls exactly upon the meridian given; and let another obſerver at the ſame time mark two diſtant points in the ſhadow of the ſecond thread: a line drawn through theſe points is the meridian line required. Thus alſo a meridian line may be drawn upon a ſouth wall, by marking two points in the ſhadow of a thread hung at a little diſtance from it. If the meridians are near, he that obſerves the ſhadow of the firſt thread may let the other know the moment it falls upon the meridian line, by ſaying *Now*: if far diſtant, it ſhould be done by the motion of the hand, becauſe ſound takes up ſome time in paſſing from one place to another. A quadrant or other aſtronomical inſtrument may now be fixed in the meridian line in ſuch a manner as to be capable of different elevations, in order to obſerve the altitudes of the different celeſtial bodies; the plane of that ſide of the inſtrument on which the degrees are marked being all the while kept in the meridian. The mural arc in the Royal Obſervatory at Greenwich is a wall of black marble, one ſide of which, ſtanding exactly in the plane of the meridian, has a large and accurately divided braſs quadrant fixed to it, moveable round its centre, and with teleſcope ſights. See ASTRONOMY, p. 414. At ſea, where they cannot have a meridian line, the greateſt height of a ſtar or the ſun is taken for the meridian height.

Having got a meridian line, it may be prolonged to what length we pleaſe, and the diſtance of it meaſured. The meridian of the royal obſervatory at Paris being found, and an inſtrument with teleſcopic ſights placed vertically therein, the north and ſouth points of the viſible horizon were obſerved through the ſights, and a pillar erected upon the north point; then, by another inſtrument placed horizontally, ſeveral diſtant objects, as ſteeples, &c. were viewed, and the angles which the viſual lines made with the meridian line were obſerved. From the places of theſe new objects then others were obſerved; and, where the natural objects were deficient, they ſet up large poles. Thus ſeveral triangles were formed along the meridian: and, in order to meaſure thoſe triangles, a paved way from *Villejuive* to *Juviſy* was made choice of for the fundamental baſe, as lying in a ſtraight line from north to ſouth. For the actual menſuration of this way, two poles were made uſe of, each of them four toiſes in length, and made of two pike-ſtaves joined together at the great ends by a ſcrew. One of the meaſuring poles was firſt laid upon the ground; the other was joined to it end to end along by a rope ſtretched from north to ſouth: the firſt pole was then taken up and laid down at the end of the ſecond, and ſo on ſucceſſively; and, for the greater eaſe in keeping the account, the meaſurer who laid down the ſecond pole had ten little ſtakes given him, one of which he ſtuck into the ground at the end of his pole every time he laid it down; ſo that every ſtake marked eight toiſes; the whole, when ſtuck into the ground, marking 80 toiſes. Thus the length of the road above mentioned was twice meaſured, and found to be 5663 toiſes and 4 feet in going, and 5663 toiſes and 1 foot in returning; ſo that, as a greater exactneſs could not be hoped for, 5663 toiſes were pitched upon as the true length of this fundamental baſe. This is repreſented, fig. 2. by the line OP; and the calculations

of the triangles upon it were made in the following manner: The angle COP was obferved from O, one end of the bafe; from the other end the angle OPC; and from the ftation C the angle OCP: and thus all the angles of the triangle CPO, and the length of one fide OP, being known, the lengths of the remaining fides OC and PC were found by calculation. The next ftep was, to obferve all the angles of the triangle OBC, and from thence, and the known length of the fide OC, to calculate the other fide OB and BC. Then all the angles being obferved, and the fide BC being known of the triangle ABC, which may be called the firft or principal triangle of the meridian of the obfervatory, the other fides AB and AC were found. Then, from one of the fides now known and the angles obferved, all the fides of the next adjoining triangle CBE were found. Thus they proceeded from one triangle to another to the place where the meridian ended in the fouth of France; and there the laft triangle was terminated by a bafe of the length of 7246 toifes, which was actually meafured in order to verify the preceding operations. The meridian line of Paris being prolonged in the manner juft now defcribed, the fituation of feveral other places in France was determined by trigonometry, and an accurate map of the country drawn, efpecially of thofe parts which lie near the meridian of Paris.

Having found a meridian line, the *tranfits* or paffages of the heavenly bodies acrofs it may be obferved by hanging two threads with plummets exactly over it, at a little diftance from one another, which confequently will be directly in the plane of the meridian: if you place your eye clofe to one of the threads in fuch a manner that you make it cover the other, and both appear as one thread, when a ftar is behind the threads, it is in the meridian. By the fame method the fun may be viewed through a fmoked glafs: when the threads pafs through his centre, he is in the meridian. But the beft way of obferving either the fun, moon, ftars, or planets, is through a telefcope placed in the meridian, with two crofs hairs, one of which is in a vertical, the other in an horizontal pofition. The fun is in the meridian when the vertical hair paffes through his centre.

To find the elevation of the pole in any place, take the greateft and leaft height of fome ftar which never fets; the middle height between thefe extremes is the elevation of the pole. Or the elevation of the pole may be found by one obfervation of the height of a ftar in the meridian, if the declination of that ftar be known; for, as the diftance from the pole is the complement of its diftance from the equator, this being fubtracted from the greateft height of the ftar leaves the elevation of the pole defired. The fame thing may be done by obferving the leaft height of a ftar, and adding to that the diftance from the pole: but for obfervations of this kind we ought to choofe the time when the ftars are in the zenith, and not pitch upon any which happen to be near the horizon, becaufe the refraction occafions fuch errors as are too confiderable not to affect the obfervations materially.

The *height of the equator* is found by taking the height of the fun or a ftar when we know by an almanack they have no declination; or it may be otherwife known by taking the meridian height of the fun, and adding or fubtracting the known declination. Having found the height of the equator, we know the elevation of the pole; or, having found the elevation of the pole, we know that of the equator; the one being the complement of the other.

A method much ufed by the ancients was that of *taking the altitudes* of the celeftial bodies by means of a gnomon, or upright pillar erected for that purpofe. Thus the height of the pole and the feafons of the year might be known by obferving the length of the meridian fhadow, which would be greater or lefs according to the altitude of the fun at that time. The moft ancient obfervations of this kind were thofe made by Pytheas, in the time of Alexander the Great, at Marfeilles in France, by which he found the meridian length of the fhadow at the fummer folftice to be to the height of the gnomon as $213\frac{1}{2}$ to 600; the fame which Gaffendus afterwards found it in the year 1636.

The elevation of the pole may be found by means of the *gnomon*, by finding the meridian height of the fun; for, this being given, we have the elevation of the equator, and confequently that of the pole. The *meridian height* of the fun may be found in the following manner: Let AC, fig. 3. be the gnomon, AB the fhadow, and CB part of a ray drawn from the centre of the fun, paffing by the top of the gnomon, and terminating the fhadow at B. Thefe three lines form a right-angled triangle BAC, whereof the two legs AB and AC are given, the number of feet and inches in them being found by actual menfuration. Hence the acute angles may be found in the following manner: Let one leg be radius, and the other will be tangent of the oppofite angle. Thus, if we make AB radius, AC will be tangent of the oppofite angle ABC. This tangent is found by the golden rule—as the number of feet, inches, &c. in AB, is to the number of feet, inches, &c. in AC; fo is the radius to a fourth number, which is the tangent required. This fourth number looked for in the table of tangents gives the meafure of the angle ABC, which is the meridian height of the fun required.

This method of obfervation, however, is by no means accurate; and Ricciolus takes notice of the following deficiencies in the ancient obfervations made in this manner: 1. They did not take into account the fun's parallax, which makes his apparent altitude ten feconds lefs than it would be if the gnomon were placed at the centre of the earth. 2. They neglected refraction, by which the apparent height of the fun is fomewhat increafed. 3. They made their calculations as if the fhadows were terminated by a ray coming from the fun's centre; whereas it is bounded by one coming from the upper edge of his limb. In many cafes, however, thefe errors are of no moment; but at any rate they may be corrected in the following manner: To the altitude of the fun found by the gnomon, add his parallax of 10″, and take from the fum the femidiameter of the fun at that time, which is about 16′; together with the refraction, which is different at different heights of the fun, and muft be had from a table of refractions. Thus the altitude of the fun will be had free of any errors, excepting thofe unavoidable ones arifing from the difficulty in finding the true length of the fhadow by reafon of the penumbra which always accompanies it.

Some gnomons fhow the altitude of the fun not by the fhadow, but by a hole in the top made in a plate of metal inferted there, through which the rays fall upon a level pavement. In gnomons of this kind the centre of the inftrument is always exactly under the hole in the metal-plate; and the method of finding the height of the fun is the fame as that already defcribed. A gnomon of this kind was made in the year 1576 by Egnatio Dante in the church of St. Petronia at Bologna. Near the top of the fouth wall of the church he placed a brafs plate about three-eighths of an inch thick, in which was cut a circular hole almoft exactly an inch in diameter. The plate was fet in the wall at an angle of about $45\frac{1}{2}$ deg. the height of the equator in that place. The height of the hole in the plate from the ground is near 66 feet, and the length of the line drawn upon the pavement is 169 feet. This line, however, is not exactly in the meridian, but as near it as the pillars of the church would admit; and on it the rays of the fun, paffing through the hole, formed an ellipfis at different diftances from the wall, according to the feafon of the year. Another

gnomon of this kind was made in the fame church by Dominico Caffini in 1645. He placed the brafs plate through which the rays of the fun were to pafs in the roof of the church, and drew a meridian line 120 feet long upon the pavement; which performance was fo much approved, that a medal was ftruck upon the occafion. In like manner Bianchini and Moraldi drew a meridian line upon the pavement of the great hall of the baths of Dioclefian, now the church of the Carthufians at Rome.

To conftruct *gnomons* of this kind, place the brafs plate with the hole in it in the fouth end of the roof of the building; by a thread with a plummet at the end of it, let down through the centre of the hole, find the point in the pavement which is exactly under it; this point is the centre of the gnomon: from this centre draw feveral concentric circles: an hour or two before and after noon mark the points where the northern as alfo where the fouthern edge of the fun's picture touches thefe circles, and there will be feveral arches, through the middle of which a line drawn from the centre of the gnomon is a meridian line, as will be underftood from what has been already faid concerning the method of drawing thefe lines. The meridians juft mentioned are ufually marked upon long plates of brafs, with which the marble pavement is inlaid; there are alfo drawn upon it lines croffing the meridians at right angles, to fhow how far the centre of the fun's image reaches at different times of the year: when this at noon is fartheft from the centre of the gnomon, the fun is then loweft, and it is the winter folftice: when the fame picture is neareft to the centre of the gnomon, the fun is higheft, and confequently he is then in his greateft north declination, and it is then the fummer folftice.

The time of the *folftice* is obferved, by marking exactly the diftance of the fun's picture from the centre of the gnomon the day before and the day after the folftitial day: if thefe diftances be exactly equal, the meridian heights of the fun are for thefe two days exactly equal; and then the time of the fun's being in the folftitial point is exactly at noon: if the diftance of the fun's picture from the centre of the gnomon be greater the day before the folftice than it is the day after, it fhows that the time of the folftice is before noon; and if lefs, that it is after noon. It is, however, extremely difficult to determine the exact moment of the folftice by this method, or even to approach within fome hours of it; for at thofe times the fun's declination, and confequently his meridian height, alters not above $15''$ in a natural day; and therefore an error of more than $15''$ in the obfervation of the fun's meridian height will occafion an error of a whole day in fixing the time of the folftice; an error of one-half of $15''$ will occafion an error of half a day; and fo in proportion.

The time of the *equinox* is found by a gnomon in the following manner: On the day of the equinox find the meridian height of the fun and the height of the equator. If thefe be equal, the equinox is exactly at noon; if the height of the fun be different from that of the equator, then as many minutes as the fun is higher than the equator, fo many hours is the moment of the equinox before noon; as many minutes as the fun is lower than the equator, fo many hours is the equinox after noon. The reafon of this computation is, that at the equinox the declination of the fun alters at the rate of 24 minutes in a natural day, which is at the rate of a minute in an hour; whence it appears that the equinoxes are much more eafily obferved than the folftices. It is probable that many of the obelifks in Egypt were erected for the purpofe of obferving the altitude of the fun by the length of the fhadow. It is likewife worth obferving, that the Spaniards at the conqueft of Peru found pillars of curious and coftly workmanfhip, by the meridian fhadows of which their *Amautas* or philofophers had, by long experience and obfervation, learned to determine the time of the equinoxes: thefe feafons of the year were celebrated by them with great feftivity and rejoicing in honour of the fun, whom they imagined to fit at thofe times in all his glory upon the throne they had erected for him; and therefore on thofe days they prefented him with rich offerings of gold, filver, jewels, and other valuable gifts; adorning his throne, as they did alfo the pillars, with fragrant herbs and flowers.

The principal ufes which geographers have for obferving the altitudes of the celeftial bodies with fuch accuracy are, to determine the length of the year, the feafons, but efpecially the diftance of places on the earth, their fituation with regard to one another, and the dimenfions of the whole. An account of the moft remarkable attempts for difcovering the circumference of the globe has been given in the preceding fection. The foundation of the whole is to obtain an exact meafure of one degree of the meridian; which being once got, we have only to multiply the number of miles, feet, or any other meafure employed, by 360, the number of degrees in the circumference, and the product is that of the whole globe. This being obtained, we may eafily determine its fuperficial and folid contents by the geometrical methods employed in other cafes. According to the beft calculations which have yet appeared, the dimenfions of this globe are as follow:

	English Miles.
One minute of a degree contains -	$1\frac{9}{75}$
A degree - - -	$69\frac{1}{2}$
The circumference - -	24,930
The diameter - -	$7935\frac{2}{5}$
The femidiameter - -	$3967\frac{1}{2}$
The fuperficial meafure -	200,000,000

The folid contents, two hundred and fixty-fix thoufand millions of cubic miles.

A fecond of a degree is no more than $101\frac{1}{2}$ Englifh feet.

In making meafurements of this kind, the principal difficulty arifes from the want of an abfolutely level furface, the length of which may be determined by actual menfuration as the foundation of our calculations. Snellius, as has already been mentioned, had a fingular opportunity of this kind by means of a great extent of ice; and fimilar conveniencies might be had on the frozen lakes in the north of Europe, though difficulties would there arife from the great refraction of the atmofphere. It muft likewife be confidered, that there is always fome difference between the *apparent level* and the *true*, which in great diftances is apt to affect our calculations materially. A truly level furface is the fegment of any fpherical furface concentric to the furface of the earth: thus the furface of the fea or any piece of water when at reft forms itfelf into a true level. A true line of level then is an arc of a great circle, which we fuppofe to be defcribed upon a truly level furface. The apparent level is a ftraight line drawn tangent to the true level; whence every point of the apparent level, excepting only that of contact, is fomewhat higher than the true level. The difference is eafily known after the femidiameter of the earth is known. Thus, in fig. 4. let the obferver ftanding at A look through a telefcope placed horizontally at the object B; here BAC is a right-angled triangle, in which, if AC be made radius, AB will be tangent, and CB fecant of the angle ACB. Now, to find this tangent, fay, A the number of feet in AC is to the number of feet in AB, the diftance of the object; fo is AC as radius to AB as tangent. Then having found the tangent AB in the table, we have the fecant CB; from which if the radius CG be taken, the remainder GB is the excefs of the fecant above the radius, or the height of the apparent level above the true. The following Table was conftructed by Caffini.

A TABLE *shewing the Height of the Apparent Level above the True.*

If the distance of the object from the place of the spectator be	Which measured in a great circle upon the earth amounts to		The height of the apparent level above the true will be	If the distance of the object from the place of the spectator be	Which measured in a great circle upon the earth amounts to	The height of the apparent level above the true will be	
Sec.	Feet.	Inch.	Inch.	Min.	Feet.	Feet.	Inch.
1	101	6.8		1	6094	0	10.680
2	203	1.6		2	12188	3	6.580
3	304	8.4		3	18282	7	11.853
4	406	3.2		4	24376	14	1.812
5	507	10.0	0.074	5	30470	22	1.932
6	609	4.8		6	36564	31	11.412
7	710	11.6		7	42658	42	5.436
8	812	6.4		8	48752	56	9.384
9	914	1.2		9	54846	71	9.876
10	1015	8.0	0.296	10	60940	88	7.728
11	1117	2.8		11	67034	107	2.940
12	1218	9.6		12	73128	127	7.512
13	1320	4.4		13	79222	149	9.444
14	1421	11.2		14	85316	173	8.736
15	1523	6.0		15	91410	199	4.320
16	1625	0.8		16	97504	226	9.264
17	1726	7.6		17	103598	255	11.568
18	1828	2.4		18	109692	286	11.232
19	1929	9.2		19	115786	319	7.188
20	2031	4.0	1.186	20	121880	354	0.504
21	2132	10.8		21	127974	390	4.248
22	2234	5.6		22	134068	428	5.352
23	2336	0.4		23	140162	468	10.224
24	2437	7.2		24	146256	510	6.084
25	2539	2.0		25	152350	553	11.232
26	2640	8.8		26	158444	599	1.776
27	2742	3.6		27	164538	646	1.680
28	2843	10.4		28	170632	694	10.944
29	2945	5.2		29	176726	745	5.568
30	3047	0.0	2.670	30	182820	797	8.484
31	3148	6.8		31	188914	851	9.828
32	3250	1.6		32	195008	907	8.532
33	3351	8.4		33	201102	965	3.528
34	3453	3.2		34	207196	1024	7.884
35	3554	10.0		35	213290	1085	9.600
36	3656	4.8		36	219384	1148	8.676
37	3757	11.6		37	225478	1213	5.112
38	3859	6.4		38	231572	1277	10.908
39	3961	1.2		39	237666	1348	2.064
40	4062	8.0	4.746	40	243760	1417	1.764
41	4164	2.8		41	249854	1496	11.388
42	4265	9.6		42	255948	1569	10.452
43	4367	4.4		43	262042	1638	9.084
44	4468	11.2		44	268136	1716	0.108
45	4570	6.0		45	274230	1794	11.424
46	4672	0.8		46	280324	1875	7.032
47	4773	7.6		47	286418	1958	0.000
48	4875	2.4		48	292512	2042	2.328
49	4976	9.2		49	298606	2128	2.016
50	5078	4.0	7.409	50	304700	2215	6.792
51	5179	10.8		51	310794	2305	5.472
52	5281	5.6		52	316888	2396	9.240
53	5383	0.4		53	322982	2489	10.368
54	5484	7.2		54	329076	2584	8.856
55	5586	2.0		55	335170	2681	4.704
56	5687	8.8		56	341264	2779	9.912
57	5789	3.6		57	347358	2880	0.480
58	5890	10.4		58	353452	2982	0.408
59	5992	5.2		59	359546	3085	8.628
				60	365640	3191	2.208

The uses of this Table are, 1. An arc of a great circle on the earth being given in seconds or minutes, to find the length of it in miles or feet. Thus an arc of 8 seconds is 812 feet six inches and four-tenths of an inch; and thus again an arc of 20′ is 121880 English feet. 2. An arc of a great circle upon the earth being given in seconds or minutes, or in feet or inches, to find the height of the apparent level above the true. In very small arcs this is so little, that it may be disregarded, and is therefore marked only at 5″, and afterwards at every 10″ in the table of seconds, and at every single minute in the other. 3. The distance of any object which is viewed through sights placed horizontally being given, the height of it may be found; or conversely, the height of any object being given, the distance of it may be found. Thus, if the distance of an object whose top is in the horizon be 15′ or 91410 feet, the height of that object is 199 feet 4 inches; and thus conversely, if the height of an object whose top is in the horizon be 199 feet 4 inches, the distance will be 91,410 feet. 4. If the distance of an object given be a number of feet which is not in the table, take that which is next to it, and say, as the square of the number thus taken is to the square of the number given; so is the height of the apparent level above the true, corresponding to the number taken, to the height of the apparent level which corresponds to the number given. Thus, if it be inquired what is the height of the apparent level above the true, when the distance of the object is 200,000 feet, the nearest number to this in the table is 201,102, the height of the level corresponding thereto is 965 feet; say then, as the square of 201,102 is to the square of 200,000; so is 965 to a fourth number, by which the apparent level exceeds the height of the true one, at the distance of 200,000 feet.

Hitherto we have supposed the line of level to be a tangent to an arc of a great circle drawn upon the surface of the earth; whereas, in levelling, the eye is usually at some distance above the surface, suppose 4 feet: but this makes no difference in levelling; for as the height of the eye must be added to the secant CB, fig. 4. because ML is supposed in levelling to be parallel to HD, there is indeed a difference between the length of AI and BL, but it is quite insensible. Another use of the table is for levelling, in order to convey water from one place to another. See LEVELLING. We shall now proceed to give a solution of some geographical problems relating to the horizon.

1. *To find the extent of the visible horizon*, the semidiameter of the earth and height of the eye being given. Let ADE, fig. 5. be an arc of a great circle upon the earth, C the centre of the earth, B the eye of the observer, BD the height of the eye, BA and BE lines drawn from the eye touching the surface of the earth at A and E, and terminating the visible horizon; the length of BA is required. In order to find it, add DB the height of the eye, which suppose to be 5 feet, to DC the semidiameter of the earth, which is 20,949,655 feet, and you have the length of CB 20,949,660 feet; draw CA, and you have a triangle BAC whose angle at A is a right one; make the hypothenuse CB radius, and CA will be the sine of the opposite angle ABC. Say then, as CB is to CA; so is the whole sine or radius to the sine of the angle ABC. This angle being found, its complement ACB is known, and consequently also the arc AD, which may be found in feet or miles by the table: Thus, in the foregoing example, as 20,949,660 is to 20,949,655; so is the radius 1000, &c. to a fourth number, viz. 9,999,993, which number is the sine of an angle of 89° 56′; the angle ABC then is 89° 56′; and therefore its complement ACD is 4′, and arc DA is 4′; that is, by the table, 24376 feet.

2. To find the *depression of the visible horizon* of the sea at a given height of the eye. In fig. 5. if the eye be at B, the sensible horizon is FG, the depression of the horizon of the sea is the

angle FBA; which, being the complement of ABC, is equal to ACD, that is, 4′.

3. To find the *extent of the viſible horizon* at any height of the eye by obſervation. The ſemidiameter of the horizon does not ſenſibly differ from an arch of a great circle upon the earth of the ſame number of minutes and ſeconds as the angle of depreſſion is obſerved to be; and the number of feet contained in that arc may be found in the table: Thus, if the depreſſion of the horizon be 30′, its ſemidiameter is alſo 30′; that is, by the table 182,820 feet. Various accounts of the extent of the viſible horizon are given by different authors; either becauſe they differ in their accounts of the earth's ſemidiameter from whence that of the horizon is computed, or in the meaſures they make uſe of.

The following table, taken from Caſſini, ſhows the different *depreſſions of the horizon of the ſea* at different heights of the eye, both by obſervation and calculation; with the difference betwixt the two occaſioned by refraction.

The height of the eye above the ſurface of the ſea.		The depreſſion of the horizon of the ſea.	
Feet	Inches	′ ″	
1157	6,9	32 30	by obſervation
		36 18	by calculation
Difference by refraction		3 48	
775	2,3	27 0	by obſervation
		29 36	by calculation
Difference by refraction		2 36	
571	11,0	24 0	by obſervation
		25 25	by calculation
Difference by refraction		1 25	
387	3,4	19 45	by obſervation
		20 54	by calculation
Difference by refraction		1 9	
288	4,3	15 0	by obſervation
		17 1	by calculation
Difference by refraction		2 1	
187	0,9	13 0	by obſervation
		14 41	by calculation
Difference by refraction		1 41	
9	7,3	3 20	by obſervation
		3 18	by calculation

Here the calculated depreſſion is greater than that by obſervation in all the caſes except the laſt, which is leſs by two ſeconds; but the inſtrument uſed by our author would not diſcover ſuch a ſmall difference. Refraction, by raiſing the objects of viſion, makes the angle of depreſſion leſs; but refraction itſelf is variable, and of conſequence the depreſſion and extent of the horizon alſo. Caſſini informs us, that, even in the fineſt weather, refraction was different at the ſame hours of different days, and at different hours of the ſame day. The truth of this poſition is eaſily ſeen by fixing a teleſcope with croſs hairs, ſo that the weather-cock of a diſtant ſteeple may be viewed through it: for at different times of the day, the weather-cock will ſometimes appear in the centre of the object-glaſs, ſometimes above and ſometimes below it: the ſame experiment may alſo be tried with plain ſights. It has long been obſerved, that the top of a diſtant hill may at ſome times, when the refraction is greateſt, be ſeen from a ſtation from which at other times, when refraction is leſs, it cannot be ſeen, even when the weather is ſufficiently clear.

Hitherto we have ſuppoſed the circumference of the earth to be exactly circular, or the globe itſelf to be a perfect ſphere; but, from ſome obſervations, this appears not to be the caſe. Some time ago, the French made an obſervation ſhowing that a pendulum vibrates ſlower in proportion as it is brought nearer to the equator: that is, the gravity or celerity of deſcent of the pendulum, and of all other bodies, is leſs in countries approaching to the equator than in places near either pole. This excited the curioſity of the celebrated philoſophers Huygens and Newton, who thence conjectured that the earth muſt have ſome other figure than what was commonly ſuppoſed. Sir Iſaac Newton afterwards demonſtrated that this diminution of weight naturally ariſes from the earth's rotation round its axis; which, according to the laws of circular motion, repels all heavy bodies from the axis of motion: ſo that, this motion being ſwifter at the equator than in parts more remote, the weight of bodies muſt alſo be much leſs there than nearer the poles. To determine this matter, ſeveral mathematicians were by the French king employed to meaſure a degree on the earth's ſurface in different parts of the world; and, according to their menſurations, the diameter of the earth from north to ſouth is ſhorter than that from eaſt to weſt by 36 miles.

The method of finding the longitudes and latitudes of particular places has been already ſpoken of under ASTRONOMY, pages 401 and 410. The ſame thing, however, may be done by other methods. Thus the latitude may be found by obſerving exactly the meridian altitude of the ſun, and knowing his declination for that day; the declination ſubtracted from the meridian altitude gives the complement of the latitude, and this laſt ſubtracted from 90° leaves the latitude required. As to the longitude, Mr. Harriſon, by his invention of time-pieces, which go much more exactly than either clocks or watches could be made to do formerly, hath in a great meaſure facilitated that. For, ſuppoſing any perſon poſſeſſed of one of theſe time-pieces, to ſet out on a journey, *e. g.* from London: if he adjuſt his time-piece properly before he goes away, he will know the hour at London exactly, let him go where he pleaſes; and when he hath proceeded ſo far either eaſtward or weſtward, that a difference is perceived betwixt the hours ſhown by his time-piece, and thoſe on the clocks or watches at the place to which he goes, the diſtance of that place from London in degrees and minutes of longitude will be known; and if the length of a degree of longitude is known, the real diſtance between the two places may alſo be eaſily found. It is not to be expected, however, that any inſtrument, with whatever care it may be conſtructed, can always be depended upon as an exact meaſurer of time; and therefore frequent corrections of longitudes taken in this manner will be neceſſary. The method of finding the longitude from the eclipſes of Jupiter's ſatellites appears to be the beſt of any. Eclipſes of the ſun, and occultations of the ſtars by the moon, are alſo very proper, though they happen but ſeldom. Eclipſes of the moon have alſo been made uſe of for this purpoſe; but it is found impoſſible to obſerve either the beginning or end of a lunar eclipſe, with the accuracy neceſſary for determining the longitude of any place. All theſe different methods agree in this, that they determine the longitude by the difference of time between the obſervation of the phenomenon in two different places; and of this time, four minutes are to be allowed for every degree of longitude either eaſt or weſt.

After the geographer is thus become acquainted with the longitudes and latitudes of a great number of different places, he

may delineate them upon paper, or make a *map*, either of the whole world, or of any particular country with which he is beſt acquainted. General maps of the world, or of very large tracts, anſwer the purpoſe of ſhowing in what manner the different countries of the world lie with reſpect to each other. They cannot be made of ſuch a ſize as to admit the delineation of many particular towns or cities, neither indeed is it at all required. Where the whole world is delineated at once, the mind can hardly take in more than the idea of the ſituations of different kingdoms from one another; the ſituations of the different cities of each particular kingdom being almoſt wholly overlooked, and not attended to: and this happens likewiſe where a very large portion of the globe, as one of the four quarters, is repreſented on a ſingle map. Beſides theſe, therefore, it is neceſſary to have particular maps of all the different countries done upon a larger ſcale, that thus the mind may not be fatigued by endeavouring to comprehend too much at once. The qualifications which maps ought to have, in order to render them complete, are, 1. That they repreſent the countries exactly of the ſame ſhape, and in the ſame proportions to the eye, that they really have on the earth itſelf. 2. That the diviſions of one country from another be diſtinctly marked, and readily perceptible, without a diſagreeable and tedious ſearch. 3. That the longitudes and latitudes of different places be found exactly on the map, and with little or no trouble.

The foundation of all maps is what is called *the projection of the ſphere*, i. e. the delineation of thoſe circles apparently traced out by the ſun in the heavens, upon ſome ſubſtance, either plane or ſpherical, deſigned to repreſent the ſurface of the earth; upon which alſo are delineated the parallels of latitude, and the meridians, in as great number as the ſize of the map will admit of without confuſion.

Theſe delineations upon a ſpherical ſurface are very eaſy: and under the article Globe, directions are given for the conſtruction of the ſpherical ſubſtances upon which maps of the earth and the heavens are uſually delineated; and which, when furniſhed with the reſt of their apparatus, are called *terreſtrial* and *celeſtial globes*. The method of drawing the maps for theſe globes is never followed in any other caſe; for which reaſon it is alſo referred to the article Globe. The ordinary kinds of maps are conſtructed by delineating the circles of the ſphere upon a plane ſurface, according to the rules of perſpective. This is properly the projection of the ſphere, and is deſigned to give a view of the terraqueous globe, as it would appear, at ſome diſtance, to an eye that could take in the whole extent of it at once.

§ 1. *Of* Projections *of the* Spheres *and* Maps.

Of projections there are two kinds, the *orthographic* and *ſtereographic*; both of which repreſent the ſurface of the earth projected upon the plane of one of its great circles.

I. The *orthographic* ſuppoſes the eye to be placed at an infinite diſtance in the axis of the circle of projection; while the ſtereographic ſuppoſes it to be only in the pole of that circle. The circles on which the projections are uſually made are, the equator, ſome of the meridians, or the rational horizon of ſome particular place. For maps of the world a meridian is generally choſen, and moſt commonly that one which paſſes through Ferro, one of the Canary iſlands, becauſe thus the continents of Europe, Aſia, and Africa, are conveniently delineated in one circle, and America in the other.

1. To project the ſphere orthographically on the plane of any meridian, we have only to conſider, that, as the eye is ſuppoſed to be at an infinite diſtance, all the rays which come from the diſk of the earth are parallel; and conſequently all lines drawn from the eye to the diſk muſt be perpendicular to the latter. Let therefore A B C D (fig. 6. pl. 38.) repreſent the plane of one of the meridians. The equator, which cuts all the meridians in the middle, muſt be repreſented by an infinite number of points let fall upon the plane of projection, and dividing it exactly in the middle: that is, by the right line B D. The parallels of latitude, being alſo perpendicular to the plane of the meridian, will be marked out by an infinite number of right lines let fall from their peripheries upon that plane, thus forming the right lines *a b*, *c d*, &c. The meridians will likewiſe be repreſented on the diſk by an infinite number of right lines let fall perpendicularly from their peripheries upon the plane of projection, and thus will form the elliptic curves A10C, A20C, &c. From an inſpection of the figure, therefore, it appears, that in this projection both longitudes and latitudes are meaſured by a line of ſines, and both of them decreaſe prodigiouſly as we approach the edges of the diſk; and hence the countries which lie at a diſtance from the equator are exceedingly diſtorted, and it is even impoſſible to draw them with any degree of accuracy. The orthographic projection on the plane of a meridian, therefore, is never uſed but for a map of the world.

2. On the plane of the equator, the orthographic projection repreſents the meridians as ſtraight lines diverging from a centre, and the parallels of latitude as concentric circles. See fig. 7. The latter, however, are by no means to be placed at equal diſtances from each other; for the meridians are to be divided by the line of ſines, as in the laſt; and thus the equatorial parts of the globe are as much diſtorted and confuſed as the polar ones were in the foregoing. This projection, therefore, is ſeldom uſed for a map of the whole world, though it anſwers very well for a repreſentation of the polar regions.

3. On the horizon of any particular place, except either of the poles, or any point lying directly under the equator, the orthographic projection repreſents both parallels and meridians by ſegments of ellipſes. Figure 8. ſhows a map done on the horizon of Ur of the Chaldees: it is obvious, however, that a conſiderable degree of diſtortion takes place here alſo, though leſs than in the former caſes. Projections of this kind, therefore, are uſed only for the conſtruction of ſolar eclipſes. See Astronomy, ſect. x.

II. The *ſtereographic* projection of the ſphere ſuppoſes the eye to be in the pole of the circle of projection. The laws of this projection are, 1. A right circle is projected into a line of half tangents. 2. The repreſentation of a right circle, perpendicularly oppoſed to the eye, will be a circle in the plane of the projection. 3. The repreſentation of a circle placed oblique to the eye will be a circle in the plane of the projection. 4. If a great circle is to be projected upon the plane of another great circle, its centre will lie in the line of meaſures, diſtant from the centre of the primitive by the tangent of its elevation above the plane of the primitive. 5. If a leſſer circle, whoſe poles lie in the plane of the projection, were to be projected, the centre of its repreſentation would be in the line of meaſures, diſtant from the centre of the primitive, by the ſecant of the leſſer circle's diſtance from its pole, and its ſemidiameter or radius be equal to the tangent of that diſtance. 6. If a leſſer circle were to be projected, whoſe poles lie not in the plane of the projection, its diameter in the projection, if it falls on each ſide of the pole of the primitive, will be equal to the ſum of the half tangents of its greateſt and neareſt diſtance from the pole of the primitive, ſet each way from the centre of the primitive in the line of meaſures. 7. If the leſſer circle to be projected fall entirely on one ſide of the pole of the projection, and do not encompaſs it: then will its diameter be equal to the difference of the half tangents of its greateſt and neareſt diſtance from the pole of the primitive, ſet off from the centre of the primitive one; and the ſame way in the line of meaſures. 8. In the ſtereographic projection, the angles made by the circles of the ſurface of the ſphere are equal to the angles made by their repreſentatives in the plane of their projection.

For a demonſtration of theſe laws, ſee the articles PERSPECTIVE and PROJECTION. The method of delineating general maps of the world will, however, be eaſily underſtood by the following directions.

1. To delineate *a map of the earth* upon the *plane of a meridian*. Draw a circle of any convenient magnitude, as ABCD, fig. 1. pl. 39, repreſenting half of the earth's diſc; draw two diameters AB, CD, interſecting each other at right angles: AB will then repreſent the equator, and CD that meridian which is directly perpendicular to the plane of projection, C will be the north pole, and D the ſouth pole. Divide the circle into 360 equal parts, repreſenting the degrees of latitude; or into ſmaller parts, if it can admit of ſuch a diviſion, to repreſent minutes. Then, by means of a ſector, divide the equator AB into two lines of ſemi-tangents EA and EB, which will repreſent the degrees of longitude. Then with the ſecant of 80° as a radius deſcribe the arch of the circle C *c* D, which repreſents a meridian cutting the plane of projection at an angle of 80°; with the ſecant of 70° deſcribe the arch C *d* D, which repreſents a meridian cutting the plane of projection at 70°; and thus proceed with the reſt of the meridians, which are uſually drawn at every 10 degrees longitude, as the parallels are at every 10 degrees latitude. Theſe laſt are to be drawn with the tangents for radii as the meridians are with the ſecants; GH repreſenting the parallel of 10 degrees with the tangent of 80°, that of 20 with the tangent of 70, &c. The ecliptic AQB is drawn with the tangent of 66.31 for a radius, its greateſt diſtance from the equator being 23.29. This, though the moſt common projection for maps of the world, has this diſadvantage, however, that neither the degrees of longitude nor latitude continue of the ſame length, even under the ſame parallel; and conſequently the ſhape of the countries is ſomewhat diſtorted: it is alſo exceedingly difficult to find the preciſe degree of longitude or latitude belonging to any place upon maps of this kind, as muſt be evident from an inſpection of the figures.

2. On the *plane of the horizon*. Suppoſe, for inſtance, it is deſired to have London the centre of the map: its latitude we will ſuppoſe to be 51 degrees 32 minutes. Take then the point *E* fig. 2. for London, and from this, as a centre, deſcribe the circle *ABCD* to repreſent the horizon; which you are then to divide into four quadrants, and each of theſe into 90 degrees. Let the diameter *BD* be the meridian, *B* the northern quarter, *D* the ſouthern; the line of equinoctial eaſt and weſt ſhows the firſt vertical, *A* the weſt, *C* the eaſt, or a place of 90 degrees from the zenith in the firſt vertical. All the verticals are repreſented by right lines drawn from the centre *E* to the ſeveral degrees of the horizon. Divide *BD* into 180 degrees, as in the former method; the point in *EB* repreſenting 51 deg. 32 min. of the arch *BC* will be the projection of the north pole, which note with the letter *P*. The point in *ED* repreſenting 51 deg. 32 min. of the arch *DC* (reckoning from *C* towards *D*) will be the projection of the interſection of the equator and meridian of London; and from this, towards *P*, write the numbers of the degrees, 1, 2, 3, &c. As alſo towards *D*, and from *B* towards *P*, viz. 51, 52, 53, &c. Then taking the correſponding points of equal degrees, 88, 89, &c. about thoſe, as diameters, deſcribe circles, which will repreſent parallels, or circles of latitude, with the equator, tropics, and polar circles. For the meridians, firſt deſcribe a circle through the three points *A*, *P*, *C*. This will repreſent the meridian 90 degrees from London. Let its centre be *M* in *BD* (continued to the point *N*, which repreſents the ſouth pole), *PN* being the diameter: through *M* draw a parallel to *AC*, viz. *FH*, continued each way to *K* and *L*. Divide the circle *PHNF* into 360 degrees, and from the point *P* draw right lines to the ſeveral degrees cutting *KFHL*: through the ſeveral points of interſection, and the poles *P*, *N*, as through three given points, deſcribe circles repreſenting all the meridians. The centres for deſcribing the arches will be in the ſame *KL*, as being the ſame that are found by the former interſection, but are to be taken with this caution, that, for the meridian next *BDN* towards *A*, the moſt remote centre towards *L* be taken for the firſt, the ſecond from this, &c. The circles of longitude and latitude thus drawn, inſert the places from a table.

Maps of this kind may be uſeful for particular purpoſes: but the irregular length of the degrees, both of longitude and latitude, render them very unfit for repreſenting the countries in their proper ſhape; and the difficulties in finding the particular degrees of longitude and latitude are even greater in this than any other projection, as is evident from the inſpection of fig. 3.

III. Beſides theſe, there may be a variety of other projections, though few of them are applicable to any particular purpoſe. The three following are thoſe moſt generally uſeful, as having each ſome peculiar property which cannot be found in any other but themſelves.

1. If, inſtead of its globular figure, we ſuppoſe the earth to have a *conical* one, it is plain, that the meridians would be repreſented by ſtraight lines diverging from the apex of the cone, while the parallels are ſhown by concentric circles placed at *equal* diſtances. This kind of projection is not without its uſe. It hath this great advantage, that the longitudes and latitudes may be found with the greateſt eaſe by means of a moveable index placed on the centre. The whole earth may alſo be thus repreſented on a ſingle circle: but thus the countries towards the ſouth pole are prodigiouſly augmented in breadth in proportion to their length; for the degrees of longitude conſtantly increaſe the farther we are removed from the pole, while thoſe of latitude ſtill remain the ſame. This apparent error, however, doth not in the leaſt affect the real proportion of the map, or render it more difficult to find the longitudes or latitudes upon it. See fig. 7 in plate 38.

2. *Mercator's projection* ſuppoſes the earth, inſtead of a globular, to have a *cylindrical* figure; in conſequence of which, the degrees of longitude become of an equal length throughout the whole ſurface, and are marked out on the map by parallel lines. The circles of latitude alſo are repreſented by lines croſſing the former at right angles, but at unequal diſtances. The farther we remove from the equator, the longer the degrees of latitude become in proportion to thoſe of longitude, and that in no leſs a degree than as the ſecant of an arch to the radius of the circle: that is, if we make one degree of longitude at the equator the radius of a circle; at one degree diſtant from the equator, a degree of latitude will be expreſſed by the ſecant of one degree; at ten degrees diſtance, by the ſecant of ten degrees; and ſo on. A map of the world, therefore, cannot be delineated upon this projection, without diſtorting the ſhape of the countries in an extraordinary manner. The projection itſelf is, however, very uſeful in navigation, as it ſhows the different bearings with perfect accuracy, which cannot be done upon any other map. See plate 40.

3. The *globular projection* is an invention of M. de la Hire, and is more uſeful than any of the former for exhibiting the true ſhape of the countries. It may be made in the following manner: Having drawn a circle repreſenting one-half of the earth's diſc, draw two diameters as before, which repreſent the equator and vertical meridian. Divide each of thoſe into 18 equal parts for the meaſures of the degrees of longitude and latitude. Then through the two poles, and every tenth diviſion on the equator, draw arches of circles for the meridians; and in like manner through every tenth degree on each ſemicircle draw an arch, which ſhall likewiſe paſs through every tenth diviſion on the meridian for the parallels of latitude.

IV. The conſtruction of maps of particular parts of the earth

requires a different operation. Large portions of its furface may indeed be drawn on the plane of the meridian, as before directed; but when a fmall part, as the ifland of Britain, for inftance, is to be reprefented on a large fcale, it would be found difficult to draw the arches of fuch large circles as are neceffary, and therefore the following method may be adopted. In this cafe, the degrees of longitude and latitude may be both reprefented by ftraight lines. It is to be remembered, however, that, though the degrees of latitude always continue of an equal length, it is not fo with thofe of longitude. They muft neceffarily decreafe as we approach the pole. The proportion in which they decreafe may be found by the line of longitudes on the plane fcale, or by the following

TABLE, fhowing the Number of Miles contained in a Degree of Longitude, in each Parallel of Latitude from the Equator.

Degrees of Latitude.	Miles.	100th parts of a mile.	Degrees of Latitude.	Miles.	100th parts of a mile.	Degrees of Latitude.	Miles.	100th parts of a mile.
1	59	96	31	51	43	61	29	04
2	59	94	32	50	88	62	28	17
3	59	92	33	50	32	63	27	24
4	59	86	34	49	74	64	26	30
5	59	77	35	49	15	65	25	36
6	59	67	36	48	54	66	24	41
7	59	56	37	47	92	67	23	45
8	59	40	38	47	28	68	22	48
9	59	20	39	46	62	69	21	51
10	59	08	40	46	00	70	20	52
11	58	89	41	45	28	71	19	54
12	58	68	42	44	95	72	18	55
13	58	46	43	43	88	73	17	54
14	58	22	44	43	16	74	16	53
15	58	00	45	42	43	75	15	52
16	57	60	46	41	68	76	14	51
17	57	30	47	41	00	77	13	50
18	57	04	48	40	15	78	12	48
19	56	73	49	39	36	79	11	45
20	56	38	50	38	57	80	10	42
21	56	00	51	37	73	81	09	38
22	55	63	52	37	00	82	08	35
23	55	23	53	36	18	83	07	32
24	54	81	54	35	26	84	06	28
25	54	38	55	34	41	85	05	23
26	54	00	56	33	55	86	04	18
27	53	44	57	32	67	87	03	14
28	53	00	58	31	70	88	02	09
29	52	48	59	30	90	89	01	05
30	51	96	60	30	00	90	00	00

Suppofe then it is required to draw the meridians and parallels for a map of Britain. This ifland is known to lie between 50 and 60 degrees of latitude, and two and feven of longitude. Having therefore chofen the length of your degrees of latitude, you muft next proportion your degrees of longitude to it. By the table you find, that in the latitude of 50° the length of a degree of longitude is to one of latitude as 38,57 is to 60; that is, a degree of longitude in latitude 50 is fomewhat more than half the length of a degree of latitude. The exact proportion may eafily be taken by a diagonal fcale; after which, you are to mark out feven or eight of thofe degrees upon a right line for the length of your intended map. On the extremities of this line raife two perpendiculars, upon which mark out ten degrees of latitude for the height of it. Then, having completed the parallelogram, confult the table for the length of a degree of longitude in lat. 60°, which is found to be very nearly one half a degree of latitude. It will always be proper, however, to draw a vertical meridian exactly in the middle of the parallelogram, to which the meridian on each fide may converge; and from this you are to fet off the degrees of longitude on each fide. Then, having divided the lines bounding your map into as many parts as can conveniently be done to ferve for a fcale, you may by their means fet off the longitudes and latitudes with much lefs trouble than where curve-lines are ufed. This method may always be followed where a particular kingdom is to be delineated, and will reprefent the true figure and fituation of the places with tolerable exactnefs. The particular points of the compafs on which the towns lie with refpect to one another, or their bearings, cannot be exactly known, except by a globe or Mercator's projection. Their diftances, however, may by this means be accurately expreffed; and this is the only kind of maps to which a fcale of miles can be truly adapted.

§ 2. Description *and* Use *of the* Globes *and* Armillary Sphere.

When we have thus difcovered, by means of maps or any other way, the true fituation of the different places of the earth with regard to one another, we may eafily know every other particular relative to them; as, how far diftant they are from us, what hour of the day it is, what feafon of the year, &c. at any particular place. As each of thefe problems, however, would require a particular and fometimes troublefome calculation, machines have been invented, by which all the calculations may be faved, and every problem in geography may be folved mechanically, and in the moft eafy and expeditious manner. Thefe machines are the celeftial and terreftrial globes, and the armillary fphere; of which, and the method of ufing them, we proceed to give a defcription.

If a map of the world be accurately delineated on a fpherical ball, the furface thereof will reprefent the furface of the earth: for the higheft hills are fo inconfiderable with refpect to the bulk of the earth, that they take off no more from its roundnefs than grains of fand do from the roundnefs of a common globe; for the diameter of the earth is 8000 miles in round numbers, and no known hill upon it is much above three miles in perpendicular height. With regard to what we call *up* and *down*, fee the article Gravity.

To an obferver placed any where in the indefinite fpace, where there is nothing to limit his view, all remote objects appear equally diftant from him, and feem to be placed in a vaft concave fphere, of which his eye is the centre. The moon is much nearer to us than the fun; fome of the planets are fometimes nearer and fometimes farther from us than the fun; others of them never come fo near to us as the fun always is; the remoteft planet in our fyftem is beyond comparifon nearer to us than any of the fixed ftars are: and yet all thefe celeftial objects appear equally diftant from us. Therefore, if we imagine a large hollow fphere of glafs to have as many bright ftuds fixed to its infide as there are ftars vifible in the heaven, and thefe ftuds to be of different magnitudes, and placed at the fame angular diftances from each other as the ftars are, the fphere will be a true reprefentation of the ftarry heaven, to an eye fuppofed to be in its centre, and viewing it all around. And if a fmall globe, with a map of the earth upon it, be placed on an axis in the centre of this ftarry fphere, and the fphere be made to turn round on this axis, it will reprefent the apparent motion of the heavens round the earth.

If a great circle be fo drawn upon this fphere as to divide it into two equal parts or hemifpheres, and the plane of the circle

be perpendicular to the axis of the fphere, this circle will reprefent the *equinoctial*, which divides the heaven into two equal parts, called the *northern* and the *fouthern hemifpheres*; and every point of that circle will be equally diftant from the *poles*, or ends of the axis in the fphere. That pole which is in the middle of the northern hemifphere will be called the *north pole of the fphere*; and that which is in the middle of the fouthern hemifphere, the *fouth pole*.

If another grand circle be drawn upon the fphere in fuch a manner as to cut the equinoctial at an angle of $23\frac{1}{2}$ degrees in two oppofite points, it will reprefent the *ecliptic*, or circle of the fun's apparent annual motion; one half of which is on the north fide of the equinoctial, and the other half on the fouth.

If a large ftud be made to move eaftward in this ecliptic in fuch a manner as to go quite round it in the time that the fphere is turned round weftward 366 times upon its axis, this ftud will reprefent the *fun* changing his place every day a 365th part of the ecliptic, and going round weftward the fame way as the ftars do; but with a motion fo much flower than the motion of the ftars, that they will make 366 revolutions about the axis of the fphere in the time that the fun makes only 365. During one half of thefe revolutions, the fun will be on the north fide of the equinoctial; during the other half, on the fouth; and at the end of each half, in the equinoctial.

If we fuppofe the terreftrial globe in this machine to be about one inch in diameter, and the diameter of the ftarry fphere to be about five or fix feet, a fmall infect on the globe would fee only a very little portion of its furface; but it would fee one half of the ftarry fphere, the convexity of the globe hiding the other half from its view. If the fphere be turned weftward round the globe, and the infect could judge of the appearances which arife from that motion, it would fee fome ftars rifing to its view in the eaftern fide of the fphere, whilft others were fetting on the weftern: but as all the ftars are fixed to the fphere, the fame ftars would always rife in the fame points of view on the eaft fide, and fet in the fame points of view on the weft fide. With the fun it would be otherwife; becaufe the fun is not fixed to any point of the fphere, but moves flowly along an oblique circle in it. And if the infect fhould look towards the fouth, and call that point of the globe where the equinoctial in the fphere feems to cut it on the left fide, the eaft point; and where it cuts the globe on the right fide, the weft point; the little animal would fee the fun rife north of the eaft, and fet north of the weft, for $182\frac{1}{2}$ revolutions; after which, for as many more, the fun would rife fouth of the eaft, and fet fouth of the weft. And in the whole 365 revolutions, the fun would rife only twice in the eaft point, and fet twice in the weft. All thefe appearances would be the fame, if the ftarry fphere ftood ftill (the fun only moving in the ecliptic), and the earthly globe were turned round the axis of the fphere eaftward. For, as the infect would be carried round with the globe, he would be quite infenfible of its motion, and the fun and ftars would appear to move weftward.

1. *Defcription of the* Terrestrial Globe.

The equator, ecliptic, and tropics, polar circles, and meridians, are laid down upon the globe in the manner already defcribed. The ecliptic is divided into 12 figns, and each fign into 30 degrees. Each tropic is $23\frac{1}{2}$ degrees from the equator, and each polar circle $23\frac{1}{2}$ degrees from its refpective pole. Circles are drawn parallel to the equator, at every 10 degrees diftance from it on each fide to the poles: thefe circles are called *parallels of latitude*. See plate 39. On large globes there are circles drawn perpendicularly through every tenth degree of the equator, interfecting each other at the poles: but on globes of or under a foot diameter, they are only drawn through every fifteenth degree of the equator: thefe circles are generally called *meridians*, fometimes *circles of longitude*, and at other times *hour circles*.

The globe is hung in a brafs-ring A, called the *brazen meridian*, and turns upon a wire in each pole funk half its thicknefs into one fide of the meridian ring; by which means that fide of the ring divides the globe into two equal parts, called the *eaftern* and *weftern hemifpheres*; as the equator divides it into two equal parts, called the *northern* and *fouthern hemifpheres*. The ring is divided into 360 equal parts or degrees, on the fide wherein the axis of the globe turns. One half of thefe degrees are numbered, and reckoned, from the equator to the poles, where they end at 90: their ufe is to fhow the latitudes of places. The degrees on the other half of the meridian are numbered from the poles to the equator, where they end at 90: their ufe is to fhow how to elevate either the north or fouth pole above the horizon, according to the latitude of any given place, as it is north or fouth of the equator.

The brazen meridian is let into two notches made in a broad flat ring called the *wooden horizon*, B, C; the upper furface of which divides the globe into two equal parts, called the *upper* and *lower hemifpheres*. One notch is in the north point of the horizon, and the other in the fouth. On this horizon are feveral concentric circles, which contain the months and days of the year, the figns and degrees anfwering to the fun's place for each month and day, and the 32 points of the compafs and the circles of amplitude and azimuth. The graduated fide of the brafs meridian lies towards the eaft fide of the horizon, and fhould be generally kept towards the perfon who works problems by the globes.

There is a fmall horary circle D, fo fixed to the north part of the brazen meridian, that the wire in the north pole of the globe is in the centre of that circle; and on the wire is an index, which goes over all the 24 hours of the circle, as the globe is turned round its axis. Sometimes there are two horary circles, one between each pole of the globe and the brazen meridian.

There is a thin flip of brafs, called the *quadrant of altitude*, which is divided into 90 equal parts or degrees, anfwering exactly to fo many degrees of the equator. It is occafionally fixed to the uppermoft point of the brazen meridian by a nut and fcrew. The divifions end at the nut E, and the quadrant is turned round upon it.

There is alfo applied occafionally to the globe a magnetic needle, freely moving over a circle divided into four times 90 degrees; reckoning from the north and fouth points towards the eaft and weft, and alfo into the 32 points of the compafs. As this needle makes nearly a certain conftant angle with the meridian in every place, called the *variation*, therefore this compafs being added to the frame will rectify the pofition of the meridian of the globe when the variation of the needle is known. Thus at London the variation of the needle is at this time about 23 degrees northward; therefore, by moving the frame of the globe about till the needle fettles itfelf over the 23d degree, reckoning weftward from the north point or *fleur de lis*, we fhall have the brafs meridian coinciding with the true meridian. The compafs is fometimes fixed between the legs underneath the globe.

2. *Defcription and Ufe of the* Armillary Sphere.

The exterior parts of this machine are, a compages of brafs rings, which reprefent the principal circles of the heavens, viz. 1. The equinoctial AA, pl. 39, which is divided into 360 degrees (beginning at its interfection with the ecliptic in Aries), for fhowing the fun's right afcenfion in degrees; and alfo into 24 hours, for fhowing his right afcenfion in time. 2. The ecliptic BB, which is divided into 12 figns, and each fign into 30 degrees, and alfo into the months and days of the year; in fuch

a manner that the degree or point of the ecliptic in which the fun is, on any given day, ftands over that day in the circle of months. 3. The tropic of Cancer CC, touching the ecliptic at the beginning of Cancer in *e*, and the tropic of Capricorn DD, touching the ecliptic at the beginning of Capricorn in *f*; each $23\frac{1}{2}$ degrees from the equinoctial circle. 4. The arctic circle E, and the antarctic circle F, each $23\frac{1}{2}$ degrees from its refpective pole at N. and S. 5. The equinoctial colure GG, paffing through the north and fouth poles of the heaven at N and S, and through the equinoctial points Aries and Libra in the ecliptic. 6. The folftitial colure HH, paffing through the poles of the heaven, and through the folftitial points Cancer and Capricorn in the ecliptic. Each quarter of the former of thefe colures is divided into 90 degrees, from the equinoctial to the poles of the world, for fhowing the declination of the fun, moon, and ftars; and each quarter of the latter, from the ecliptic at *e* and *f* to its poles *b* and *d*, for fhowing the latitude of the ftars.

In the north pole of the ecliptic is a nut *b*, to which is fixed one end of a quadrantal wire, and to the other end a fmall fun Y, which is carried round the ecliptic BB, by turning the nut: and in the fouth pole of the ecliptic is a pin *d*, on which is another quadrantal wire, with a fmall moon Z upon it, which may be moved round by the hand: but there is a particular contrivance for caufing the moon to move in an orbit which croffes the ecliptic at an angle of $5\frac{1}{3}$ degrees, in two oppofite points called the *moon's nodes*; and alfo for fhifting thefe points backward in the ecliptic, as the moon's nodes fhift in the heaven.

Within thefe circular rings is a fmall terreftrial globe I, fixed on an axis KK, which extends from the north and fouth poles of the globe at *n* and *s*, to thofe of the celeftial fphere at N and S. On this axis is fixed the flat celeftial meridian LL, which may be fet directly over the meridian of any place on the globe, and then turned round with the globe, fo as to keep over the fame meridian upon it. This flat meridian is graduated the fame way as the brafs meridian of a common globe, and its ufe is much the fame. To this globe is fitted the moveable horizon MM, fo as to turn upon two ftrong wires proceeding from its eaft and weft points to the globe, and entering the globe at the oppofite points of its equator, which is a moveable brafs ring let into the globe in a groove all around its equator. The globe may be turned by hand within this ring, fo as to place any given meridian upon it, directly under the celeftial meridian LL. The horizon is divided into 360 degrees all around its outermoft edge, within which are the points of the compafs for fhowing the amplitude of the fun and moon both in degrees and points. The celeftial meridian LL paffes through two notches in the north and fouth points of the horizon, as in a common globe: but here, if the globe be turned round, the horizon and meridian turn with it. At the fouth pole of the fphere is a circle of 24 hours, fixed to the rings; and on the axis is an index which goes round that circle, if the globe be turned round its axis.

The whole fabric is fupported on a pedeftal N, and may be elevated or depreffed upon the joint O, to any number of degrees from 0 to 90, by means of the arc P, which is fixed in the ftrong brafs arm Q, and flides in the upright piece R, in which is a fcrew at *r*, to fix it at any proper elevation.

In the box T are two wheels (as in Dr. Long's fphere), and two pinions, whofe axes come out at V and U; either of which may be turned by the fmall winch W. When the winch is put upon the axis V, and turned backward, the terreftrial globe, with its horizon and celeftial meridian, keeps at reft; and the whole fphere of circles turns round from eaft, by fouth, to weft, carrying the fun Y, and moon Z, round the fame way, and caufing them to rife above and fet below the horizon. But when the winch is put upon the axis U, and turned forward, the fphere with the fun and moon keep at reft; and the earth, with its horizon and meridian, turn round from weft, by fouth, to eaft; and bring the fame points of the horizon to the fun and moon, to which thefe bodies came when the earth kept at reft and they were carried round it; fhowing that they rife and fet in the fame points of the horizon, and at the fame times in the hour-circle, whether the motion be in the earth or in the heaven. If the earthly globe be turned, the hour-index goes round its hour-circle; but, if the fphere be turned, the hour-circle goes round below the index.

And fo, by this conftruction, the machine is equally fitted to fhow either the real motion of the earth or the apparent motion of the heaven.

To rectify the fphere for ufe, firft flacken the fcrew *r* in the upright ftem R, and, taking hold of the arm Q, move it up or down until the given degree of latitude for any place be at the fide of the ftem R; and then the axis of the fphere will be properly elevated fo as to ftand parallel to the axis of the world, if the machine be fet north and fouth by a fmall compafs: this done, count the latitude from the north pole, upon the celeftial meridian LL, down towards the north notch of the horizon, and fet the horizon to that latitude; then turn the nut *b* until the fun comes to the given day of the year in the ecliptic, and the fun Y will be at its proper place for that day: find the place of the moon's afcending node, and alfo the place of the moon, by an ephemeris, and fet them right accordingly: laftly, turn the winch W, until either the fun comes to the meridian LL, or until the meridian comes to the fun (according as you want the fphere or earth to move), and fet the hour-index to the XII, marked noon, and the whole machine will be rectified. Then turn the winch, and obferve when the fun or moon rife and fet in the horizon, and the hour-index will fhow the times thereof for the given day.

As thofe who underftand the ufe of the globes will be at no lofs to work many other problems by this fphere, it is needlefs to enlarge any farther upon it.

3. *Directions for ufing* Globes.

In ufing globes, keep the eaft fide of the horizon towards you (unlefs the problem requires the turning of it), which fide you may know by the word Eaft upon the horizon; for then you have the graduated fide of the meridian towards you, the quadrant of altitude before you, and the globe divided exactly into two equal parts, by the graduated fide of the meridian.

In working fome problems, it will be neceffary to turn the whole globe and horizon about, that you may look on the weft fide thereof; which turning will be apt to jog the ball fo, as to fhift away that degree of the globe which was before fet to the horizon or meridian: to avoid which inconvenience, you may thruft in the feather end of a quill between the ball of the globe and the brazen meridian; which, without hurting the ball, will keep it from turning in the meridian, whilft you turn the weft fide of the horizon towards you.

Prob. I. *To find the latitude and longitude of any given place upon the globe.*—Turn the globe on its axis, until the given place comes exactly under that graduated fide of the brazen meridian on which the degrees are numbered from the equator, and obferve what degree of the meridian the place then lies under; which is its latitude, north or fouth, as the place is north or fouth of the equator.

The globe remaining in this pofition, the degree of the equator which is under the brazen meridian is the longitude of the place, which is eaft or weft, as the place lies on the eaft or weft fide of the firft meridian of the globe. All the Atlantic ocean and America are on the weft fide of the meridian of London; and the greateft part of Europe and of Africa, together with all

Asia, is on the east side of the meridian of London, which is reckoned the first meridian of the globe by the British geographers and astronomers.

PROB. II. *The longitude and latitude of a place being given, to find that place on the globe.*—Look for the given longitude in the equator (counting it eastward or westward from the first meridian, as it is mentioned to be east or west); and bringing the point of longitude in the equator to the brazen meridian, on that side which is above the south point of the horizon: then count from the equator, on the brazen meridian, to the degree of the given latitude, towards the north or south pole, according as the latitude is north or south; and under that degree of latitude on the meridian you will have the place required.

PROB. III. *To find the difference of longitude, or difference of latitude, between any two given places.*—Bring each of these places to the brazen meridian, and see what its latitude is: the lesser latitude subtracted from the greater, if both places are on the same side of the equator, or both latitudes added together if they are on different sides of it, is the difference of latitude required. And the number of degrees contained between these places, reckoned on the equator, when they are brought separately under the brazen meridian, is their difference of longitude, if it be less than 180; but, if more, let it be subtracted from 360, and the remainder is the difference of longitude required. Or,

Having brought one of the places to the brazen meridian, and set the hour-index to XII, turn the globe until the other place comes to the brazen meridian; and the number of hours and parts of an hour passed over by the index will give the longitude in time; which may be easily reduced to degrees, by allowing 15 degrees for every hour, and one degree for every four minutes.

Observe: when we speak of bringing any place to the brazen meridian, it is the graduated side of the meridian that is meant.

PROB. IV. *Any place being given, to find all those places that have the same longitude or latitude with it.*—Bring the given place to the brazen meridian; then all those places which lie under that side of the meridian, from pole to pole, have the same longitude with the given place. Turn the globe round its axis; and all those places which pass under the same degree of the meridian that the given place does have the same latitude with that place.

Since all latitudes are reckoned from the equator, and all longitudes are reckoned from the first meridian, it is evident, that the point of the equator which is cut by the first meridian has neither latitude nor longitude. The greatest latitude is 90 degrees, because no place is more than 90 degrees from the equator: and the greatest longitude is 180 degrees, because no place is more than 180 degrees from the first meridian.

PROB. V. *To find the* antœci, periœci, *and* antipodes, *of any given place.*—Bring the given place to the brazen meridian; and, having found its latitude, keep the globe in that situation, and count the same number of degrees of latitude from the equator towards the contrary pole; and where the reckoning ends, you have the *antœci* of the given place upon the globe. Those who live at the equator have no *antœci*.

The globe remaining in the same position, set the hour-index to the upper XII on the horary circle, and turn the globe until the index comes to the lower XII; then the place which lies under the meridian in the same latitude with the given place is the *periœci* required. Those who live at the poles have no *periœci*.

As the globe now stands (with the index at the lower XII), the *antipodes* of the given place will be under the same point of the brazen meridian where its *antœci* stood before. Every place upon the globe has its *antipodes*.

PROB. VI. *To find the distance between any two places on the globe.*—Lay the graduated edge of the quadrant of altitude over both the places, and count the number of degrees intercepted between them on the quadrant; then multiply these degrees by 60, and the product will give the distance in geographical miles: but to find the distance in miles, multiply the degrees by $69\frac{1}{2}$, and the product will be the number of miles required. Or, take the distance betwixt any two places with a pair of compasses, and apply that extent to the equator; the number of degrees intercepted between the points of the compasses is the distance in degrees of a great circle: which may be reduced either to geographical miles, or to English miles, as above.

PROB. VII. *A place on the globe being given, and its distance from any other place; to find all the other places upon the globe which are at the same distance from the given place.*—Bring the given place to the brazen meridian, and screw the quadrant of altitude to the meridian directly over that place; then keeping the globe in that position, turn the quadrant quite round upon it, and the degree of the quadrant that touches the second place will pass over all the other places which are equally distant with it from the given place.

This is the same as if one foot of a pair of compasses was set in the given place, and the other foot extended to the second place, whose distance is known; for if the compasses be then turned round the first place as a centre, the moving foot will go over all those places which are at the same distance with the second from it.

PROB. VIII. *The hour of the day at any place being given, to find all those places where it is noon at that time.*—Bring the given place to the brazen meridian, and set the index to the given hour; this done, turn the globe until the index points to the upper XII, and then all the places that lie under the brazen meridian have noon at that time.

Observe: the upper XII always stands for noon; and when the bringing of any place to the brazen meridian is mentioned, the side of that meridian on which the degrees are reckoned from the equator is meant, unless the contrary side be mentioned.

PROB. IX. *The hour of the day at any place being given, to find what o'clock it then is at any other place.*—Bring the given place to the brazen meridian, and set the index to the given hour; then turn the globe, until the place where the hour is required comes to the meridian, and the index will point out the hour at that place.

PROB. X. *To find the sun's place in the ecliptic, and his declination, for any given day of the year.*—Look on the horizon for the given day, and right against it you have the degree of the sign in which the sun is (or his place) on that day at noon. Find the same degree of that sign in the ecliptic line upon the globe, and, having brought it to the brazen meridian, observe what degree of the meridian stands over it; for that is the sun's declination, reckoned from the equator.

PROB. XI. *The day of the month being given, to find all those places of the earth over which the sun will pass vertically on that day.*—Find the sun's place in the ecliptic for the given day, and, having brought it to the brazen meridian, observe what point of the meridian is over it; then, turning the globe round its axis, all those places which pass under that point of the meridian are the places required: for as their latitude is equal, in degrees and parts of a degree, to the sun's declination, the sun must be directly over-head to each of them at its respective noon.

PROB. XII. *A place being given in the torrid zone, to find those two days of the year on which the sun shall be vertical to that place.*—Bring the given place to the brazen meridian, and mark the degree of latitude that is exactly over it on the meri-

dian; then turn the globe round its axis, and obſerve the two degrees of the ecliptic which paſs exactly under that degree of latitude: laſtly, find on the wooden horizon the two days of the year in which the ſun is in thoſe degrees of the ecliptic, and they are the days required: for on them, and none elſe, the ſun's declination is equal to the latitude of the given place; and, conſequently, he will then be vertical to it at noon.

PROB. XIII. *To find all thoſe places of the north frigid zone, where the ſun begins to ſhine conſtantly without ſetting, on any given day, from the 21ſt of March to the 23d of September.*—On theſe two days, the ſun is in the equinoctial, and enlightens the globe exactly from pole to pole: therefore, as the earth turns round its axis, which terminates in the poles, every place upon it will go equally through the light and the dark, and ſo make the day and night equal to all places of the earth. But as the ſun declines from the equator towards either pole, he will ſhine juſt as many degrees round that pole as are equal to his declination from the equator: ſo that no place within that diſtance of the pole will then go through any part of the dark, and conſequently the ſun will not ſet to it. Now, as the ſun's declination is northward from the 21ſt of March to the 23d of September, he muſt conſtantly ſhine round the north pole all that time; and on the day that he is in the northern tropic, he ſhines upon the whole north frigid zone: ſo that no place within the north polar circle goes through any part of the dark on that day. Therefore,

Having brought the ſun's place for the given day to the brazen meridian, and found his declination (by Prob. IX), count as many degrees on the meridian, from the north pole, as are equal to the ſun's declination from the equator, and mark that degree from the pole where the reckoning ends; then turning the globe round its axis, obſerve what places in the north frigid zone paſs directly under that mark; for they are the places required.

The like may be done for the ſouth frigid zone, from the 23d of September to the 21ſt of March, during which time the ſun ſhines conſtantly on the ſouth pole.

PROB. XIV. *To find the place over which the ſun is vertical at any hour of a given day.*—Having found the ſun's declination for the given day (by Prob. X.), mark it with a pencil on the brazen meridian: then bring the place where you are (ſuppoſe Edinburgh) to the brazen meridian, and ſet the index to the given hour; which done, turn the globe on its axis, until the index points to XII at noon; and the place on the globe, which is then directly under the point of the ſun's declination marked upon the meridian, has the ſun that moment in the zenith, or directly over-head.

PROB. XV. *The day and hour of a lunar eclipſe being given, to find all thoſe places of the earth to which it will be viſible.*—The moon is never eclipſed but when ſhe is full, and ſo directly oppoſite to the ſun, that the earth's ſhadow falls upon her. Therefore, whatever place of the earth the ſun is vertical to at that time, the moon muſt be vertical to the antipodes of that place: ſo that the ſun will be then viſible to one half of the earth, and the moon to the other.

Find the place to which the ſun is vertical at the given hour (by Prob. XIV.), elevate the pole to the latitude of that place, and bring the place to the upper part of the brazen meridian, as in the former problem: then, as the ſun will be viſible to all thoſe parts of the globe which are above the horizon, the moon will be viſible to all thoſe parts which are below it, at the time of her greateſt obſcuration.

PROB. XVI. *To rectify the globe for the latitude, the zenith, and the ſun's place.*—Find the latitude of the place (by Prob. I.), and if the place be in the northern hemiſphere, raiſe the north pole above the north point of the horizon, as many degrees (counted from the pole upon the brazen meridian) as are equal to the latitude of the place. If the place be in the ſouthern hemiſphere, raiſe the ſouth pole above the ſouth point of the horizon as many degrees as are equal to the latitude. Then turn the globe till the place comes under its latitude on the brazen meridian, and faſten the quadrant of altitude ſo, that the chamfered edge of its nut (which is even with the graduated edge) may be joined to the zenith, or point of latitude. This done, bring the ſun's place in the ecliptic for the given day (found by Prob. X.) to the graduated ſide of the brazen meridian, and ſet the hour-index to XII at noon, which is the uppermoſt XII on the hour-circle; and the globe will be rectified.

PROB. XVII. *The latitude of any place, not exceeding $66\frac{1}{2}$ degrees, and the day of the month being given, to find the time of the ſun's riſing and ſetting, and conſequently the length of the day and night.*—Having rectified the globe for the latitude, and for the ſun's place on the given day (as directed in the preceding problem), bring the ſun's place in the ecliptic to the eaſtern ſide of the horizon, and the hour-index will ſhow the time of ſun-riſing; then turn the globe on its axis, until the ſun's place comes to the weſtern ſide of the horizon, and the index will ſhow the time of ſun-ſetting.

The hour of ſun-ſetting doubled gives the length of the day; and the hour of ſun-riſing doubled gives the length of the night.

PROB. XVIII. *The latitude of any place and the day of the month being given, to find when the morning twilight begins, and the evening twilight ends, at that place.*—This problem is often limited: for, when the ſun does not go 18 degrees below the horizon, the twilight continues the whole night; and for ſeveral nights together in ſummer, between 49 and $66\frac{1}{2}$ degrees of latitude; and the nearer to $66\frac{1}{2}$, the greater is the number of theſe nights. But when it does begin and end, the following method will ſhow the time for any given day:

Rectify the globe, and bring the ſun's place in the ecliptic to the eaſtern ſide of the horizon; then mark with a chalk that point of the ecliptic which is in the weſtern ſide of the horizon, it being the point oppoſite to the ſun's place: this done, lay the quadrant of altitude over the ſaid point, and turn the globe eaſtward, keeping the quadrant at the chalk mark, until it is juſt 18 degrees high on the quadrant; and the index will point out the time when the morning twilight begins: for the ſun's place will then be 18 degrees below the eaſtern ſide of the horizon. To find the time when the evening twilight ends, bring the ſun's place to the weſtern ſide of the horizon; and the point oppoſite to it, which was marked with the chalk, will be riſing in the eaſt: then bring the quadrant over that point, and, keeping it thereon, turn the globe weſtward, until the ſaid point be 18 degrees above the horizon on the quadrant, and the index will ſhow the time when the evening twilight ends; the ſun's place being then 18 degrees below the weſtern ſide of the horizon.

PROB. XIX. *To find on what day of the year the ſun begins to ſhine conſtantly, without ſetting, on any given place in the north frigid zone; and how long he continues to do ſo.*—Rectify the globe to the latitude of the place, and turn it about until ſome point of the ecliptic, between Aries and Cancer, coincides with the north point of the horizon where the brazen meridian cuts it; then find, on the wooden horizon, what day of the year the ſun is in that point of the ecliptic; for that is the day on which the ſun begins to ſhine conſtantly on the given place without ſetting. This done, turn the globe until ſome point of the ecliptic, between Cancer and Libra, coincides with the north point of the horizon, where the brazen meridian cuts it; and find, on the wooden horizon, on what day the ſun is in that point of the ecliptic; which is the day that the ſun leaves off conſtantly ſhining on the ſaid place, and riſes and ſets to it as to other places on the globe. The number of natural days,

or complete revolutions of the ſun about the earth, between the two days above found, is the time that the ſun keeps conſtantly above the horizon without ſetting: for all that portion of the ecliptic which lies between the two points which interſect the horizon in the very north never ſets below it, and there is juſt as much of the oppoſite part of the ecliptic that never riſes; therefore the ſun will keep as long conſtantly below the horizon in winter as above it in ſummer.

Prob. XX. *To find in what latitude the ſun ſhines conſtantly without ſetting, for any length of time leſs than* $182\frac{1}{2}$ *of our days and nights.*—Find a point in the ecliptic half as many degrees from the beginning of Cancer (either toward Aries or Libra) as there are natural days in the time given, and bring that point to the north ſide of the brazen meridian, on which the degrees are numbered from the pole towards the equator; then keep the globe from turning on its axis, and ſlide the meridian up or down until the aforeſaid point of the ecliptic comes to the north point of the horizon, and then the elevation of the pole will be equal to the latitude required.

Prob. XXI. *The latitude of a place not exceeding* $66\frac{1}{2}$ *degrees, and the day of the month, being given; to find the ſun's amplitude, or point of the compaſs on which he riſes or ſets.*—Rectify the globe, and bring the ſun's place to the eaſtern ſide of the horizon; then obſerve what point of the compaſs on the horizon ſtands right againſt the ſun's place, for that is his amplitude at riſing. This done, turn the globe weſtward until the ſun's place comes to the weſtern ſide of the horizon, and it will cut the point of his amplitude at ſetting. Or, you may count the riſing amplitude in degrees, from the eaſt point of the horizon to that point where the ſun's place cuts it; and the ſetting amplitude, from the weſt point of the horizon to the ſun's place at ſetting.

Prob. XXII. *The latitude, the ſun's place, and his altitude, being given; to find the hour of the day, and the ſun's azimuth, or number of degrees that he is diſtant from the meridian.*—Rectify the globe, and bring the ſun's place to the given height upon the quadrant of altitude; on the weſtern ſide of the horizon, if the time be in the forenoon, or the eaſtern ſide if it be in the afternoon: then the index will ſhow the hour; and the number of degrees in the horizon intercepted between the quadrant of altitude and the ſouth point will be the ſun's true azimuth at that time.

Prob. XXIII. *The latitude, hour of the day, and the ſun's place, being given; to find the ſun's altitude and azimuth.*—Rectify the globe, and turn it until the index points to the given hour; then lay the quadrant of altitude over the ſun's place in the ecliptic, and the degree of the quadrant cut by the ſun's place is his altitude at that time above the horizon; and the degree of the horizon cut by the quadrant is the ſun's azimuth reckoned from the ſouth.

Prob. XXIV. *The latitude, the ſun's altitude, and his azimuth, being given; to find his place in the ecliptic, the day of the month, and hour of the day, though they had all been loſt.*—Rectify the globe for the latitude and zenith, and ſet the quadrant of altitude to the given azimuth in the horizon; keeping it there, turn the globe on its axis until the ecliptic cuts the quadrant in the given altitude; that point of the ecliptic which cuts the quadrant there will be the ſun's place, and the day of the month anſwering thereto will be found over the like place of the ſun on the wooden horizon. Keep the quadrant of altitude in that poſition, and having brought the ſun's place to the brazen meridian, and the hour index to XII at noon, turn back the globe until the ſun's place cuts the quadrant of altitude again, and the index will ſhow the hour.

Any two points of the ecliptic, which are equidiſtant from the beginning of Cancer or of Capricorn, will have the ſame altitude and azimuth at the ſame hour, though the months be different; and therefore it requires ſome care in this problem not to miſtake both the month and the day of the month; to avoid which, obſerve, that, from the 20th of March to the 21ſt of June, that part of the ecliptic which is between the beginning of Aries and beginning of Cancer is to be uſed; from the 21ſt of June to the 23d of September, between the beginning of Cancer and beginning of Libra; from the 23d of September to the 21ſt of December, between the beginning of Libra and the beginning of Capricorn; and from the 21ſt of December to the 20th of March, between the beginning of Capricorn and beginning of Aries. And as one can never be at a loſs to know in what quarter of the year he takes the ſun's altitude and azimuth, the above caution with regard to the quarters of the ecliptic will keep him right as to the month and day thereof.

Prob. XXV. *To find the length of the longeſt day at any given place.*—If the place be on the north ſide of the equator, find its latitude (by prob. I.), and elevate the north pole to that latitude; then bring the beginning of Cancer to the brazen meridian, and ſet the hour index to XII at noon. But if the given place be on the ſouth ſide of the equator, elevate the ſouth pole to its latitude, and bring the beginning of Capricorn to the braſs meridian, and the hour-index to XII. This done, turn the globe weſtward until the beginning of Cancer or Capricorn (as the latitude is north or ſouth) comes to the horizon; and the index will then point out the time of ſun-ſetting, for it will have gone over all the afternoon hours, between mid-day and ſun-ſet; which length of time being doubled will give the whole length of the day from ſun-riſing to ſun-ſetting: for in all latitudes the ſun riſes as long before mid-day as he ſets after it.

Prob. XXVI. *To find in what latitude the longeſt day is, of any given length leſs than 24 hours.*—If the latitude be north, bring the beginning of Cancer to the brazen meridian, and elevate the north pole to about $66\frac{1}{2}$ degrees; but, if the latitude be ſouth, bring the beginning of Capricorn to the meridian, and elevate the ſouth pole to about $66\frac{1}{2}$ degrees; becauſe the longeſt day in the north latitude is when the ſun is in the firſt point of Cancer, and in ſouth latitude when he is in the firſt point of Capricorn. Then ſet the hour-index to XII at noon, and turn the globe weſtward until the index points at half the number of hours given; which done, keep the globe from turning on its axis, and ſlide the meridian down in the notches, until the aforeſaid point of the ecliptic (viz. Cancer or Capricorn) comes to the horizon); then the elevation of the pole will be equal to the latitude required.

Prob. XXVII. *The latitude of any place, not exceeding* $66\frac{1}{2}$ *degrees, being given; to find in what climate the place is.*—Find the length of the longeſt day at the given place by prob. XXV. and whatever be the number of hours whereby it exceeds twelve, double that number, and the ſum will give the climate in which the place is.

Prob. XXVIII. *The latitude and the day of the month being given; to find the hour of the day when the ſun ſhines.*—Set the wooden horizon truly level, and the brazen meridian due north and ſouth by a mariner's compaſs; then, having rectified the globe, ſtick a ſmall ſewing-needle into the ſun's place in the ecliptic, perpendicular to that part of the ſurface of the globe: this done, turn the globe on its axis until the needle comes to the brazen meridian, and ſet the hour-index to XII at noon; then turn the globe on its axis until the needle points exactly towards the ſun (which it will do when it caſts no ſhadow on the globe), and the index will ſhow the hour of the day.

4. *The Uſe of the* Celestial Globe.

Having done for the preſent with the terreſtrial globe, we ſhall proceed to the uſe of the celeſtial; firſt premiſing, that, as the equator, ecliptic, tropics, polar circles, horizon, and brazen meridian, are exactly alike on both globes, all the former pro-

blems concerning the ſun are ſolved the ſame way by both globes. The method alſo of rectifying the celeſtial globe is the ſame as rectifying the terreſtrial. *N. B.* The ſun's place for any day of the year ſtands directly over that day on the horizon of the celeſtial globe, as it does on that day of the terreſtrial. See plate 39.

The *latitude* and *longitude* of the ſtars, or of all other celeſtial phenomena, are reckoned in a very different manner from the latitude and longitude of places on the earth: for all terreſtrial latitudes are reckoned from the equator, and longitudes from the meridian of ſome remarkable place, as of London by the Britiſh, and of Paris by the French. But the aſtronomers of all nations agree in reckoning the latitudes of the moon, ſtars, planets, and comets, from the ecliptic; and their longitudes from the equinoctial colure, in that ſemicircle of it which cuts the ecliptic at the beginning of Aries; and thence eaſtward, quite round, to the ſame ſemicircle again. Conſequently thoſe ſtars which lie between the equinoctial and the northern half of the ecliptic have north declination and ſouth latitude; thoſe which lie between the equinoctial and the ſouthern half of the ecliptic have ſouth declination and north latitude; and all thoſe which lie between the tropics and poles have their declinations and latitudes of the ſame denomination.

There are ſix great circles on the celeſtial globe which cut the ecliptic perpendicularly, and meet in two oppoſite points in the polar circles, which points are each ninety degrees from the ecliptic, and are called its poles. Theſe polar points divide thoſe circles into 12 ſemicircles, which cut the ecliptic at the beginnings of the twelve ſigns They reſemble ſo many meridians on the terreſtrial globe; and as all places which lie under any particular meridian-ſemicircle on that globe have the ſame longitude, ſo all thoſe points of the heaven through which any of the above ſemicircles are drawn have the ſame longitude. And as the greateſt latitudes on the earth are at the north and ſouth poles of the earth, ſo the greateſt latitudes in the heaven are at the north and ſouth poles of the ecliptic.

For the diviſion of the ſtars into conſtellations, &c. ſee Astronomy, page 400.

Prob. I. *To find the right aſcenſion and declination of the ſun, or any fixed ſtar.*—Bring the ſun's place in the ecliptic to the brazen meridian; then that degree in the equinoctial which is cut by the meridian is the ſun's *right aſcenſion*; and that degree of the meridian which is over the ſun's place is his *declination*. Bring any fixed ſtar to the meridian, and its right aſcenſion will be cut by the meridian in the equinoctial; and the degree of the meridian that ſtands over is its declination. So that right aſcenſion and declination on the celeſtial globe are found in the ſame manner as longitude and latitude on the terreſtrial.

Prob. II. *To find the latitude and longitude of any ſtar.*—If the given ſtar be on the north ſide of the ecliptic, place the 90th degree of the quadrant of altitude on the north pole of the ecliptic, where the 12 ſemicircles meet, which divide the ecliptic into the 12 ſigns; but if the ſtar be on the ſouth ſide of the ecliptic, place the 90th degree of the quadrant on the ſouth pole of the ecliptic: keeping the 90th degree of the quadrant on the proper pole, turn the quadrant about until its graduated edge cuts the ſtar: then the number of degrees in the quadrant between the ecliptic and the ſtar is the latitude; and the degree of the ecliptic cut by the quadrant is the ſtar's longitude, reckoned according to the ſign in which the quadrant then is.

Prob. III. *To repreſent the face of the ſtarry firmament, as ſeen from any given place of the earth, at any hour of the night.*—Rectify the celeſtial globe for the given latitude, the zenith, and ſun's place in every reſpect, as taught by the XVIth problem for the terreſtrial, and turn it about until the index points to the given hour; then the upper hemiſphere of the globe will repreſent the viſible half of the heaven for that time, all the ſtars upon the globe being then in ſuch ſituations as exactly correſpond to thoſe in the heaven. And if the globe be placed duly north and ſouth, by means of a ſmall ſea-compaſs, every ſtar in the globe will point toward the like ſtar in the heaven, by which means the conſtellations and remarkable ſtars may be eaſily known. All thoſe ſtars which are in the eaſtern ſide of the horizon are then riſing in the eaſtern ſide of the heaven; all in the weſtern are ſetting in the weſtern ſide; and all thoſe under the upper part of the brazen meridian, between the ſouth point of the horizon and the north pole, are at their greateſt altitude if the latitude of the place be north; but if the latitude be ſouth, thoſe ſtars which lie under the upper part of the meridian, between the north point of the horizon and the ſouth pole, are at their greateſt altitude.

Prob. IV. *The latitude of the place, and day of the month, being given; to find the time when any known ſtar will riſe, or be upon the meridian, or ſet.*—Having rectified the globe, turn it about until the given ſtar comes to the eaſtern ſide of the horizon, and the index will ſhow the time of the ſtar's riſing; then turn the globe weſtward, and, when the ſtar comes to the brazen meridian, the index will ſhow the time of the ſtar's coming to the meridian of your place; laſtly, turn on until the ſtar comes to the weſtern ſide of the horizon, and the index will ſhow the time of the ſtar's ſetting. *N. B.* In northern latitudes, thoſe ſtars which are leſs diſtant from the north pole than the quantity of its elevation above the north point of the horizon never ſet; and thoſe which are leſs diſtant from the ſouth pole than the number of degrees by which it is depreſſed below the horizon never riſe; and *vice verſa* in ſouthern latitudes.

Prob. V. *To find at what time of the year a given ſtar will be upon the meridian at a given hour of the night.*—Bring the given ſtar to the upper ſemicircle of the braſs meridian, and ſet the index to the given hour; then turn the globe until the index points to XII at noon, and the upper ſemicircle of the meridian will then cut the ſun's place, anſwering to the day of the year ſought; which day may be eaſily found againſt the like place of the ſun among the ſigns on the wooden horizon.

Prob. VI. *The latitude, day of the month, and azimuth of any known ſtar being given; to find the hour of the night.*—Having rectified the globe for the latitude, zenith, and ſun's place, lay the quadrant of altitude to the given degree of azimuth in the horizon; then turn the globe on its axis until the ſtar comes to the graduated edge of the quadrant; and, when it does, the index will point out the hour of the night.

Prob. VII. *The latitude of the place, the day of the month, and altitude of any known ſtar, being given; to find the hour of the night.*—Rectify the globe as in the former problem, gueſs at the hour of the night, and turn the globe until the index points at the ſuppoſed hour: then lay the graduated edge of the quadrant of altitude over the known ſtar; and if the degree of the ſtar's height in the quadrant upon the globe anſwers exactly to the degree of the ſtar's obſerved altitude in the heaven, you have gueſſed exactly: but if the ſtar on the globe is higher or lower than it was obſerved to be in the heaven, turn the globe backwards or forwards, keeping the edge of the quadrant upon the ſtar, until its centre comes to the obſerved altitude in the quadrant; and then the index will ſhow the true time of the night.

Prob. VIII. *An eaſy method for finding the hour of the night by any two known ſtars, without knowing either their altitude or azimuth; and then of finding both their altitude and azimuth, and thereby the true meridian.*—Tie one end of a thread to a common muſket bullet; and, having rectified the globe as above, hold the other end of the thread in your hand, and carry it ſlowly round betwixt your eye and the ſtarry heaven, until you find it cuts any two known ſtars at once. Then gueſſing

at the hour of the night, turn the globe until the index points to that time in the hour-circle; which done, lay the graduated edge of the quadrant over any one of these two stars on the globe which the thread cut in the heaven. If the said edge of the quadrant cuts the other star also, you have guessed the time exactly; but, if it does not, turn the globe slowly backwards or forwards, until the quadrant (kept upon either star) cuts them both through their centres: and then the index will point out the exact time of the night; the degree of the horizon cut by the quadrant will be the true azimuth of both these stars from the south; and the stars themselves will cut their true altitudes in the quadrant. At which moment, if a common azimuth-compass be so set upon a floor or level pavement, that these stars in the heaven may have the same bearing upon it (allowing for the variation of the needle) as the quadrant of altitude has in the wooden horizon of the globe, a thread extended over the north and south points of that compass will be directly in the plane of the meridian: and if a line be drawn upon the floor or pavement along the course of the thread, and an upright wire be placed in the southmost end of the line, the shadow of the wire will fall upon that line, when the sun is on the meridian and shines upon the pavement.

PROB. IX. *To find the place of the moon, or of any planet; and thereby to show the time of its rising, southing, and setting.*—See in Parker's or Weaver's ephemeris the geocentric place of the moon or planet in the ecliptic for the given day of the month; and according to its longitude and latitude, as shown by the ephemeris, mark the same with a chalk upon the globe. Then having rectified the globe, turn it round its axis westward; and as the said mark comes to the eastern side of the horizon, to the brazen meridian, and to the western side of the horizon, the index will show at what time the planet rises, comes to the meridian, and sets, in the same manner as it would do for a fixed star. For the equation of time, see ASTRONOMY, p. 398.

5. *Description of the Modern Improvements applied to Globes.*

GLOBES mounted in the common manner, and with their hour-circles fixed on the meridian, although instructive instruments for explaining the first principles of geography and the spherical doctrine of astronomy, yet have several defects; as they prevent any elevation of the north and south poles near to their axes, or the brass meridian from being moveable quite round in the horizon. They do not show how all the phenomena illustrated by them arise from the motion of the earth—a matter of consequence to beginners: and they are only adapted to the present age, consequently do not serve accurately the purposes of chronology and history, which they might be made to do, if the poles whereon they turn were contrived to move in a circle round those of the ecliptic, according to its present obliquity.

The late Mr. John Senex F. R. S. invented a contrivance for remedying these defects, by fixing the poles of the diurnal motion to two shoulders or arms of brass at the distance of $23\frac{1}{2}$ deg. from the poles of the ecliptic. These shoulders are strongly fastened at the other end to an iron axis, which passes through the poles of the ecliptic, and is made to move round with a very stiff motion; so that, when it is adjusted to any point of the ecliptic which the equator is made to intersect, the diurnal motion of the globe on its axis will not disturb it. When it is to be adjusted for any time, past or future, one of the brazen shoulders is brought under the meridian, and held fast to it with one hand, whilst the globe is turned about with the other; so that the point of the ecliptic which the equator is to intersect may pass under the 0 degree of the brazen meridian: then holding a pencil to that point, and turning the globe about, it will describe the equator according to its position at the time required; and transferring the pencil to $23\frac{1}{2}$ and $66\frac{1}{2}$ degrees on the brazen meridian, the tropics and polar circles will be so described for the same time. By this contrivance, the celestial globe may be so adjusted, as to exhibit not only the rising and setting of the stars in all ages and in all latitudes, but likewise the other phenomena that depend upon the motion of the diurnal axis round the annual axis. Senex's celestial globes, especially the two greatest, of 17 and 28 inches in diameter, have been constructed upon this principle; so that, by means of a nut and screw, the pole of the equator is made to revolve about the pole of the ecliptic. Phil. Transf. N° 447. p. 201, 203. or Martyn's Abr. vol. viii. p. 217. and N° 493. art. 18. in Phil. Transf. vol. xlvi. p. 290.

To represent the above phenomena in the most natural and easy manner, the late Mr. B. Martin applied to Mr. Senex's contrivance a moveable equinoctial and solstitial colure; a moveable equinoctial circle, and a moveable ecliptic; all so connected together, as to represent those imaginary circles in the heavens for any age of the world.

Mr. Joseph Harris, late assay-master of the mint, contrived to remedy the former of the defects above mentioned, by placing two horary circles under the meridian, one at each pole; these circles are fixed tight between two brass rollers placed about the axis, so that when the globe is turned they are carried round with it, the meridian serving as an index to cut the horary divisions. The globe in this state serves universally and readily for solving problems in north and south latitudes, and also in places near the equator; whereas in the common construction the axis and horary circle prevent the brass meridian from being moveable quite round in the horizon. This globe is also adapted for showing how the vicissitudes of day and night, and the alteration of their lengths, are really occasioned by the motion of the earth: for this purpose, he divided the brass meridian at one of the poles into months and days, according to the sun's declination, reckoning from the pole. Therefore, by bringing the day of the month to the horizon, and rectifying the globe according to the time of the day, the horizon will represent the circle separating light and darkness; and the upper half of the globe, the illuminated hemisphere, the sun being in the zenith Phil. Transf. N° 456. p. 321. or Martyn's Abr. vol. viii. p. 352.

The late Mr. George Adams made some additional improvements in the construction of the globes. His globes, like others, are suspended at their poles in a strong brass circle NZÆS (see the figure of the celestial globe in plate 39), and turn therein upon two iron pins which form the axis. They have each a thin brass semicircle NHS moveable about these poles, with a small, thin, sliding circle H thereon; which semicircle is divided into two quadrants of 90 degrees each, from the equator to both the poles. On the terrestrial globe this semicircle is a moveable meridian, and its small sliding circle, which is divided into a few points of the compass, is the visible horizon of any particular place to which it is set. On the celestial globe this semicircle is a moveable circle of declination, and its small annexed circle an artificial sun or planet. Each globe has a brass wire TWY placed at the limits of the crepusculum or twilight, which, together with the globe, is mounted in a wooden frame, having underneath a magnetic needle in a compass-box. On the strong brass circle of the terrestrial globe, and about $23\frac{1}{2}$ degrees on each side of the north pole, the days of each month are laid down according to the sun's declination; and this brass circle is so contrived, that the globe may be placed with the north and south poles in the plane of the horizon, and with the south pole elevated above it. The equator on the surface of either globe serves the purpose of the horary circle, by means of a semicircular wire placed in the plane of the equator ÆF, carrying two indices, one on the east, the

other on the weſt ſide of the ſtrong braſs circle: one of which is occaſionally to be uſed to point out the time upon the equator. In theſe globes, therefore, the indices being ſet to the particular time on the equator, the globes are turned round, and the indices point out the time by remaining fixed; whereas, in the globes as generally mounted, the indices move over the horary circles while the globe is moving, and thus point out the change of time. For farther particulars of theſe globes, and the method of uſing them, ſee Adams's Treatiſe on the Conſtruction and Uſe of the Globes.

But notwithſtanding theſe ingenious and valuable alterations of Mr. Adams, to novices in the ſcience of geography, the improved globes of Mr. Martin and Mr. Wright, deſcribed below, are ſaid to have the advantage in ſimplicity, and to obviate ſeveral material defects that attend the conſtruction of other globes. The chief defect in the old globes is, that the horary circle being ſcrewed on the meridian at the north pole prevents the elevation of the ſouth pole, which is neceſſary for the performance of problems for all latitudes. In Mr. Adams's, the ſemicircular wire ÆF preventing the equator's being placed exactly in the horizon, or the poles in the zenith, the great diſtance of the ſtrong braſs circle NZÆS from the ſurface of the globe, on account of the braſs ſemicircles, renders the ſolution of problems, which require the uſe of the ſtrong circle, not very eaſy nor accurate.

An eaſy and expeditious method of elevating the ſouth pole of the terreſtrial globe, and by which means the new diſcoveries, tracks, &c. made of late years by Captain Cook and other eminent navigators in the ſouth ſeas may be clearly ſeen and traced by the eye over all the ſouthern ocean, was made uſe of by Mr. B. Martin in the conſtruction of the following improvement:

There is a groove turned out on the back part of the braſs meridian A (ſee the figure of the terreſtrial globe); and by unſcrewing the nut of the hour-circle D at the north pole, the circle is made to ſlide away to any other part of the meridian, as at G. The meridian is fixed or moveable at pleaſure, by a ſcrew paſſing into the groove through the piece or ſide of the notch in which it moves, on the bottom or nadir point: by properly looſening this ſcrew, the meridian is free to move, and the globe with it, into any required poſition; but at the ſame time it is confined within the notch of the braſs piece, and thereby the globe is prevented from falling out of the frame in any poſition thereof whatſoever. The hour-circle being removed, both the north and ſouth poles of the globe may be placed in the horizon, and thereby form a right ſphere, which the uſual mounting of the globes does not admit of.

Alſo by this conſtruction the ſouth pole may be elevated for all latitudes: for this purpoſe there is an hour-circle about the ſouth pole between the meridian and the globe, which does not obſtruct the ſight of any land, none having been thereabouts diſcovered. Conſequently the globe is thus equally uſeful for the ſolution of all common geographical problems in the ſouthern as in the northern hemiſphere, and more extenſively ſo than heretofore.

In this new method of mounting the globe, it may readily be converted into a *tellurian*; for, as the globe cannot fall out of the frame, the horizon of the globe may be placed in a perpendicular poſition: then the ſun's place in the ecliptic being brought to the meridian, and its declination found, the pole of the globe muſt be elevated to that declination; which may be done by means of the degrees cut on the outer edge of the meridian for that purpoſe. If a lighted candle be placed at a conſiderable diſtance, exactly the height of the centre of the globe, and in a line with the meridian, the globe will exhibit all the phenomena of our earth for that day; for in this caſe the horizon of the globe becomes the ſolar horizon, and divides the whole into the enlightened and dark hemiſpheres: therefore upon turning the globe about its axis from weſt to eaſt, it will clearly appear that all places emerging out of the dark hemiſphere into the luminous one, under the weſtern part of the horizon, will ſee the ſun then as riſing; when they arrive at the meridian, it will be their noon; and when they deſcend into the dark hemiſphere at the eaſtern part of the horizon, they will ſee the ſun as ſetting.

When any place is under the meridian, ſet the hour-index to XII, and revolve the globe; then you will ſee the natural motion and poſition of that place at certain hours of the day, at what time the ſun riſes or ſets to it, the length of the diurnal and nocturnal arches, or of day and night, at what places the ſun does not riſe and ſet at that time, and from whence the viciſſitudes of the ſeaſons throughout the year in all latitudes, &c. &c. To give this experiment the beſt effect, the candle ſhould be encloſed within a common dark lanthorn, and its light paſſed through a hole or lens made for that purpoſe.

On the outer part of the ſliding hour-circle, at the north pole, are uſually engraved the points of the compaſs; ſo that, by bringing that circle centrally over any place on the globe, it will appear, by inſpection only, upon what point of the compaſs any other place bears from it, and that all over the globe.

This contrivance of the ſliding hour-circle is equally applicable to the celeſtial globe. Mr. G. Wright of London has yet farther ſimplified the conſtruction of the hour-circle, and it is thereby rather leſs operoſe than Mr. Martin's. It conſiſts of the following particulars: There are engraved on the globes two hour-circles, one at each of the poles; which are divided into a double ſet of 12 hours, as uſual in the common braſs ones, except that the hours are figured round both to the right and left (ſee pl. 39. fig. 4.). The hour-hand or index is placed in ſuch a manner under the braſs meridian, as to be moveable at pleaſure to any required part of the hour-circle, and yet remain there fixed during the revolution of the globe on its axis, and is entirely independent of the poles of the globe. In this manner, the motion of the globe round its axis carrying the hour-circle, the fixed index ſerves to point out the time, the ſame as in the reverſe way by Mr. Martin's or other globes.

There is a ſmall advantage by having the hour-circle figured both ways, as one hour ſerves as a complement to XII for the other, and the time of ſun-riſing and ſetting, and *vice verſa*, may both be ſeen at the ſame time on the hour-circle. In the problems generally to be performed, the inner circle is the circle of reckoning, and the outer one only the complement. Fig. 5. is a repreſentation of the globe, with Mr. Wright's improved hour-circle at C.

Mr. Jones of Holborn, in conſtructing the globes of Meſſrs. Martin and Wright, applies a compaſs of a portable ſize to the eaſt part of the wooden horizon-circle of both globes (ſee F in the figure of the terreſtrial globe), by a dove-tail ſlider on the lid of the compaſs box; which method is found more convenient and ready in the performance of problems than when fixed underneath the frame at their feet; and as it occaſionally ſlides away from the globes, the compaſs becomes uſeful in other ſituations.

In order to the performance of the problems which relate to the altitudes and azimuths of celeſtial objects, the late Mr. Smeaton made ſome improvements applicable to the celeſtial globe; and, to give ſome idea of the conſtruction, they may be deſcribed as follows: Inſtead of a thin flexible ſlip of braſs, which generally accompanies the globes, called the *quadrant of altitude*, Mr. Smeaton ſubſtitutes an arch of a circle of the ſame radius, breadth, and ſubſtance, as the braſs meridian, divided into degrees, &c. ſimilar to the diviſions of that circle, and which, on account of its ſtrength, is not liable to be bent out

of the plane of a vertical circle, as uſual with the common quadrant put to globes. That end of this circular arch at which the diviſions begin reſts on the horizon, being filed off ſquare to fit and reſt ſteadily on it throughout its whole breadth; and the upper end of the arch is firmly attached, by means of an arm, to a vertical ſocket, in ſuch a manner that, when the lower end of the arch reſts on the horizon, the lower end of this ſocket ſhall reſt on the upper edge of the braſs meridian, directly over the zenith of the globe. This ſocket is fitted to and ground with a ſteel-ſpindle of the ſame length, ſo that it will turn freely on it without ſhaking; and the ſteel-ſpindle has an apparatus attached to its lower end, by which it can be faſtened in a vertical poſition to the braſs meridian, with its centre directly over the zenith point of the globe. The ſpindle being fixed firmly in this poſition, and the ſocket which is attached to the circular arch put on to it, and ſo adjuſted that the lower end of the arch juſt reſts on and fits cloſe to the horizon, it is evident that the altitude of any object above the horizon will be ſhown by the degree which it interſects on this arch, and its azimuth by that end of the arch which reſts on the horizon.

Beſides this improvement, Mr. Smeaton directs to place the index which is uſually fixed on one end of the axis to point out the hour, in ſuch a manner that its upper ſurface may move in the plane of the hour-circle rather than above it, as it uſually does. He files off the end of this index to a circular arch, of the ſame radiu. with the inner edge of the hour-circle, to which it is to fit very exactly; and a fine line is drawn on its upper ſurface to determine the time by, inſtead of the tapering point which is generally uſed. By theſe means half minutes may be diſtinguiſhed, if the hour-circle be four inches in diameter. Mr. Smeaton alſo deſcribes a contrivance for preventing the meridian from ſhifting after being rectified for the latitude of the place, and while the operator is engaged in adjuſting other parts of the apparatus. But as the purpoſe which this is intended to anſwer appears to be much better performed by the turned groove on the meridian in Mr. Martin's contrivance deſcribed as above, we ſhall omit the particular deſcription, and, for farther explanations and figures of Mr. Smeaton's improvements, refer the reader to the Phil. Tranſ. vol. 79. part. 1.

For another improvement made to the celeſtial globe by Mr. Ferguſon, ſee Astronomy, page 413.

The ſmall circles in plate 38. marked *Iſland*, *Promontory*, &c. are added in order to render the maps more intelligible, by ſhowing how the different ſubjects are commonly delineated on them.

Having thus explained the uſe of the globes, and general principles of geography, we muſt refer to the Maps for the ſituation of each particular country, with regard to longitude, latitude, &c. and to the names of the countries as they occur in the order of the alphabet, for other particulars concerning them.

GEOMANCY, Geomantia, a kind of divination, performed by means of a number of little points or dots made on paper at random: and conſidering the various lines and figures which thoſe points preſent, and thence forming a pretended judgment of futurity, and deciding any queſtion propoſed. The word is of the Greek γῆ, *terra*, "earth," and μαντεία, "divination;" it being the ancient cuſtom to caſt little pebbles on the ground, and thence to form their conjectures, inſtead of the points afterwards made uſe of. Polydore Virgil defines geomancy a kind of divination performed by means of clefts or chinks made in the ground, and takes the Perſian Magi to have been the inventors of it.

GEOMETRY,

SIGNIFIES the art of meaſuring the earth: but the ſcience of magnitude in general is comprehended under this term, with the doctrine and relations of whatever is ſuſceptible of augmentation or diminution, conſidered in that light.

This ſcience is ſuppoſed to have had its riſe among the Egyptians, who invented it to remedy the confuſion which generally happened in their lands from the inundations of the river Nile. Thus this invention, which at firſt conſiſted only in meaſuring particular lands, was called *Geometry*, or the art of meaſuring land; and it is probable that the ſchemes which they were annually compelled to make helped them to diſcover many of the general properties of figures.

From Egypt geometry is ſuppoſed to have paſſed into Greece, where it received improvements from Thales, Pythagoras, Euclid, Archimedes, &c.

We may diſtinguiſh the progreſs of geometry into three ages: in the firſt, by the Elements of Euclid it was reduced into a ſcience; the ſecond, beginning with Archimedes, reaches to the time of Des Cartes, who, by applying algebra to the elements of geometry, gave a new turn to this ſcience. In the laſt, Sir Iſaac Newton and Mr. Leibnitz introduced greater improvements by the invention and application of fluxions.

In treating this uſeful ſubject, we ſhall divide it into two parts; the firſt containing the general principles; and the ſecond, the application of theſe principles to the meaſuration of ſurfaces, ſolids, &c.

Part I. GENERAL PRINCIPLES of GEOMETRY.

From the ſight and touch we gain the ideas of diſtance. The ſight gives the idea of the diſtance between two objects. From the touch we gain the idea of a ſolid ſubſtance. From the ſight we have the idea of length and breadth. 1. The part of an object ſeen is called the ſurface. 2. The extremities of this ſurface are called lines.

The extremities of a line are points; as the extremities of the line AB are the points A and B, fig. 1.

If the line AB be the neareſt diſtance between its extremes A and B, then it is called a *ſtraight line*, as AB; but if it be not the neareſt diſtance, then it is called a *curve line*, as *ab*, fig. 1.

A ſurface is conſidered as having only length and breadth, but no thickneſs, as fig. 2.

The terms or boundaries of a ſurface are lines.

A plain ſurface is that which lies equally between its extremes.

The inclination between two lines meeting one another (provided they do not make one continued line), or the opening between them, is called an *angle*, or corner; thus the inclination of the line AB to the line CB (fig. 3.) meeting one another at B, or the opening between the two lines AB and CB, is called an *angle*.

When the lines forming the angle are right lines, then it is called a *right-lined angle*, as fig. 4.; if one of them be right and the other curved, it is called a *mixed angle*, as fig. 5; if both of them be curved, it is called a *curve-lined angle*, as fig. 6.

If a right line AB fall upon another DC (fig. 7.) fo as to make the angles ABD, ABC, on each fide equal to one another, then the line AB is faid to be *perpendicular* to the line DC, and the two angles are called *right-angles*.

An obtufe angle is greater than a right one, as fig. 8.; and an acute angle is lefs than a right one, as fig. 9.

If a right line DC be faftened at one of its ends C, and the other end D be carried quite round, then the fpace comprehended is called a *circle*; the curve-line defcribed by the point D is called the *periphery* or *circumference* of the circle; the fixed point C is called the *centre*, fig. 10.

The line CD is called the *radius*, and all radii of the fame or equal circles are equal.

Any line drawn through the centre, and ended both ways by the circumference, is called a *diameter*, as BD is a diameter of the circle BADE. The diameter divides the circle and circumference into two equal parts, and is double the radius.

The circumference of every circle may be divided into 360 equal parts called *degrees*; and each degree into 60 equal parts called *minutes*; and each minute into 60 equal parts called *feconds*; and thefe into *thirds, fourths*, &c.

Any part of the circumference is called an *arch* or *arc*, of as many degrees as it contains parts of the 360 into which the circumference was divided: thus if AD be the $\frac{1}{8}$th of the circumference, then the arc AD is an arc of 45 degrees.

A line drawn from one end of an arc to the other is called a *chord*, and is the meafure of the arc: thus the right line AB is the chord of the arc ADB, fig. 11.

Any part of a circle cut off by a chord is called a *fegment*; thus the fpace comprehended between the chord AB and circumference ADB (which is cut off by the chord AB) is called a *fegment*. Hence

1ft, All chords divide the circle into two fegments.

2dly, The lefs the chord is, the more unequal are the fegments, and *e contra*.

3dly, When the chord is greateft, viz. when it is a diameter, then the fegments are equal, viz. each a femicircle.

Any part of a circle (lefs than a femicircle) contained between two radii and an arc is called a *fector*; thus the fpace contained between the two radii, AC, BC, and the arc AB, is called the *fector*, fig. 12.

The right fine of an arc is a line drawn perpendicular from one end of the arc to a diameter drawn through the other end: thus (fig. 13.) AD is the right fine of the arc AB, it being a line drawn from A, the one end of the arc AB, perpendicular to CB, a diameter paffing through B, the other end of the arc AB.

If the point A moves from B to E, and the fines are drawn from each point, they increafe till they come to the centre, and then become the radius; hence the radius EC is the greateft poffible fine, and for that reafon it is called the *whole fine*.

Since the whole fine EC muft be perpendicular to the diameter FB, the two diameters FB, EG, muft crofs one another at right angles, and fo the circumference of the circle muft be divided by them into four parts, EB, BG, GF, and FE, and thefe four parts are equal to one another, and EB is a quadrant or fourth part of the circumference; therefore the radius EC is always the fine of the quadrant, or fourth part of the circle EB.

Sines are faid to be of fo many degrees as the arc contains; hence the radius being the fine of a quadrant, or fourth part of the circumference, is the fine of 90 degrees.

The part of the radius comprehended between the extremity of the right fine and the lower end of the arc DB is the verfed fine of the arc AB.

If to any point in the circumference B is drawn a diameter FCB, and from the point B perpendicular to that diameter is drawn the line BH, that line is called a *tangent* to the circle in the point B, and it can touch the circle only in one point B; for, if it touched the circle in more, it would go within it, and fo not be a tangent but a chord.

The tangent of any arc AB is a right line drawn perpendicular to a diameter through the one end of the arc B, and terminated by a line CAH, drawn from the centre through the other end A; thus BH is the tangent of the arc AB.

The line CH which terminates the tangent is called the fecant of the arc AB.

What an arc wants of a quadrant is called the *complement* of that arc; thus AE is called the complement of the arc AB.

What an arc wants of a femicircle is called the *fupplement* of that arc; thus AF is the fupplement of the arc AB.

The fine, tangent, &c. of the complement of any arc is called the *co-fine, co-tangent*, &c. of that arc; thus the fine, tangent, &c. of the arc AE is called the co-fine, co-tangent, &c. of the arc AB.

The fine of the fupplement of an arc is the fame with the fine of the arc.

A right-lined angle is meafured by an arc of a circle defcribed upon the angular point as a centre, comprehended between the two legs forming the angle; thus (fig. 14.) the angle ABD is meafured by the arc AD of the circle CADE, defcribed upon the point B as a centre, and the angle is faid to be of as many degrees as the arc is; fo if the arc AD be 45 degrees, then the angle ABD is faid to be an angle of 45 degrees.

When one line falls perpendicularly on another, as AB on CD (fig. 15.), then the angles are right; and defcribing a circle on the centre B, fince the angles ABC, ABD are equal, their meafures muft be fo too—*i. e.* the arcs AC, AD muft be equal; but the whole CAD is a femicircle, fince CD, a line paffing through the centre B, is a diameter; therefore each of the parts AC, AD is a quadrant, *i. e.* 90 degrees; fo the meafure of a right angle is always 90 degrees.

If one line AB falls upon another CD, then the fum of the two angles ABC, ABD is always equal to the fum of two right angles (fig. 16.). For on the point B, defcribing the circle CAD, it is plain that CAD is a femicircle, but CAD is equal to CA, and AD the meafure of the two angles; therefore the fum of the two angles is equal to a femicircle, that is, to two right angles.

Cor. 1. All the angles which can be made from a point in any line towards one fide of the line are equal to two right angles.

2. And all the angles which can be made about a point are equal to four right ones.

If one line AC crofs another BD in the point E, then the oppofite angles are equal, viz. BEA to CED, and BEC equal to AED (fig. 17.). Upon the point E as a centre defcribe the circle ABCD; ABC is a femicircle, as alfo BCD: therefore the arc ABC is equal to the arc BCD: take away the common arc BC, and there remains AB equal to CD, *i. e.* the angle BEA equal to the angle CED. After the fame manner

we may prove, that the triangle BEC is equal to the angle AED.

Lines whofe perpendicular diftance from each other, produced if neceffary, is every where the fame, are called *parallel lines*; as AB, CD (fig. 18.).

A line GH croffing two parallels AB, CD (fig. 19.) makes the external oppofite angles equal, GEB equal to CFH, and AEG equal to HFD; the alternate angles AEF and EFD, or CFE and FEB, equal; the external angle GEB equal to the internal oppofite one EFD, or GEA equal to CFE; and the fum of the two internal angles BEF and DFE, or AEF and CFE equal to two right angles. From E draw EK perpendicular to CD, and from F, FI perpendicular to AB; then, fince AB, CD are parallel, the lines IF, EK are equal. Therefore the fines of the angles IEF, EFK in the fame circle are equal, and confequently the angles IEF, EFK are equal. The angle IEF is equal to the angle GEB, therefore the angles GEB, EFD are equal; but EFD is equal to CFH, therefore GEB, CFH are equal. Alfo, fince GEB, BEF are together equal to two right angles, BEF, EFD are together equal to two right angles; and fince GEB, CFH are equal, their fupplements AEG, HFD muft be equal; confequently AEG, CFE muft be equal, and the two angles AEF, CFE together equal to two right angles.

A figure is any part of fpace bounded by lines. A *rectilineal figure*, as fig. 20. is bounded by ftraight lines; a *curvilineal figure*, as fig. 21. and fig. 22. is bounded by curve lines; a *mixt figure*, as fig. 23. is bounded by both curve and ftraight lines; a figure bounded by three lines is called a *triangle*, as fig. 24.

Triangles are divided into different kinds with refpect to fides and angles; with refpect to their fides, into three kinds, *viz.*

An *equilateral triangle* has all its three fides equal.

A triangle having only two of its fides equal is called an *ifofceles triangle.*

A triangle having its fides unequal is called a *fcalene triangle.*

Triangles with refpect to their angles are divided into three different kinds, *viz.*

A triangle having one of its angles right is called a *right-angled triangle.*

A triangle having one of its angles obtufe is called an *obtufe-angled triangle.*

A triangle having all its angles acute is called an *acute-angled triangle.*

In all right-angled triangles, the fides comprehending the right angle are called the *legs*, and the fide oppofite to the right angle is called the *hypothenufe*. Thus in the right-angled triangle ABC, fig. 25. (the right angle being at B), the two fides AB and BC are the legs, and the fide AC, oppofite to the right angle ABC, is the hypothenufe.

Both obtufe and acute-angled triangles are in general called *oblique-angled triangles*; in all which any fide is called the *bafe*, and the other two the *fides*.

The perpendicular height of any triangle is a line drawn from the vertex to the bafe perpendicularly; thus, if in the triangle ABC (fig. 26.) BC be made its bafe, then A is the vertex; and the line AD, perpendicular to BC, is the height of the triangle.

A figure bounded by four fides is called a *quadrilateral* or *quadrangular figure*, as ABDC, fig. 27.

Quadrilateral figures whofe oppofite fides are parallel are called *parallelograms.*

A parallelogram having all its fides equal and angles right is called a *fquare.*

That which hath only the oppofite fides equal and its angles right is called a *rectangle.*

3

That which hath equal fides, but oblique angles, is called a *rhombus.*

That which hath only the oppofite fides equal and the angles oblique is called a *rhomboides.*

When none of the fides are parallel to another, then the quadrilateral figure is called a *trapezium.*

Every other right-lined figure that has more fides than four is in general called a *polygon*: One of five fides is called a *pentagon*, of fix a *hexagon*, of feven a *heptagon*, and fo on. When the fides forming the polygon are equal to one another, the figure is called a regular figure or polygon.

In any triangle ABC (fig. 28.) *one of its legs, as* BC, *being produced towards* D, *the external angle* ACD *is equal to both the internal oppofite ones taken together, viz.* to ABC *and* BAC. Through C draw CE parallel to AB; then, fince CE is parallel to AB, and the lines AC and BD crofs them, the angle ECD is equal to ABC and the angle ACE equal to CAB, therefore the angles ECD and ECA are equal to the angles ABC and CAB; but the angles ECD and ECA are together equal to the angle ACD; therefore the angle ACD is equal to both the angles ABC and CAB taken together.

The three angles of any triangle taken together are equal to two right angles. By the laft propofition, the angle ACD is equal to the fum of the two CAB and ABC; to both add the angle ACB; then the fum of the angles ACD and ACB will be equal to the fum of the angles CAB and CBA and ACB. But the fum of the angles ACD and ACB is equal to two right ones; therefore the fum of the three angles CAB and CBA and ACB is equal to two right angles.

If in any two triangles, ABC (fig. 29) DEF (fig. 30.), two legs of the one, AB and AC, be equal to two legs of the other, DE and DF, *i. e.* AB to DE and AC to DF; and the angle BAC equal to the angle EDF; then the remaining leg of the one fhall be equal to the remaining leg of the other, *viz.* BC to EF; and the angles oppofite to equal legs fhall be equal, *viz.* ABC equal to DEF, and ACB equal to DFE. For if the triangle ABC be put upon the triangle DEF, and the point A on the point D; fince BA and DE are of equal length, the point E will fall upon the point B; and fince the angles BAC, EDF are equal, the line AC will fall upon the line DF; and the point C will fall upon the point F; then the line BC will exactly agree with the line EF, and the triangle ABC will be equal to the triangle DEF; the angle ABC to the angle DEF, and the angle ACB to the angle DFE.

Cor. 1. If in any two triangles ABC, DEF, two angles ABC and ACB of the one be equal to two angles DEF and DFE of the other, *viz.* the angle ABC to the angle DEF, and the angle ACB equal to the angle DFE, and the fides included between thefe angles be alfo equal, *viz.* BC equal to EF, then the remaining angles, and the fides oppofite to the equal angles, will alfo be equal each to each refpectively; *viz.* the angle BAC equal to the angle EDF, the fide AB equal to DE, and AC equal to DF: for if the triangle ABC be laid upon the triangle DEF, the point B being put upon the point E, and the line BC upon the line EF, fince BC and EF are of equal lengths, the point C will fall upon the point F; and fince the angle ACB is equal to the angle DFE, the line CA will fall upon the line FD, and the line BA will fall upon the line ED; therefore the point of interfection of the two lines BA and CA, *viz.* A, will fall upon the point of interfection of the two lines ED and FD, *viz.* D; and confequently BA will be equal to ED, and AC equal to DF, and the angle BAC equal to the angle EDF.

Cor. 2. If any triangle ABC (fig. 31.) has two of its fides AB and AC equal to one another, the angles oppofite to thefe fides will be equal. For let the line AD divide the angle BAC into two equal angles BAD and CAD; and meet BC in D; then the line AD will divide the whole triangle BAC into two trian-

gles ABD and DAC; in which BA and AD, two fides of the one, are equal to CA and AD two fides of the other, each to each refpectively, and the included angles BAD and DAC are equal; therefore the angle ABC muft be equal to the angle ACB.

Any angle, as BAD (fig. 32.), *at the circumference of a circle* BADE, *is but half the angle* BCD *at the centre ftanding on the fame arch* BED. Draw through A and C the right line ACE, then the angle ECD is equal to the angles DAC and ADC; but fince AC and CD are equal, the angles fubtended by them muft be equal; therefore the fum of DAC and ADC is double of CAD, and therefore ECD is double of DAC: the fame way it may be proved, that ECB is double of CAB; therefore the angle BCD is double of the angle BAD, or BAD is the half of BCD.

Cor. 1. Hence all angles ACB, ADB, AEB, &c. (fig. 33.) at the circumferenee of a circle, ftanding on the fame chord AB, are equal to one another.

Cor. 2. An angle in a fegment greater than a femicircle is lefs than a right angle; an angle in a femicircle is a right angle; and an angle in a fegment lefs than a femicircle is greater than a right angle, for the angle is meafured by half the arc on which it ftands.

If from the centre C *of the circle* ABE (fig. 34.) *the perpendicular* CD *be let fall on the chord* AB, *it will bifect the chord.*—Join CA, CB; then, fince CA and CB are equal, the angles CAB, CBA muft be equal alfo; but the perpendicular CD divides the triangle ACB into two right-angled triangles ACD and CDB; therefore the fum of the angles ACD and CAD in the one is equal to the fum of the angles DCB and CDB in the other, but CAD is equal to CBD, therefore ACD is equal to BCD. So in the two triangles ACD and BCD, the two legs AC and CD in the one are equal to the two legs BC and CD in the other, each to each refpectively, and the included angles ACD and BCD are equal; therefore the remaining legs AD and BD are equal, and confequently AB is bifected in D.

If from the centre C of a circle ABE there be drawn a perpendicular CD on the chord AB, and produced till it meet the circle in F, then the line CF bifects the arch AB in the point F; join the points A and F, F and B by the ftraight lines AF, FB, then in the triangles ADF, BDF, AD is equal to DB, and DF common to both; therefore AD and DF, two legs of the triangle ADF, are equal to BD and DF, two legs of the triangle BDF, and the included angles ADF, BDF are equal, being both right; therefore the remaining legs AF and FB are equal; but in the fame circle equal lines are chords of equal arches, therefore the arehes AF and FB are equal.

In any triangle the half of each fide is the fine of the oppofite angle; for if a circle be drawn through the three angular points A, B, and D, of the triangle ABD (fig. 35.), then the angle DAB is meafured by half the arch BKD; but the half of BD, *viz.* BE, is the fine of half the arch BKD, *viz.* the fine of BK, which is the meafure of the angle BAD; therefore the half of BD is the fine of the angle BAD: the fame way it may be proved, that the half of AD is the fine of the angle ABD, and the half of AB is the fine of the angle ADB.

The fine, tangent, &c. of any arch is called alfo the *fine, tangent,* &c. of the angle whofe meafure the arc is.

If two equal and parallel lines, AB *and* CD (fig. 36.), *be joined by two others,* AC *and* BD, *then thefe fhall alfo be equal and parallel.*—Join A and D; then the line AD divides the quadrilateral ACDB into two triangles, ABD, ACD, in which AB, a leg of the one, is equal to DC a leg of the other, and AD is common to both triangles; and, fince AB is parallel to CD, the angle BAD will be equal to the angle ADC; therefore in the two triangles BA and AD, and the angle BAD, is equal to CD and DA, and the angle ADB; that is, two legs and the included angle in the one are equal to two legs and the included angle in the other; therefore BD is equal to AC, and fince the angle DAC is equal to the angle ADB, the lines BD, AC are parallel.

Cor. 1. Hence the quadrilateral ABDC is a parallelogram, fince the oppofite fides are parallel.

Cor. 2. In any parallelogram the line joining the oppofite angles (called the *diagonal),* as AD, divides the figure into two equal parts, fince it has been proved that the triangles ABD, ACD are equal to one another.

All parallelograms on the fame or equal bafes, and between the fame parallels, are equal to one another. Let BD and GH (fig. 37.) be equal, and the lines BH and AF be parallel, then the parallelograms ABDC, BDFE, and EFHG are equal to one another. For AC is equal to EF, each being equal to BD. To both add CE; then AE will be equal to CF. So in the two triangles ABE, CDF, AB, a leg of the one, is equal to CD, a leg in the other; and AE is equal to CF, and the angle BAE is equal to the angle DCF; therefore the two triangles ABE, CDF are equal; and taking the triangle CKE from both, the figure ABKC will be equal to the figure KDFE, to both which add the little triangle KBD, then the parallelogram ABDC will be equal to the parallelogram BDFE. The fame way it may be proved, that the parallelogram EFHG is equal to the parallelogram EFDB; fo the three parallelograms ABDC, BDFE, and EFHG will be equal to one another.

Cor. Hence triangles on the fame bafe and between the fame parallels are equal, fince they are the half of the parallelograms on the fame bafe and between the fame parallels.

In any right-angled triangle, ABC (fig. 38.), *the fquare of the hypothenufe* BC, *viz.* BCMH, *is equal to the fum of the fquares made on the two fides* AB *and* AC, viz. *to* ABDE *and* ACGF.—Through the point A draw AKL perpendicular to the hypothenufe BC; join AH, AM, DC, and BG; in the two triangles DBC, ABH, the two legs DB and BC in the one are equal to the two legs AB and BH in the other; and the included angles DBC and ABH are alfo equal, being made of a right angle and a common angle ABC; therefore the triangles DBC, ABH are equal; but the triangle DBC is half of the fquare ADBE, and the triangle ABH is half the parallelogram BKLH, therefore half the fquare ABDE is equal to half the parallelogram BKLH. Confequently the fquare ABDE is equal to the parallelogram BKLH. The fame way it may be proved, that the fquare ACGF is equal to the parallelogram KCML. So the fum of the fquares ABDE and ACGF is equal to the fum of the parallelograms BKLH and KCML; but the fum of thefe parallelograms is equal to the fquare BCMH; therefore the fum of the fquares on AB and AC is equal to the fquare on BC.

In any triangle ABC (fig. 39.), if one of its fides, as AC, be bifected in E, and through E be drawn ED parallel to BC, then BC will be double of ED, and AB double of AD. Through D draw DF parallel to AC, meeting BC in F: fince DF is parallel to AC, and DE parallel to BC, the angle BFD will be equal to the angle BCA, and the angle BCA will be equal to the angle DEA; confequently the angle BFD will be equal to the angle DEA, and the angle BDF will be equal to the angle DAE: fince DF is parallel to EC, and DE parallel to FC, the quadrilateral DFCE will be a parallelogram; and therefore DF will be equal to EC, which by conftruction is equal to AE; fo in the two triangles BDF, DAE, the two angles BFD and BDF in the one are equal to the two angles DEA and DAE in the other, each to each refpectively, and DF is equal to AE; therefore AD will be equal to DB, and confequently AB double of AD; alfo DE will be equal to BF, but DE is equal to FC; therefore BF and ED together, or BC, will be double of DE.

After the ſame manner it may be proved, that if in the triangle AKG (fig. 40.) AE be taken equal to a third part of AK, and through E be drawn ED parallel to KG and meeting AG in D; then ED will be equal to a third part of GK, and AD equal to a third part of AG.

Likewiſe if in any triangle ABC (fig. 41.), upon the ſide AB, be taken AE, equal to one-fourth, one-fifth, one-ſixth, &c. of AB, and through E be drawn ED parallel to BC and meeting AC in D; then D will be one-fourth, one-fifth, one-ſixth, &c. of BC, and AD the like part of AC; and, in general, if in any triangle ABC, there be aſſumed a point E on one of its ſides AB, and through that point be drawn a line ED, parallel to one of its ſides BC, and meeting the other ſide AC in D; then whatever part AE is of AB, the ſame part will ED be of BC, and AD of AC.

Cor. Hence it follows, that if in any triangle ABC there be drawn ED, parallel to one of its ſides BC, and meeting the other two in the points E and D, then AE : AB :: ED : BC :: AD : AC; that is, AE is to AB, as ED is to BC, that is, as AD to AC.

If any two triangles ABC (fig. 42.) a b c (fig. 43.) are ſimilar, or have all the angles of the one equal to all the angles of the other, each to each reſpectively; that is, the angle CAB equal to the angle c a b, and the angle ABC equal to the angle a b c, and the angle ACB equal to the angle a c b; then the legs oppoſite to the equal angles are proportionals, *viz.* AB : a b :: AC : a c :: and AB : a b :: BC : b c :: and AC : a c :: BC : b c. On AB of the largeſt triangle ſet off AE equal to a b, and through E draw ED parallel to BC, meeting AC in D; then, ſince DE and BC are parallel, and AB croſſing them, the angle AED will be equal to the angle ABC, which is equal to the angle a b c, alſo the angle DAE is equal to the angle c a b; ſo in the two triangles AED, a b c, the two angles DAE, AED of the one are equal to two angles c a b, a b c of the other, each to each reſpectively, and the included ſide AE is equal to the included ſide a b; therefore AD is equal to a c, and DE equal to c b; but ſince in the triangle ABC there is drawn DE parallel to BC, one of its ſides, and meeting the two other ſides in the points D and E, AB : AE :: AC : AD, and AB : AE :: BC : DE, and AC : AD :: BC : DE; and in the three laſt proportions, inſtead of the lines AE, DE, and AD, putting in their equals a b, b c, and a c, we ſhall have AB : a b :: AC : a c, and AB : a b :: BC : b c; and laſtly, AC : a c :: BC : b c.

The chord, ſine, tangent, &c. of any arc in one circle, is to the chord, ſine, tangent, &c. of the ſame arc in another, as the radius of the one is to the radius of the other (fig. 44.). Let ABD, a b d be two circles, BD, b d two arcs of theſe circles, equal to one another, or conſiſting of the ſame number of degrees; FD, f d the tangents, BD, b d the chords, BE, b e the ſines, &c. of theſe two arcs BD, b d, and CD, c d the radii of the circles; then ſay, CD : c d :: FD : f d, and CD : c d :: BD : b d, and CD : c d :: BE : b e, &c. For ſince the arcs BD, b d are equal, the angles BCD, b c d will be equal; and FD, f d, being tangents to the points D and d, the angles CDF, c d f will be equal, being each a right angle: ſo in the two triangles CDF, c d f, the two angles FCD, CDF of the one being equal to the two angles f c d, c d f of the other, each to each, the remaining angle CFD will be equal to the remaining angle c f d; therefore the triangles CFD, c f d are ſimilar, and conſequently CD : c d :: FD : f d. In the ſame manner it may be demonſtrated, that CD : c d :: BD : b d, and CD : c d :: BE : b e, &c.

Let ABD (fig. 45.) be a quadrant of a circle deſcribed by the radius CD: BD any arc of it, and BA its complement; BG or CF the ſine, CG or BF the co-ſine; DE the tangent, and CE the ſecant of that arc BD. Then ſince the triangles CDE, CBG are ſimilar or equiangular, DE : EC :: GB : BC, *i. e.* the tangent of any arc is to the ſecant of the ſame, as the ſine of it is to the radius. Alſo, ſince DE : EC :: GB : BC; by inverting that proportion, we have EC : DE :: BC : GB, *i. e.* the ſecant is to the tangent, as the radius is to the ſine of any arc.

Again, ſince the triangles CDE, CGB are ſimilar, CD : CE :: CG : CB, *i. e.* as the radius is to the ſecant of any arc, ſo is the co-ſine of that arc to the radius. And, by inverting the proportion, the ſecant of any arc is to the radius, as the radius to the coſine of that arc.

In all circles the chord of 60 is always equal in length to the radius. Thus in the circle AEBD (fig. 46.), if the arc AEB be an arc of 60 degrees, then drawing the chord AB, I ſay AB ſhall be equal to the radius CB or AC; for in the triangle ACB, the angle ACB is 60 degrees, being meaſured by the arc AEB; therefore the ſum of the other two angles is 120 degrees, but ſince AC and CB are equal, the two angles CAB, CBA will alſo be equal; conſequently each of them half their ſum 120, *viz.* 60 degrees; therefore, all the three angles are equal to one another, conſequently all the legs, therefore AB is equal to CB.

PART II. THE APPLICATION OF THE FOREGOING PRINCIPLES TO THE MENSURATION OF SURFACES, SOLIDS, &c.

CHAP. I. *Of the Menſuration of Lines and Angles.*

A LINE or length to be meaſured, whether it be diſtance, height, or depth, is meaſured by a line leſs than it. With us the leaſt meaſure of length is an inch: not that we meaſure no line leſs than it, but becauſe we do not uſe the name of any meaſure below that of an inch; expreſſing leſſer meaſures by the fractions of an inch.

The yard is 3 feet, or 36 inches. A pole is ſixteen feet and a half, or five yards and a half. The chain, commonly called *Gunter's Chain*, is four poles, or 22 yards, that is, 66 feet. A ſtatute-mile is fourſcore chains, or 1760 yards, that is, 5280 feet.

The chain (which is now much in uſe, becauſe it is very convenient for ſurveying) is divided into 100 links, each of which is $7\frac{92}{100}$ of an inch: whence it is eaſy to reduce any number of thoſe links to feet, or any number of feet to links.

In the following table, the moſt noted meaſures are expreſſed in inches and decimals of an inch.

	Inch.	*Dec.*
The foot is	12	000
The Paris foot,	12	788
The Rhineland foot, meaſured by Mr. Picart,	12	362
The Scots foot,	12	065
The Amſterdam foot, by Snellius and Picart,	11	172
The Dantzick foot, by Hevelius,	11	297
The Daniſh foot, by Mr. Picart,	12	465
The Swediſh foot, by the ſame,	11	692
The Bruſſels foot, by the ſame,	10	828

	Inch.	Dec.
The Lyons foot, by Mr. Auzout,	13	458
The Bononian foot, by Mr. Caffini,	14	938
The Milan foot, by Mr. Auzout,	15	631
The Roman palm ufed by merchants, according to the fame,	9	791
The Roman palm ufed by architects,	8	779
The palm of Naples, according to Mr. Auzout,	10	314
The Englifh yard,	36	000
The Englifh ell,	45	000
The Scots ell,	37	200
The Paris aune ufed by mercers, according to Mr. Picart,	46	786
The Paris aune ufed by drapers, according to the fame,	46	680
The Lyons aune, by Mr. Auzout,	46	570
The Geneva aune,	44	760
The Amfterdam ell,	26	800
The Danifh ell, by Mr. Picart,	24	930
The Swedifh ell,	23	380
The Norway ell,	24	510
The Brabant or Antwerp ell,	27	170
The Bruffels ell,	27	260
The Bruges ell,	27	550
The brace of Bononia, according to Auzout,	25	200
The brace ufed by architects in Rome,	30	730
The brace ufed in Rome by merchants,	34	270
The Florence brace ufed by merchants, according to Picart,	22	910
The Florence geographical brace,	21	570
The vara of Seville,	33	127
The vara of Madrid,	39	166
The vara of Portugal,	44	031
The cavedo of Portugal,	27	354
The ancient Roman foot,	11	632
The Perfian arifh, according to Mr. Græves,	38	364
The fhorter pike of Conftantinople, according to the fame,	25	576
Another pike of Conftantinople, according to Meffrs. Mallet and De la Porte,	27	920

To defcribe the ftructure of the geometrical fquare.—The geometrical fquare is made of any folid matter, as brafs or wood, or of any four plain rulers joined together at right angles (as in (fig. 47.), where A is the centre, from which hangs a thread with a fmall weight at the end, fo as to be directed always to the centre. Each of the fides BE and DE is divided into an hundred equal parts, or (if the fides be long enough to admit of it) into a thoufand parts; C and F are two fights, fixed on the fide AD. There is moreover an index GH, which, when there is occafion, is joined to the centre A, in fuch manner as that it can move round, and remain in any given fituation. On this index are two fights perpendicular to the right line going from the centre of the inftrument: thefe are K and L. The fide DE of the inftrument is called the upright fide; EB the reclining fide.

Fig. 48. *To meafure an acceffible height* AB *by the help of a geometrical fquare, its diftance being known.*—Let BR be an horizontal plane, on which there ftands perpendicularly any line AB: let 1 D, the given diftance of the obferver from the height, be 96 feet: let the height of the obferver's eye be fuppofed 6 feet; and let the inftrument, held by a fteady hand, or rather leaning on a fupport, be directed towards the fummit A, fo that one eye (the other being fhut) may fee it clearly through the fights; the perpendicular or plumb line meanwhile hanging free, and touching the furface of the inftrument; let now the perpendicular be fuppofed to cut off on the right fide KN 80 equal parts. It is clear that LKN, ACK, are fimilar triangles; for the angles LKN, ACK are right angles, and LN and AC are parallel, confequently the angles KLN, KAC, are equal; wherefore the angles LNK and CAK are equal: therefore NK : KL :: KC (i. e. BD) : CA; or 80 : 100 :: 96 feet : CA. Therefore CA is 120 feet, and the whole height is 126 feet.

Fig. 49. *To meafure any diftance at land or fea, by the geometrical fquare.*—In this operation, the index is to be applied to the inftrument, as was fhown in the defcription; and, by the help of a fupport, the inftrument is to be placed horizontally at the point A; then let it be turned till the remote point F, whofe diftance is to be meafured, be feen through the fixed fights; and bringing the index to be parallel with the other fide of the inftrument, obferve by the fights upon it any acceffible mark B, at a fenfible diftance: then carrying the inftrument to the point B, let the immoveable fights be directed to the firft ftation A, and the fights of the index to the point F. If the index cut the right fide of the fquare, as in K, in the two triangles BRK and BAF, which are equiangular, it will be as BR to RK, fo BA (the diftance of the ftations to be meafured with a chain) to AF; and the diftance AF fought will be found by the rule of three. But if the index cut the reclined fide of the fquare in any point L, where the diftance of a more remote point is fought: in the triangles BLS, BAG, the fide LS fhall be to SB, as BA to AG, the diftance fought; which accordingly will be found by the rule of three.

Fig. 50. *To defcribe the conftruction and ufe of the geometrical quadrant.*—The geometrical quadrant is the fourth part of a circle divided into 90 degrees, to which two fights are adapted, with a perpendicular or plumb-line hanging from the centre. The general ufe of it is for inveftigating angles in a vertical plane, comprehended under right lines going from the centre of the inftrument, one of which is horizontal, and the other is directed to fome vifible point. This inftrument is made of any folid matter, as wood, copper, &c.

Fig. 51. *To defcribe and make ufe of the graphometer.*—The graphometer is a femicircle made of any hard matter, of wood, for example, or brafs, divided into 180 degrees; fo fixed on a fulcrum, by means of a brafs ball and focket, that it eafily turns about, and retains any fituation; two fights are fixed on its diameter. At the centre there is commonly a magnetical needle in a box. There is likewife a moveable ruler, which turns round the centre, and retains any fituation given it. The ufe of it is to obferve any angle, whofe vertex is at the centre of the inftrument in any plane (though it is moft commonly horizontal, or nearly fo), and to find how many degrees it contains.

Fig. 52 and 53. *To defcribe the manner in which angles are meafured by a quadrant or graphometer.*—Let there be an angle in a vertical plane, comprehended between a line parallel to the horizon HK, and the right line RA, coming from any remarkable point of a tower or hill, or from the fun, moon, or a ftar. Suppofe that this angle RAH is to be meafured by the quadrant; let the inftrument be placed in the vertical plane, fo as that the centre A may be in the angular point; and let the fights be directed towards the object at R (by the help of the ray coming from it, if it be the fun or moon, or by the vifual ray, if it is any thing elfe), the degrees and minutes in the arc BC, cut off by the perpendicular, will meafure the angle RAH required. For, from the make of the quadrant, BAD is a right angle; therefore BAR is likewife right, being equal to it. But, becaufe HK is horizontal, and AC perpendicular, HAC will be a right angle, and therefore equal alfo to BAR. From thofe angles fubtract the part HAB that is common to both; and there will remain the angle BAC equal to the angle RAH. But

the arc BC is the meafure of the angle BAC; confequently, it is likewife the meafure of the angle RAH.

Let it now be required to meafure the angle ACB (fig. 53.) in any plane comprehended between the right lines AC and BC, drawn from two points A and B, to the place of ftation C. Let the graphometer be placed at C, fupported by its fulcrum, and let the immoveable fights on the fide of the inftrument DE be directed towards the point A; and the fights of the ruler FG be directed to the point B. It is evident that the moveable ruler cuts off an arc DHG, which is the meafure of the angle ACB fought.

FIG. 54, 55, 56, 57, and 58. *To defcribe the conftruction and ufe of the protractor, of the line of chords, and of the line of equal parts.* The protractor is a fmall femicircle of brafs, or fuch folid matter. The femicircumference is divided into 180 degrees. The ufe of it is, to draw angles on any plane, as on paper, or to examine the extent of angles already laid down. For this laft purpofe, let the fmall point in the centre of the protractor be placed above the angular point, and let the fide AB coincide with one of the fides that contain the angle propofed; the number of degrees cut off by the other fide, computing on the protractor from B, will fhow the quantity of the angle that is to be meafured.

But if an angle is to be made of a given quantity on a given line, and at a given point of that line, let AB coincide with the given line, and let the centre A of the inftrument be applied to that point. Then let there be a mark made at the given number of degrees, and a right line drawn from that mark to the given point will conftitute an angle with the given right line of the quantity required, as is manifeft.

This is the moft natural and eafy method, either for examining the extent of an angle on paper, or for defcribing on paper an angle of a given quantity.

But when there is fcarcity of inftruments, or becaufe a line of chords is more eafily carried about (being defcribed on a ruler on which there are many other lines befides), practical geometricians frequently make ufe of it. It is made thus: let the quadrant of a circle be divided into 90 degrees (as in fig. 55.). The line BC is the chord of 90 degrees; the chord of every arc of the quadrant is transferred to this line, which is always marked with the number of degrees in the correfponding arc.

Note, That the chord of 60 degrees is equal to the radius. If now a given angle EDF is to be meafured by the line of chords from the centre D, with the diftance DG (the chord of 60 degrees), defcribe the arc GF; and let the points G and F be marked where this arc interfects the fides of the angle. Then if the diftance GF, applied on the line of chords from C to B, gives (for example) 25 degrees, this fhall be the meafure of the angle propofed.

When an obtufe angle is to be meafured with this line, let its complement to a femicircle be meafured, and thence it will be known. It were eafy to transfer to the diameter of a circle the chords of all arches to the extent of a femicircle; but fuch are rarely found marked upon rules.

But now, if an angle of a given quantity, fuppofe of 50 degrees, is to be made at a given point M of the right line KL (fig. 6.) From the centre M, and the diftance MN, equal to the chord of 60 degrees, defcribe the arc QN. Take off an arc NR, whofe chord is equal to that of 50 degrees on the line of chords; join the points M and R; and it is plain that MR fhall contain an angle of 50 degrees with the line KL propofed.

But fometimes we cannot produce the fides till they be of the length of a chord of 60 degrees on our fcale; in which cafe it is fit to work by a circle of proportions (that is, a fector), by which an arc may be made of a given number of degrees to any radius.

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The quantities of angles are likewife determined by other lines ufually marked upon rules, as the lines of fines, tangents, and fecants; but as thefe methods are not fo eafy or fo proper in this place, we omit them.

To delineate figures fimilar or like to others given, befides the equality of the angles, the fame proportion is to be preferved among the fides of the figure that is to be delineated, as is among the fides of the figures given. For which purpofe, on the rules ufed by artifts, there is a line divided into equal parts, more or lefs in number, and greater or lefs in quantity according to the pleafure of the maker. Fig. 58.

A foot is divided into inches; and an inch, by means of tranfverfe lines, into 100 equal parts; fo that with this fcale, any number of inches below 12, with any part of an inch, can be taken by the compaffes, providing fuch part be greater than the 100th part of an inch. And this exactnefs is very neceffary in delineating the plans of houfes, and in other cafes.

The diameter of a circle being given, to find its circumference nearly.—The periphery of any polygon infcribed in the circle is lefs than the circumference, and the periphery of any polygon defcribed about a circle is greater than the circumference. Whence Archimedes firft difcovered that the diameter was in proportion to the circumference, as 7 to 22 nearly; which ferves for common ufe. But the moderns have computed the proportion of the diameter to the circumference to greater exactnefs. Suppofing the diameter 100, the periphery will be more than 314, but lefs than 315. The diameter is more nearly to the circumference as 113 to 355. But Ludolphus van Cuelen exceeded the labours of all; for by immenfe ftudy he found, that fuppofing the diameter

100,000 000,000,000,000,000,000,000,000,000,

the periphery will be lefs than

314,159,265,358,979,323,846,264,338,327,951,

but greater than

314,159,265,358,979,323,846,264,338,327,950;

whence it will be eafy, any part of the circumference being given in degrees and minutes, to affign it in parts of the diameter.

CHAP. II. *Of Surveying and Meafuring Land.*

HITHERTO we have treated of the meafuring of angles and fides, whence it is abundantly eafy to lay down a field, a plane, or an entire country; for to this nothing is requifite but the protraction of triangles and of other plain figures, after having meafured their fides and angles. But as this is efteemed an important part of practical geometry, we fhall fubjoin here an account of it with all poffible brevity; fuggefting withal, that a furveyor will improve himfelf more by one day's practice than by a great deal of reading.

To explain what furveying is, and what inftruments Surveyors ufe.—Firft, it is neceffary that the furveyor view the field that is to be meafured, and inveftigate its fides and angles, by means of an iron chain (having a particular mark at each foot of length, or at any number of feet, as may be moft convenient for reducing lines or furfaces to the received meafures), and the graphometer defcribed above. Secondly, it is neceffary to delineate the field *in plano*, or to form a map of it; that is, to lay down on paper a figure fimilar to the field; which is done by the protractor (or line of chords) and the line of equal parts. Thirdly, it is neceffary to find out the area of the field fo furveyed and reprefented by a map. Of this laft we are to treat below.

The fides and angles of fmall fields are furveyed by the help of a plain-table: which is generally of an oblong rectangular

figure, and supported by a *fulcrum*, so as to turn every way by means of a ball and socket. It has a moveable frame, which surrounds the board, and serves to keep a clean paper put on the board close and right to it. The sides of the frame facing the paper are divided into equal parts every way. The board hath besides a box with a magnetic needle, and moreover a large index with two sights. On the edge of the frame of the board are marked degrees and minutes, so as to supply the room of a graphometer.

FIG. 59. *To delineate a field by the help of a plain-table, from one station whence all its angles may be seen and their distances measured by a chain.*—Let the field that is to be laid down be ABCDE. At any convenient place F, let the plain-table be erected, cover it with clean paper, in which let some point near the middle represent the station. Then applying at this place the index with the sights, direct it so as that through the sights some mark may be seen at one of the angles, suppose A; and from the point F, representing the station, draw a faint right line along the side of the index: then, by the help of the chain, let FA the distance of the station from the foresaid angle be measured. Then taking what part you think convenient for a foot or pace from the line of equal parts, set off on the faint line the parts corresponding to the line FA that was measured; and let there be a mark made representing the angle of the field A. Keeping the table immoveable, the same is to be done with the rest of the angles; then right lines joining those marks shall include a figure like to the field.

The same thing is done in like manner by the graphometer: for having observed in each of the triangles, AFB, BFC, CFD, &c. the angle at the station F, and having measured the lines from the station to the angles of the field, let similar triangles be protracted on paper, having their common vertex in the point of station. All the lines, excepting those which represent the sides of the field, are to be drawn faint or obscure.

Note 1. When a surveyor wants to lay down a field, let him place distinctly in a register all the observations of the angles, and the measures of the sides, until, at time and place convenient, he draw out the figure on paper.

Note 2. The observations made by the help of the graphometer are to be examined: for all the angles about the point F ought to be equal to four right ones.

FIG. 60. *To lay down a field by means of two stations, from each of which all the angles can be seen, by measuring only the distance of the stations.*—Let the instrument be placed at the station F: and having chosen a point representing it upon the paper which is laid upon the plain table, let the index be applied at this point, so as to be moveable about it. Then let it be directed successively to the several angles of the field: and when any angle is seen through the sights, draw an obscure line along the side of the index. Let the index, with the sights, be directed after the same manner to the station G: on the obscure line drawn along its side, pointing to A, set off from the scale of equal parts a line corresponding to the measured distance of the stations, and this will determine the point G. Then remove the instrument to the station G, and, applying the index to the line representing the distance of the stations, place the instrument so that the first station may be seen through the sights. Then the instrument remaining immoveable, let the index be applied to the point representing the second station G, and be successively directed by means of its sights to all the angles of the field, drawing (as before) obscure lines: and the intersection of the two obscure lines that were drawn to the same angle from the two stations will always represent that angle on the plan. Care must be taken that those lines be not mistaken for one another. Lines joining those intersections will form a figure on the paper like to the field.

It will not be difficult to do the same by the graphometer, if you keep a distinct account of your observations of the angles made by the line joining the stations, and the lines drawn from the stations to the respective angles of the field. And this is the most common manner of laying down whole countries. The tops of two mountains are taken for two stations, and their distance is either measured by some of the methods mentioned above, or is taken according to common repute. The sights are successively directed towards cities, churches, villages, forts, lakes, turning of rivers, woods, &c.

Note, The distance of the stations ought to be great enough, with respect to the field that is to be measured; such ought to be chosen as are not in a line with any angle of the field. And care ought to be taken likewise that the angles, for example, FAG, FDG, &c. be neither very acute, nor very obtuse. Such angles are to be avoided as much as possible; and this admonition is found very useful in practice.

FIG. 61. *To lay down any field, however irregular its figure may be, by the help of the graphometer.*—Let ABCEDHG be such a field. Let its angles (in going round it) be observed with a graphometer, and noted down; let its sides be measured with a chain; and let a figure like the given field be protracted on paper. If any mountain is in the circumference, the horizontal line hid under it is to be taken for a side, which may be found by two or three observations according to some of the methods described above; and its place on the map is to be distinguished by a shade, that it may be known a mountain is there.

If not only the circumference of the field is to be laid down on the plan, but also its contents, as villages, gardens, churches, public roads, we must proceed in this manner.

Let there be (for example) a church F, to be laid down in the plan. Let the angles ABF, BAF be observed and protracted on paper in their proper places, the intersection of the two sides BF and AF will give the place of the church on the paper: or, more exactly, the lines BF, AF being measured, let circles be described from the centres B and A, with parts from the scale corresponding to the distances BF and AF, and the place of the church will be at their intersection.

Note 1. While the angles observed by the graphometer are taken down, you must be careful to distinguish the external angles, as E and G, that they may be rightly protracted afterwards on paper.

Note 2. Our observations of the angles may be examined by computing if all the internal angles make twice as many right angles, four excepted, as there are sides of the figure. But in place of any external angle DEC, its complement to a circle is to be taken.

FIG. 62. *To lay down a plain field without instruments.*—If a small field is to be measured, and a map of it to be made, and you are not provided with instruments; let it be supposed to be divided into triangles, by right lines, as in the figure; and after measuring the three sides of any of the triangles, for example of ABC, let its sides be laid down from a convenient scale on paper. Again, let the other two sides BD, CD of the triangle CBD be measured and protracted on the paper by the same scale as before. In the same manner proceed with the rest of the triangles of which the field is composed, and the map of the field will be perfected; for the three sides of a triangle determine the triangle; whence each triangle on the paper is similar to its correspondent triangle in the field, and is similarly situated; consequently the whole figure is like to the whole field.

If the field be small, and all its angles may be seen from one station, it may be very well laid down by the plain-table. If the field be larger, and have the requisite conditions, and great exactness is not expected, it likewise may be plotted by means of

the plain-table, or by the graphometer; but in fields that are irregular and mountainous, when an exact map is required, we are to make uſe of the graphometer, but rarely of the plain table.

Having protracted the bounding lines, the particular parts contained within them may be laid down by the proper operations for this purpoſe; for we may truſt more to the meaſuring of ſides than to the obſerving of angles. We are not to compute four-ſided and many-ſided figures till they are reſolved into triangles: for the ſides do not determine thoſe figures.

In the laying down of cities, or the like, we may make uſe of any of the methods deſcribed above that may be moſt convenient.

The map being finiſhed, it is transferred on clean paper, by putting the firſt ſketch above it, and marking the angles by the point of a ſmall needle. Theſe points being joined by right lines, and the whole illuminated by colours proper to each part, and the figure of the mariner's compaſs being added to diſtinguiſh the north and ſouth, with a ſcale on the margin, the map or plan will be finiſhed and neat.

Chap. III. *Of the Surfaces of Bodies.*

The ſuperficial meaſures are, firſt, the ſquare inch; ſecondly, the ſquare foot, containing 144 ſquare inches; thirdly, the ſquare yard, containing 9 ſquare feet; fourthly, the pole, containing $30\frac{1}{4}$ ſquare yards; fifthly, the rood, containing 40 poles; ſixthly, the acre, containing 4 roods.

Fig. 63. *To find out the area of a rectangular parallelogram* ABCD.—Let the ſide AB, for example, be 5 feet long, and BC (which conſtitutes with BA a right angle at B) be 17 feet. Let 17 be multiplied by 5, and the product 85 will be the number of ſquare feet in the area of the figure ABCD. But if the parallelogram propoſed is not rectangular as BEFC, its baſe BC multiplied into its perpendicular height AB (not into its ſide BE) will give its area.

Fig. 64. *To find the area of a given triangle.*—Let the triangle BAC be given, whoſe baſe BC is ſuppoſed 9 feet long: let the perpendicular AD be drawn from the angle A oppoſite to the baſe, and let us ſuppoſe AD to be 4 feet. Let the half of the perpendicular be multiplied into the baſe, or the half of the baſe into the perpendicular, or take the half of the product of the whole baſe into the perpendicular; the product gives 18 ſquare feet for the area of the given triangle.

Fig. 65. *To find the area of any rectilineal figure.*—If the figure be irregular, let it be reſolved into triangles; and drawing perpendiculars to the baſes in each of them, let the area of each triangle be found by the preceding propoſition, and the ſum of theſe areas will give the area of the figure.

Fig. 66. *The area of the ordinate figure* ABEFGH *is equal to the product of the half circumference of the polygon, multiplied into the perpendicular drawn from the centre of the circumſcribed circle to the ſide of the polygon.*—For the ordinate figure can be reſolved into as many equal triangles as there are ſides of the figure; and ſince each triangle is equal to the product of half the baſe into the perpendicular, it is evident that the ſum of all the triangles together, that is the polygon, is equal to the product of half the ſum of the baſes (that is the half of the circumference of the polygon) into the common perpendicular height of the triangles drawn from the centre C to one of the ſides; for example, to AB.

Fig. 67. *The area of a circle is found by multiplying the half of the periphery into the radius, or the half of the radius into the periphery.*—For a circle may be conſidered as a polygon, the ſum of whoſe baſes is equal to the circumference of the circle, and the perpendicular height is the radius.

Hence alſo it appears, that the area of the ſector ABCD is produced by multiplying the half of the arc into the radius, and likewiſe that the area of the ſegment of the circle ADC is found by ſubtracting from the area of the ſector the area of the triangle ABC.

Fig. 68. *The circle is to the ſquare of the diameter as* 11 *to* 14 *nearly.*—For if the diameter AB be ſuppoſed to be 7, the circumference AHBK will be almoſt 22, and the area of the ſquare DC will be 49: and, by the preceding prop. the area of the circle will be $38\frac{1}{2}$: therefore the ſquare DC will be to the inſcribed circle as 49 to $38\frac{1}{2}$, or as 98 to 77, that is, as 14 to 11.

To meaſure the ſurface of any priſm.—A priſm is contained by planes, of which two oppoſite ſides (commonly called the baſes) are plain rectilineal figures; and other ſides are parallelograms; the whole ſuperficies of the priſm conſiſts of the ſum of thoſe taken altogether.

To meaſure the ſuperficies of any pyramid.—Since its baſis is a rectilineal figure, and the reſt of the planes terminating in the top of the pyramid are triangles; theſe meaſured ſeparately, and added together, give the ſurface of the pyramid required.

To meaſure the ſuperficies of any regular body.—Theſe bodies are called *regular*, which are bounded by equilateral and equiangular figures. The ſuperficies of the tetraedon conſiſts of four equal and equiangular triangles; the ſuperficies of the hexaedron or cube, of ſix equal ſquares; an octoedron, of eight equal equilateral triangles; a dodecaedron, of twelve equal and ordinate pentagons; and the ſuperficies of an icoſiedron, of twenty equal and equilateral triangles. Therefore it will be eaſy to meaſure theſe ſurfaces from what has been already ſhown.

In the ſame manner we may meaſure the ſuperficies of a ſolid contained by any planes.

To meaſure the ſuperficies of a cylinder.—Becauſe a cylinder differs very little from a priſm, whoſe oppoſite planes or baſes are ordinate figures of an infinite number of ſides, it appears that the ſuperficies of a cylinder, without the baſis, is equal to an infinite number of parallelograms; the common altitude of all which is the ſame with the height of the cylinder, and the baſes of them all differ very little from the periphery of the circle which is the baſe of the cylinder. Therefore this periphery multiplied into the common height gives the ſuperficies of the cylinder, excluding the baſes.

This propoſition concerning the meaſure of the ſurface of the cylinder (excluding its baſis) is evident from this, that, when it is conceived to be ſpread out, it becomes a parallelogram, whoſe baſe is the periphery of the circle of the baſe of the cylinder ſtretched into a right line, and whoſe height is the ſame with the height of the cylinder.

To meaſure the ſurface of a right cone.—The ſurface of a right cone is very little different from the ſurface of a right pyramid, having an ordinate polygon for its baſe of an infinite number of ſides; the ſurface of which (excluding the baſe) is equal to the ſum of the triangles. The ſum of the baſes of theſe triangles is equal to the periphery of the circle of the baſe, and the common height of the triangles is the ſide of the cone; wherefore the ſum of theſe triangles is equal to the product of the ſum of the baſes (i. e. the periphery of the baſe of the cone) multiplied into the half of the common height, or it is equal to the product of the periphery of the baſe.

If the ſurface of a cone is ſuppoſed to be ſpread out on a plane, it will become a ſector of a circle, whoſe radius is the ſide of the cone; and the arc terminating the ſector is made from the periphery of the baſe.

To meaſure the ſurface of a given ſphere.—Let there be a ſphere, whoſe radius is given, and let the area of its convex ſurface be required. Archimedes demonſtrates that its ſurface is equal to the area of four great circles of the ſphere; that is, let the area of the great circle be multiplied by 4, and the product

will give the area of the ſphere; or the area of the ſphere given is equal to the area of a circle whoſe radius is the diameter of the ſphere.

Chap. IV. *Of ſolid Figures and their Menſuration, comprehending likewiſe the Principles of Gauging Veſſels of all Figures.*

As in the former part of this treatiſe we took an inch for the ſmalleſt meaſure in length, and an inch ſquare for the ſmalleſt ſuperficial meaſure; ſo now, in treating of the menſuration of ſolids, we take a cubical inch for the ſmalleſt ſolid meaſure.

By act of parliament 1706, any round veſſel commonly called a *cylinder*, having an even bottom, being ſeven inches in diameter throughout, and ſix inches deep from the top of the inſide to the bottom (which veſſel will be found by computation to contain 230 $\frac{907}{1000}$ cubical inches), or any veſſel containing 231 cubical inches, and no more, is deemed to be a lawful wine-gallon. A pint therefore contains $28\frac{7}{8}$ cubical inches; 2 pints make a quart; 4 quarts a gallon; 18 gallons a roundlet; 3 roundlets and an half, or 63 gallons, make a hogſhead; the half of a hogſhead is a barrel: 1 hogſhead and a third, or 84 gallons, make a puncheon; 1 puncheon and a half, or 2 hogſheads, or 126 gallons, make a pipe or butt; the third part of a pipe, or 42 gallons, make a tierce; 2 pipes, or 3 puncheons, or 4 hogſheads, make a ton of wine. Though the wine gallon is now fixed at 231 cubical inches, the ſtandard kept in Guildhall being meaſured, before many perſons of diſtinction, May 25, 1688, it was found to contain only 224 ſuch inches.

In beer-meaſure, a gallon contains 282 cubical inches; conſequently $35\frac{1}{4}$ cubical inches make a pint, 2 pints make a quart, 4 quarts make a gallon, 9 gallons a firkin, 4 firkins a barrel. In ale, 8 gallons make a firkin, and 32 gallons make a barrel. By an act of the firſt of William and Mary, 34 gallons is the barrel, both for beer and ale, in all places, except within the weekly bill of mortality.

"For meaſures of corn, the Wincheſter gallon contains $272\frac{1}{4}$ cubical inches; 2 gallons make a peck; 4 pecks, or 8 gallons (that is, 2178 cubical inches), make a buſhel; and a quarter is 8 buſhels.

"A Paris pint is 48 cubical Paris inches, and is nearly equal to an Engliſh wine-quart. The *Boiſſeau* contains 664.68099 Paris cubical inches, or 780.36 Engliſh cubical inches.

"The Roman *amphora* was a cubical Roman foot, the *congius* was the eighth part of the *amphora*, the *ſextarius* was one-ſixth of the *congius*. They divided the *ſextarius* like the *as* or *libra*. Of dry meaſures, the *medimnus* was equal to two amphoras, that is, about $1\frac{1}{25}$ Engliſh legal buſhels; and the *modius* was the third part of the *amphora*."

To find the ſolid content of a given priſm.—Let the area of the baſe of the priſm be meaſured, and be multiplied by the height of the priſm; the product will give the ſolid content of the priſm.

To find the ſolid content of a given pyramid.—The area of the baſe being found, let it be multiplied by the third part of the height of the pyramid, or the third part of the baſe by the height; the product will give the ſolid content, by 17th 12. Eucl.

If the ſolid content of a *fruſtum* of a pyramid is required, firſt let the ſolid content of the entire pyramid be found; from which ſubtract the ſolid content of the part that is wanting, and the ſolid content of the broken pyramid will remain.

To find the content of a given cylinder.—The area of the baſe being found, multiply it by the height of the cylinder, and the ſolid contents of the cylinder will be produced.

Fig. 69. In this manner may be meaſured the ſolid content of veſſels and caſks not much different from a cylinder, as ABCD. If towards the middle EF it be ſomewhat groſſer, the area of the circle of the baſe being found and added to the area of the middle circle EF, and the half of their ſum taken for the baſe of the veſſel, and multiplied into its height, the ſolid content of the given veſſel will be nearly produced.

To find the ſolid content of a given cone.—Let the area of the baſe be multiplied into $\frac{1}{3}$ of the height, the product will give the ſolid content of the cone; for by the 10th 12. Eucl. a cone is the third part of a cylinder that has the ſame baſe and height.

To find the ſolid content of a fruſtum *of a cone cut by a plane parallel to the plane of the baſe.*—Firſt, let the height of the entire cone be found, and thence its ſolid content; from which ſubtract the ſolid content of the cone cut off at the top, there will remain the ſolid content of the *fruſtum* of the cone.

Fig. 70. Some caſks whoſe ſtaves are remarkably bended about the middle, and ſtraight towards the ends, may be taken for two portions of cones, without any conſiderable error. Thus ABEF is a *fruſtum* of a right cone, to whoſe baſe EF, on the other ſide, there is another ſimilar *fruſtum* of a cone joined, EDCF. The vertices of theſe cones, if they be ſuppoſed to be completed, will be found at G and H. Whence (by the preceding propoſition) the ſolid content of ſuch veſſels may be found.

Fig. 71. A cylinder circumſcribed about a ſphere, that is, having its baſe equal to a great circle of the ſphere, and its height equal to the diameter of the ſphere, is to the ſphere as 3 to 2.

Let ABEC be the quadrant of a circle, and ABDC the circumſcribed ſquare, and ADC a triangle. By the revolution of the figure about the right line AC, as axis, a hemiſphere will be generated by the quadrant, a cylinder of the ſame baſe and height by the ſquare, and a cone by the triangle. Let theſe three be cut any how by the plane HF, parallel to the baſe AB; the ſection in the cylinder will be a circle whoſe radius is FH, in the hemiſphere a circle of the radius EF, and in the cone a circle of the radius GF.

$EAq = HFq = EFq$ and FAq taken together (but $AFq = FGq$, becauſe $AC = CD$); therefore the circle of the radius FH is equal to a circle of the radius EF, together with a circle of the radius GF; and ſince this is true every where, all the circles together deſcribed by the reſpective *radii* HF (that is, the cylinder) are equal to all the circles deſcribed by the reſpective *radii* EF and FG (that is, to the hemiſphere and the cone taken together); but (by the 10th 12. Eucl.) the cone generated by the triangle DAC is one third part of the cylinder generated by the ſquare BC. Whence it follows, that the hemiſphere generated by the rotation of the quadrant ABEC is equal to the remaining two third parts of the cylinder, and that the whole ſphere is $\frac{2}{3}$ of the double cylinder, circumſcribed about it.

This is the celebrated 39th prop. 1. book of Archimedes of the ſphere and cylinder; in which he determines the proportion of the cylinder to the ſphere inſcribed to be that of 3 to 2.

The following method is generally made uſe of for finding the ſolid content of barrels. The double area of the greateſt circle, that is, of that which is deſcribed by the diameter AB at the middle of the caſk, is added to the area of the circle at the end, that is, of the circle DC or FG (for they are uſually equal), and the third part of this ſum is taken for a mean baſe of the caſk; which therefore multiplied into the length of the caſk OP gives the content of the veſſel required.

Fig. 72 and 73. *To find how much is contained in a veſſel that is in part empty, whoſe axis is parallel to the horizon.*—Let AGBH be the great circle in the middle of the caſk, whoſe ſegment GBH is filled with liquor, the ſegment GAH being empty; the ſeg-

ment GFH is known, if the depth EB be known, and EH a mean proportional between the ſegments of the diameter AB and EB; which are found by a rod or ruler put into the veſſel at the orifice. Let the baſis of the caſk at a medium be found, which ſuppoſe to be the circle CKDL; and let the ſegment KCL be ſimilar to the ſegment GAH (which is either found by the rule of three, becauſe as the circle AGBH is to the circle CKDL, ſo is the ſegment GAH to the ſegment KCL; or is found from the tables of ſegments made by authors); and the product of this ſegment multiplied by the length of the caſk will give the liquid content remaining in the caſk.

To find the ſolid content of a body however irregular.—Let the given body be immerſed into a veſſel of water, having the figure of a parallelopipedon or priſm, and let it be noted how much the water is raiſed upon the immerſion of the body. For it is plain, that the ſpace which the water fills after the immerſion of the body exceeds the ſpace filled before its immerſion, by a ſpace equal to the ſolid content of the body, however irregular. But when this exceſs is of the figure of a parallelopipedon or priſm, it is eaſily meaſured by multiplying the area of the baſe, or mouth of the veſſel, into the difference of the elevations of the water before and after immerſion: Whence is found the ſolid content of the body given.

In the ſame way the ſolid content of a part of a body may be found, by immerſing that part only in water.

"The following rules are ſubjoined for the ready computation of contents of veſſels, and of any ſolids in the meaſures in uſe in Great Britain.

"I. To find the content of a cylindric veſſel in wine gallons, the diameter of the baſe and altitude of the veſſel being given in inches and decimals of an inch.

"Square the number of inches in the diameter of the veſſel; multiply this ſquare by the number of inches in the height: then multiply the product by the decimal fraction .0034; and this laſt product ſhall give the content in wine-gallons and decimals of ſuch a gallon. To expreſs the rule arithmetically; let D repreſent the number of inches and decimals of an inch in the diameter of the veſſel, and H the decimals of an inch in the height of the veſſel; then the content in wine-gallons ſhall be $DDH \times \frac{34}{10000}$, or $DDH \times .0034$. *Ex.* Let the diameter $D = 51.2$ inches, the height $H = 62.3$ inches, then the content ſhall be $51.2 \times 51.2 \times 62.3 \times .0034 = 555.27.332$ wine-gallons. This follows from what has been laid down. For the area of the baſe of the veſſel is in ſquare inches $DD \times .7854$; and the content of the veſſel in ſolid inches is $DDH \times .7854$; which divided by 231 (the number of cubical inches in a wine-gallon) gives $DDH \times .0034$, the content in wine gallons. But though the charges in the exciſe are made (by ſtatute) on the ſuppoſition that the wine-gallon contains 231 cubical inches; yet it is ſaid, that in ſale 224 cubical inches, the content of the ſtandard meaſured at Guildhall (as was mentioned above), are allowed to be a wine-gallon.

"II. Suppoſing the Engliſh ale gallon to contain 282 cubical inches, the content of a cylindric veſſel is computed in ſuch gallons, by multiplying the ſquare of the diameter of a veſſel by its height as formerly, and their product by the decimal fraction .0,027,851: that is, the ſolid content in ale-gallons is $DDH \times .0,027,851$.

"Suppoſing the Wincheſter buſhel to contain 2187 cubical inches, the content of a cylindric veſſel is computed in thoſe buſhels by multiplying the ſquare of the diameter of the veſſel by the height, and the product by the decimal fraction .0,003,606. But the ſtandard buſhel having been meaſured by Mr. Everard and others in 1696, it was found to contain only 2145.6 ſolid inches; and therefore it was enacted, in the act for laying a duty upon malt, *That every round buſhel, with a plain and even bottom, being* $18\frac{1}{2}$ *inches diameter throughout, and 8 inches deep, ſhould be eſteemed a legal* Wincheſter *buſhel*. According to this act (ratified in the firſt year of queen Anne) the legal Wincheſter buſhel contains only 2150.42 ſolid inches. And the content of a cylindric veſſel is computed in ſuch buſhels, by multiplying the ſquare of the diameter by the height, and their product by the decimal fraction .0,003,625. Or the content of the veſſel in thoſe buſhels is $DDH \times .0,003,625$.

"III. To compute the content of a veſſel that may be conſidered as a fruſtum of a cone in any of thoſe meaſures.

"Let A repreſent the number of inches in the diameter of the greater baſe, B the number of inches in the diameter of the leſſer baſe. Compute the ſquare of A, the product of A multiplied by B, and the ſquare of B, and collect theſe into a ſum. Then find the third part of this ſum, and ſubſtitute it in the preceding rules in the place of the ſquare of the diameter; and proceed in all other reſpects as before. Thus, for example, the content in wine-gallons in $\overline{AA \times AB \times BB} \times \frac{1}{3} \times H \times .0034$.

"Or, to the ſquare of half the ſum of the diameters A and B, add one-third part of the ſquare of half their difference, and ſubſtitute this ſum in the preceding rules for the ſquare of the diameter of the veſſel; for the ſquare of $\frac{1}{2}A \times \frac{1}{2}B$ added to $\frac{1}{3}$ of the ſquare of $\frac{1}{2}A - \frac{1}{2}B$, gives $\frac{1}{3}AA \times \frac{1}{3}AB \times \frac{1}{3}BB$.

"IV. In general, it is uſual to meaſure any round veſſel, by diſtinguiſhing it into ſeveral fruſtums, and taking the diameter of the ſection at the middle of each fruſtum; thence to compute the content of each, as if it was a cylinder of that mean diameter; and to give their ſum as the content of the veſſel. From the total content computed in this manner, they ſubtract ſucceſſively the numbers which expreſs the circular areas that correſpond to thoſe mean diameters, each as often as there are inches in the altitude of the fruſtum to which it belongs, beginning with the uppermoſt; and in this manner calculate a table for the veſſel, by which it readily appears how much liquor is at any time contained in it, by taking either the dry or wet inches; having regard to the inclination or drip of the veſſel when it has any.

"In the uſual method of computing a table for a veſſel, by ſubducting from the whole content the number that expreſſes the uppermoſt area as often as there are inches in the uppermoſt fruſtum, and afterwards the numbers for the other areas ſucceſſively; it is obvious, that the contents aſſigned by the table, when a few of the uppermoſt inches are dry, are ſtated a little too high if the veſſel ſtands upon its baſe, but too low when it ſtands on its greater baſe; becauſe, when one inch is dry, for example, it is not the area at the middle of the uppermoſt fruſtum, but rather the area at the middle of the uppermoſt inch, that ought to be ſubducted from the total content, in order to find the content in this caſe.

"V. To meaſure round timber: Let the mean circumference be found in feet and decimals of a foot; ſquare it; multiply this ſquare by the decimal .079,577, and the product by the length. *Ex.* Let the mean circumference of a tree be 10,3 feet, and the length 24 feet. Then $10,3 \times 10,3 \times .079,577 \times 24 = 202.615$, is the number of cubical feet in the tree. The foundation of this rule is, that, when the circumference of a circle is 1, the area is 0.795,774,715, and that the areas of circles are as the ſquares of their circumferences.

"But the common way uſed by artificers for meaſuring round timber differs much from this rule. They call one fourth part of the circumference the *girt*, which is by them reckoned the ſide of a ſquare, whoſe area is equal to the area of the ſection of the tree; therefore they ſquare the *girt*, and then multiply by the length of the tree. According to their method, the tree of the laſt example would be computed at 159.13 cubical feet only.

"How ſquare timber is meaſured will be eaſily underſtood

from the preceding propoſitions. Fifty ſolid feet of hewn timber, and forty of rough timber, make a load.

"VI. To find the burden of a ſhip, or the number of tons it will carry, the following rule is commonly given. Multiply the length of the keel taken within board, by the breadth of the ſhip within board, taken from the midſhip beam from plank to plank, and the product by the depth of the hold, taken from the plank below the keelſon to the under part of the upper deck plank, and divide the product by 94; the quotient is the content of the tonnage required. This rule, however, cannot be accurate; nor can one rule be ſuppoſed to ſerve for the meaſuring exactly the burden of ſhips of all ſorts. Of this the reader will find more in the Memoirs of the Royal Academy of Sciences at Paris for the year 1721."

It may be of uſe to add briefly, that the Troy-pound contains 12 ounces, the ounce 20 penny weight, and the penny-weight 24 grains; that the Averdupois pound contains 16 ounces, the ounce 16 drams, and that 112 pounds is uſually called the hundred weight. It is commonly ſuppoſed, that 14 pounds Averdupois are equal to 17 pounds Troy. According to Mr. Everard's experiments, 1 pound Averdupois is equal to 14 ounces 12 penny-weight and 16 grains Troy, that is, to 7000 grains; and an Averdupois ounce is $437\frac{1}{2}$ grains.

G E O

GEORGE I. II. and III. kings of Great Britain. George I. the ſon of Erneſt Auguſtus, duke of Brunſwick Lunenburgh, and elector of Hanover; ſucceeded to the throne of Great Britain in 1714, in virtue of an act of parliament, paſſed in the latter part of the reign of king William III. limiting the ſucceſſion of the crown, after the demiſe of that monarch, and Queen Anne (without iſſue), to the princeſs Sophia of Hanover, and the heirs of her body, being Proteſtants. George II. the only ſon of the former, ſucceeded him in 1727, and enjoyed a long reign of glory; dying amidſt the moſt rapid and extenſive conqueſts in the 77th year of his age. He was ſucceeded by his grandſon George III. our preſent ſovereign.

King GEORGE's *Iſlands*, are two iſlands in the South Sea, lying in W. lon. 144. 56. S. lat. 14. 28. They were firſt diſcovered by commodore Byron in 1765, and have ſince been viſited by captain Cook in 1774. Commodore Byron's people had an encounter with the inhabitants, which proved fatal to ſome of the natives; but captain Cook was more fortunate. A lieutenant and two boats well armed were ſent on ſhore by captain Cook, and landed without oppoſition. As ſoon as the gentlemen landed, the iſlanders embraced them by touching noſes, a mode of civility uſed in New Zealand, which is 900 leagues diſtant, and the only place beſides this where the cuſtom has been obſerved to prevail. Notwithſtanding this ceremony, however, very little real friendſhip ſeemed to take place on the part of the iſlanders. They crowded about the boats as the people were ſtepping into them, and ſeemed in doubt whether they ſhould detain them or let them go; at laſt, however, not thinking themſelves ſufficiently ſtrong, they ſeemed contented with their departure, and aſſiſted them in puſhing off their boats; but ſome of the moſt turbulent threw ſtones into the water which fell very near them, and all ſeemed to glory that they had as it were driven them off. The Britiſh, however, brought off five dogs of a white colour with fine long hair, with which the iſland ſeemed to be plentifully ſupplied. Theſe they purchaſed with ſmall nails, and ſome ripe bananas which had been brought from the Marqueſas. On this iſland Mr. Foreſter found a kind of ſcurvy-graſs, which the natives informed him they were wont to bruiſe and mix with ſhell-fiſh; after which, they threw it into the ſea whenever they perceived a ſhoal of fiſh. This preparation intoxicates them for ſome time; and thus they are caught on the ſurface of the water without any other trouble than that of taking them out. The name of this plant among the natives is *e now*. The largeſt iſland, which they call *Tiookea*, is ſomething of an oval ſhape, and about 10 leagues in circuit; the other iſland, which lies two leagues to the weſtward of Tiookea, is four leagues long from north-eaſt to ſouth-weſt, and from five to three miles broad. The ſoil of both is extremely ſcanty; the foundation conſiſts of coral, very little elevated above the ſurface of the water.

GEORGE (St.) or GEORGE *of Cappadocia*; a name whereby ſeveral orders, both military and religious, are denominated. It took its riſe from a ſaint or hero famous throughout all the Eaſt, called by the Greeks Μεγαλομαρτυς, q. d. *great martyr*. On ſome medals of the emperors John and Manuel Comneni, we have the figure of St. George armed, holding a ſword or javelin in one hand, and in the other a buckler, with this inſcription; an O, and therein a little

P
A, and ΓΕ—ΓΙΟC, making Ο ΑΓΙΟΣ ΓΕΟΡΓΙΟΣ, *O holy George.*
O

He is generally repreſented on horſeback, as being ſuppoſed to have frequently engaged in combats in that manner. He is highly venerated throughout Armenia, Muſcovy, and all the countries which adhere to the Greek rite; from the Greek, his worſhip has long ago been received into the Latin church; and England and Portugal have both choſen him for their patron ſaint. Great difficulties have been raiſed about this ſaint or hero. His very exiſtence has been called in queſtion. Dr. Heylin, who wrote firſt and moſt about him, concluded with giving him entirely up, and ſuppoſing him only a ſymbolical device; and Dr. Pettingal has turned him into a mere Baſilidian ſymbol of victory. Mr. Pegg, in a paper in vol. I. of the Archæologia, has attempted to reſtore him. And finally, Mr. Gibbon (Hiſt. vol. II. p. 404.) has ſunk him into an Arian biſhop in the reigns of Conſtantius and Julian. The biſhop alluded to,

GEORGE *the Cappadocian*, was ſo ſurnamed, according to our author, from his parents or education; and was born at Epiphania in Cilicia, in a fuller's ſhop. "From this obſcure and ſervile origin he raiſed himſelf by the talents of a paraſite: and the patrons whom he aſſiduouſly flattered procured for their worthleſs dependent a lucrative commiſſion, or contract, to ſupply the army with bacon. His employment was mean: he rendered it infamous. He accumulated wealth by the baſeſt arts of fraud and corruption; but his malverſations were ſo notorious, that George was compelled to eſcape from the purſuits of juſtice. After this diſgrace, in which he appears to have ſaved his fortune at the expence of his honour, he embraced, with real or affected zeal, the profeſſion of Arianiſm. From the love, or the oſtentation, of learning, he collected a valuable library of hiſtory, rhetoric, philoſophy, and theology; and the choice of the prevailing faction promoted George of Cappadocia to the throne of Athanaſius." His conduct in this ſtation is repreſented by our hiſtorian as polluted by cruelty and avarice, and his death conſidered as a juſt puniſhment for the enormities of his life, among which Mr. Gibbon ſeems to rank his "enmity to the Gods."

The immediate occaſion of his death, however, as narrated by eccleſiaſtical writers, will not probably appear calculated to add

any ftain to his memory. "There was in the city of Alexandria a place in which the heathen priefts had been ufed to offer human facrifices. This place, as being of no ufe, Conftantius gave to the church of Alexandria, and George the bifhop gave orders for it to be cleared, in order to build a Chriftian church on the fpot. In doing this they difcovered an immenfe fubterraneous cavern, in which the heathen myfteries had been performed, and in it were many human fkulls. Thefe, and other things which they found in the place, the Chriftians brought out and expofed to public ridicule. The heathens, provoked at this exhibition, fuddenly took arms, and, rufhing upon the Chriftians, killed many of them with fwords, clubs, and ftones: fome alfo they ftrangled, and feveral they crucified. On this the Chriftians proceeded no farther in clearing the temple; but the heathens, purfuing their advantage, feized the bifhop as he was in the church, and put him in prifon. The next day they difpatched him; and then faftening the body to a camel, he was dragged about the ftreets all day, and in the evening they burned him and the camel together. This fate, Sozomen fays, the bifhop owed in part to his haughtinefs while he was in favour with Conftantius, and fome fay the friends of Athanafius were concerned in this maffacre; but he afcribes it chiefly to the inveteracy of the heathens, whofe fuperftitions he had been very active in abolifhing.

"This George, the Arian bifhop of Alexandria, was a man of letters, and had a very valuable library, which Julian ordered to be feized for his own ufe; and in his orders concerning it, he fays that many of the books were on philofophical and rhetorical fubjects, though many of them related to the doctrine of the impious Galileans (as in his fneering contemptuous way he always affected to call the Chriftians). 'Thefe books (fays he) I could wifh to have utterly deftroyed; but left books of value fhould be deftroyed along with them, let thefe alfo be carefully fought for.'"

But Mr. Gibbon gives a different turn to the affair of George's murder, as well as relates it with different circumftances. "The Pagans (fays he) excited his devout avarice; and the rich temples of Alexandria were either pillaged or infulted by the haughty prelate, who exclaimed, in a loud and threatening tone, 'How long will thefe fepulchres be permitted to ftand?' Under the reign of Conftantius he was expelled by the fury, or rather the juftice, of the people; and it was not without a violent ftruggle that the civil and military powers of the ftate could reftore his authority, and gratify his revenge. The meffenger who proclaimed at Alexandria the acceffion of Julian announced the downfall of the archbifhop. George, with two of his obfequious minifters, count Diodorus, and Dracontius, mafter of the mint, was ignominioufly dragged in chains to the public prifon. At the end of 24 days, the prifon was forced open by the rage of a fuperftitious multitude, impatient of the tedious forms of judicial proceedings. The *enemies of Gods* and men expired under their cruel infults; the lifelefs bodies of the archbifhop and his affociates were carried in triumph through the ftreets on the back of a camel; and the inactivity of the Athanafian party was efteemed a fhining example of evangelical patience. The remains of thefe guilty wretches were thrown into the fea; and the popular leaders of the tumult declared their refolution to difappoint the devotion of the Chriftians, and to intercept the future honours of thefe martyrs, who had been punifhed, like their predeceffors, by the enemies of their religion. The fears of the Pagans were juft, and their precautions ineffectual. The meritorious death of the archbifhop obliterated the memory of his life. The rival of Athanafius was dear and facred to the Arians, and the feeming converfion of thofe fectaries introduced his worfhip into the bofom of the Catholic church. The odious ftranger, difguifing every circumftance of time and place, affumed the mafk of a martyr, a faint, and a Chriftian hero; and the infamous George of Cappadocia has been transformed into the renowned George of England, the patron of arms, of chivalry, and of the garter."

Knights of St. GEORGE. See GARTER. There have been various other orders under this denomination, moft of which are now extinct; particularly one founded by the emperor Frederic III. in the year 1470, to guard the frontiers of Bohemia and Hungary againft the Turks; another, called *St. George of Alfama*, founded by the kings of Arragon; another in Auftria and Carinthia; and another in the republic of Genoa, ftill fubfifting, &c.

Religious of St. GEORGE. Of thefe there are various orders and congregations; particularly canons regular of St. George in Alga, at Venice, eftablifhed by authority of pope Boniface IX. in the year 1404. The foundation of this order was laid by Bartholomew Colonna, who preached in 1396 at Padua, and fome other villages in the ftate of Venice. Pope Pius V. in 1570 gave thefe canons precedence of all other religious. Another congregation of the fame was inftituted in Sicily, &c.

Crofs of St. GEORGE, a red crofs in a field argent, which makes part of the Britifh ftandard.

Fort GEORGE, a ftrong and regular fortrefs of Invernefsfhire in Scotland. It has feveral handfome ftreets of barracks, and is feated on the point of Arderfier, a peninfula running into the frith of Murray. It completely commands the entrance into the harbour of Invernefs.

Fort St. GEORGE, a fort and town of Afia, in the peninfula of Hindoftan, on the coaft of Coromandel, belonging to the Britifh; it is otherwife called MADRAS, and by the natives CHILIPATAM. It is the principal fettlement of the Englifh Eaft-India Company on the eaft fide of the peninfula, and is a fortrefs of very great ftrength, including within it a regular well-built city. It is clofe on the margin of the fea, from which it has a rich and beautiful appearance; the houfes being covered with a ftucco called chunam, which in itfelf is nearly as compact as the fineft marble, and, as it bears as high a polifh, is equally fplendid with that elegant material. They confift of long colonnades, with open porticoes, and flat roofs; and they may be confidered as elegant, particularly fo from being finifhed with fuch a beautiful material as the chunam; and the city contains many handfome and fpacious ftreets. But the inner apartments of the houfes are not highly decorated, prefenting to the eye only white walls; which however, from the marble-like appearance of the ftucco, give a frefhnefs grateful in fo hot a country. Ceilings are very uncommon in the rooms. Indeed it is impoffible to find any which will refift the ravages of that deftructive infect the white ant. Thefe animals are chiefly formidable from the immenfity of their numbers, which are fuch as to deftroy in one night's time a cieling of any dimenfions. It is the wood-work which ferves for the bafis of the ceilings, fuch as the laths, beams, &c. that thefe infects attack. "The approach to Madras from the fea," fays Mr. Hodges, "offers to the eye an appearance fimilar to what we may conceive of a Grecian city in the age of Alexander. The clear, blue, cloudlefs fky, the polifhed white buildings, the bright fandy beach, and the dark green fea, prefent a combination totally new to the eye of an Englifhman juft arrived from London, who, accuftomed to the fight of rolling maffes of clouds floating in a damp atmofphere, cannot but contemplate the difference with delight: and the eye being thus gratified, the mind foon affumes a gay and tranquil habit, analogous to the pleafing objects with which it is furrounded. Some time before the fhip arrives at her anchoring ground, fhe is hailed by the boats of the country, filled with people of bufinefs who come in crowds on board. This is the moment in which an European feels the great diftinction between Afia and his own country. The ruftling of fine linen, and the general hum of unufual converfation, prefents to his mind for a moment the idea of an affembly of females. When

he ascends upon the deck, he is struck with the long muslin dresses, and black faces adorned with very large gold ear-rings and white turbans. The first salutation he receives from these strangers is, by bending their bodies very low, touching the deck with the back of the hand, and the forehead three times. The natives first seen in India by the European voyager are Hindoos, the original inhabitants of the peninsula. In this part of India they are delicately framed; their hands, in particular, are more like those of tender females, and do not appear to be what is considered a proper proportion to the rest of the person, which is usually above the middle size. Correspondent to this delicacy of appearance are their manners—mild, tranquil, and sedulously attentive: in this last respect they are indeed remarkable, as they never interrupt any person who is speaking, but wait patiently till he has concluded; and then answer with the most perfect respect and composure. From the ship a stranger is conveyed on shore in a boat of the country, called a Masoolah boat; a work of curious construction, and well calculated to elude the violent shocks of the surf, that breaks here with great violence: they are formed without a keel, flat-bottomed, with the sides raised high, and sewed together with the fibres of the cocoa-nut tree, and caulked with the same material: they are remarkably light, and are managed with great dexterity by the natives; they are usually attended by two kattamarans (rafts) paddled by one man each, the intention of which is, that, should the boat be overset by the violence of the surf, the persons in it may be preserved. The boat is driven, as the sailors say, high and dry; and the passengers are landed on a fine, sandy beach, and immediately enter the fort of Madras. The appearance of the natives is exceedingly varied: some are wholly naked, and others so clothed that nothing but the face and neck is to be discovered; beside this, the European is struck with many other objects, such as women carried on men's shoulders on palankeens, and men riding on horseback clothed in linen dresses like women; which, with the very different face of the country from all he had ever seen, or conceived of, excite the strongest emotions of surprise." There is a second city, called the Black Town, separated from Madras by the breadth of a proper esplanade only, and, although near four miles in circuit, fortified in such a manner as to prevent a surprise from the enemy's horse; an evil to which every town in the Carnatic is subject, from the dryness and evenness of the country. Madras was settled by the English about the year 1640. It was taken by the French in 1746, but restored by the treaty of Aix-la-Chapelle. Indeed it was hardly defensible, until the destruction of Fort St. David in 1758 pointed out the necessity of fortifying it. The fort was planned by Mr. Robins, the real author of Lord Anson's Voyage, and it is perhaps one of the best fortresses in the possession of the British nation. Madras, in common with all the European settlements on this coast, has no port for shipping; the coast forming nearly a straight line; and it is incommoded also with a high and dangerous surf. Madras is 100 miles N. by E. of Pondicherry, 1030 S. W. by W. of Calcutta, and 758 S. E. of Bombay. E. lon. 80. 25. N. lat. 13. 5.

St. GEORGE'S *Key*, a small island of North America, off the coast of Honduras. It is likewise called Casina or Cayo Casina. By a convention in 1786, the English logwood-cutters in the bay of Honduras were permitted, under certain restrictions, to occupy this island.

Lake GEORGE, a lake of N. America, in the state of New York. It lies S. W. of Lake Champlain, and is 35 miles long from N. E. to S. W. but is narrow. The adjacent country is mountainous; the valleys tolerably good.

St. GEORGE *del Mina*, a fort on the Gold Coast of Guinea, and the principal settlement of the Dutch in those parts. It was taken from the Portuguese in 1630. The fort is the best on the coast. Under it is the town, called by the natives Oddena, which is very long, and pretty broad. The houses are built of stone, which is very extraordinary; for in all other places they are composed only of clay and wood. It was once very populous, but the inhabitants were destroyed by the small-pox; so that it is greatly reduced, and they are become very poor. It is about 10 miles W. of Cape Coast Castle. W. lon. 0. 22. N. lat. 5. 0.

St. GEORGE'S, a small island in the gulf of Venice, lying to the S. of Venice, to which it is subject. In it there is a Benedictine monastery, whose church is one of the finest in Italy.

St. GEORGE'S, the largest of the Bermuda Islands, lying 500 miles E. of the continent of N. America. W. lon. 63. 30. N. lat. 32. 45.

St. GEORGE'S, an island in the gulf of Mexico, opposite the mouth of the Appalachikola. W. lon. 84. 50. N. lat. 29. 30.

St. GEORGE, one of the Azores, inhabited by about 5000 persons, who cultivate wheat in great quantity. W. lon. 28. 0. N. lat. 38. 39.

St. GEORGE, an island of the United States of N. America, in the strait of St. Mary, that forms the communication between Lake Superior and Lake Huron.

GEORGE *Town*, the seat of justice in a district of the same name in S. Carolina, situated near the junction of a number of rivers, which, when united into one broad stream named the Pedee, fall into the Atlantic Ocean 12 miles below the town. It is 55 miles N. by E. of Charleston. W. lon. 79. 30. N. lat. 33. 20.

GEORGIA, a country of Asia, called by the Persians Gurgistan, and by the Turks Gurtshi. It is one of the seven Caucasian nations, in the countries included between the Black Sea and the Caspian, and comprehends the ancient Iberia and Colchis. It is bounded on the N. by Circassia, on the E. by Daghestan and Schirvan, on the S. by Armenia, and on the W. by the Cuban, or new Russian government of Caucasus. It is divided into nine provinces. Of these, five are subject to Heraclius, and form what is commonly called the kingdom of Georgia; and four, which are subject to David, form the kingdom or principality of Imeretia. This country is so extremely beautiful, that some fanciful travellers have imagined they had here found the situation of the original garden of Eden. The hills are covered with forests of oak, ash, beech, chesnuts, walnuts, and elms, encircled with vines, growing perfectly wild, but producing vast quantities of grapes. From these is annually made as much wine as is necessary for their yearly consumption; the remainder are left to rot on the vines. Cotton grows spontaneously, as well as the finest European fruit-trees. Rice, wheat, millet, hemp, and flax, are raised on the plains almost without culture. The valleys afford the finest pasturage in the world; the rivers are full of fish; the mountains abound in minerals; and the climate is delicious; so that nature appears to have lavished on this favoured country every production that can contribute to the happiness of its inhabitants. On the other hand, the rivers of Georgia, being fed by mountain torrents, are always either too rapid or too shallow for the purposes of navigation; the Black Sea, by which commerce and civilization might be introduced from Europe, has been till very lately in the exclusive possession of the Turks; the trade of Georgia by land is greatly obstructed by the high mountains of Caucasus; and this obstacle is still increased by the swarms of predatory nations, by which those mountains are inhabited. The inhabitants are Christians of the Greek communion, and appear to have received their present name from their attachments to St. George, the tutelary saint of these countries. Their dress nearly resembles that of the Cossacs; but men of rank frequently wear the habit of Persia. They usually dye their hair, beards, and nails with red. The women employ the same colour to stain the palms of their hands. On their heads they wear a cap or fillet, under which their black hair falls on their forehead; behind, it is

braided into feveral treffes: their eyebrows are painted with black in fuch a manner as to form one entire line, and the face is perfectly coated with white and red. Their air and manner are extremely voluptuous, and being generally educated in convents, they can all read and write; a qualification which is very unufual among the men, even of the higheft rank. Girls are betrothed as foon as poffible, often at three or four years of age. In the ftreets the women of rank are always veiled, and then it is indecent in any man to accoft them: it is likewife uncivil, in converfation, to inquire after the wives of any of the company. Travellers accufe the Georgians of drunkennefs, fuperftition, cruelty, floth, avarice, and cowardice; vices which are every where common to flaves and tyrants, and are by no means peculiar to the natives of this country. The defcendants of the colonifts carried by Shach Abbas and fettled at Peria, near Ifpahan, and in Mafanderan, have changed their character with their government; and the Georgian troops employed in Perfia againft the Affghans were advantageoufly diftinguifhed by their docility, their difcipline, and their courage. The other inhabitants of Georgia are Tartars, Offi, and Armenians. Thefe laft are found all over Georgia, fometimes mixed with the natives, and fometimes in villages of their own. They fpeak among themfelves their own language, but all underftand and can talk the Georgian. Their religion is partly the Armenian, and partly the Roman Catholic. They are the moft oppreffed of the inhabitants, but are ftill diftinguifhed by that inftinctive induftry which every where characterizes the nation. Befide thefe, there are in Georgia confiderable numbers of Jews, fome having villages of their own, and others mixed with the Georgian, Armenian, and Tartar inhabitants, but never with the Offi: they pay a fmall tribute above that of the natives. Teffis is the capital of Georgia. See Imeritia.

Georgia, the moft fouthern of the United States of N. America, bounded on the E. by the Atlantic Ocean, on the S. by E. and W. Florida, on the W. by the river Miffiffippi, and on the N. by N. and S. Carolina, being divided from the latter by the river Savannah. It is about 600 miles long and 250 broad, lying between 80° and 91° W. lon. and 31° and 35° N. lat. It is divided into 11 counties, namely, Chatham, Effingham, Burke, Richmond, Wilkes, Liberty, Glynn, Camden, Wafhington, Greene, and Franklin. The capital is Augufta. The principal rivers are the Savannah, Ogeechee, Alatamaha, Turtle River, Little Sitilla, Great Sitilla, Crooked River, St. Mary's, and Appalachikola. The winters in Georgia are very mild and pleafant. Snow is feldom or never feen. The foil and its fertility are various, according to fituation and different improvements. By culture are produced rice, indigo, cotton, filk, India corn, potatoes, oranges, figs, pomegranates, &c. Rice at prefent is the ftaple commodity; but great attention begins to be paid to the raifing of tobacco. The whole coaft of Georgia is bordered with iflands, the principal of which are Skidaway, Waffaw, Offahaw, St. Catharine's, Sapelo, Frederica, Jekyl, Cumberland, and Amelia.

Georgia, *Southern*, an ifland of the S. Pacific Ocean, difcovered by captain Cook in 1775, and fo named by him. It is 31 leagues long, and its greateft breadth is about 10. It feems to abound with bays and harbours, which the vaft quantities of ice render inacceffible the greateft part of the year. Two rocky iflands are fituated at the N. end; one of which was named Willis' Ifland, from the perfon who difcovered it. It is a craggy cliff, nearly perpendicular, which contained the nefts of many thoufand fhags. The other received the name of Bird Ifland, from the innumerable flocks of birds of all forts that were feen near it, from the largeft albatroffes down to the leaft petrals. Several porpufes and feals were likewife obferved. Here are perpendicular ice-cliffs, of confiderable height, like thofe at Spitzbergen. Pieces were continually breaking off, and floating out to fea. The valleys were covered with fnow; and the only vegetation obferved was a bladed grafs growing in tufts, wild burnet, and a plant, like mofs, which fprung from the rocks. Not a ftream of frefh water was to be feen on the whole coaft. This ifland lies between 38. 13. and 35. 34. W. lon. and 53. 57. and 54. 57. S. lat.

GEORGIC, a poetical compofition upon the fubject of hufbandry, containing rules therein, put into a pleafing drefs, and fet off with all the beauties and embellifhments of poetry. The word is borrowed from the Latin *georgicus*, and that of the Greek γεωργικος, of γη, *terra*, "earth," and εργαζομαι, *opero*, "I work, or labour," of εργον, *opus*, "work." Hefiod and Virgil are the two greateft mafters in this kind of poetry. The moderns have produced nothing in this way, except Rapin's book of Gardening; and the celebrated poem intitled Cyder, by Mr. Philips, who, if he had enjoyed the advantage of Virgil's language, would have been fecond to Virgil in a much nearer degree.

Georgium *Sidus*. See Astronomy, p. 357 and 361.

GEPIDÆ, Gepides, or Gepidi, according to Procopius, were a Gothic people, or a canton or branch of them; fome of whom, in the migration of the Goths, fettled in an ifland at the mouth of the Viftula, which they called *Gepidos*, after their own name, which denotes lazy or flothful; others in Dacia, calling their fettlement there *Gepidia*.

GEPPING, an imperial town of Germany, in the circle of Suabia and duchy of Wirtemberg, feated on the river Wils, 25 miles E of Stutgard. E. lon. 9. 45. N. lat. 48. 44.

GERA, a town of Germany, in Mifnia, with a handfome college, on the river Elfter. E. lon. 11. 56. N. lat. 50. 50.

GERANITES, in natural hiftory, an appellation given to fuch of the femipellucid gems as are marked with a fpot refembling a crane's eye.

GERANIUM, cranes-bill, in botany; a genus of the decandria order, belonging to the monadelphia clafs of plants, and in the natural method ranking under the 14th order, *Gruinales*. Its characters are thefe: The flower hath a permanent empalement, compofed of five fmall oval leaves, and five oval or heart-fhaped petals, fpreading open, which are in fome fpecies equal, and in others the upper two are much larger than the three lower. It has ten ftamina, alternately longer than each other, but fhorter than the petals, and terminated by oblong fummits. In the bottom of the flower is fituated a five-cornered germen, which is permanent. The flower is fucceeded by five feeds, each being wrapped up in the hufk of the beak, where they are twifted together at the point, fo as to form the refemblance of a ftork's beak. There are above 80 fpecies.

The common wild forts of this plant, and thofe alfo which are brought to the curious from the colder climates, are hardy enough, and require little care; but the African fpecies, and the others from hot countries, which make fo very beautiful a figure in our green-houfes, require great care in their culture and propagation. Thefe may be propagated by feed, which fhould be fown toward the end of March in beds of light earth, carefully fhading them from the fun, and giving them frequent but gentle waterings till they are well rooted. The mats with which thefe beds are covered fhould be taken off in gentle fhowers, and always in the hot weather at nights, that the plants may have the benefit of the dew. They fhould remain about two months in this bed, by which time they will have taken root. Some pots of about feven inches wide are then to be filled with light earth, and the plants are to be carefully taken up with as much as poffible of their own earth about them, and planted feverally in the middle of thefe pots; when they are to be fet in a fhady place, and watered at times till they have taken root. When they are well rooted, they fhould be fet in a more expofed place to harden them, and fhould ftand out till the middle of October; but when the mornings begin to grow frofty,

they muſt be removed into the green-houſe, and then placed as near the windows as poſſible, and the windows ſhould be opened upon them till the weather is very cold. During the winter, they muſt be frequently watered a little at a time, and their dead leaves ſhould be pulled off. They muſt not ſtand under the ſhade of other plants, nor do they need any artificial heat.

Thoſe who are deſirous that their plants ſhould be large and flower ſoon, muſt ſow the ſeeds on a moderate hot-bed in the ſpring; when they are come up, they ſhould not be drawn weak, and the pots into which they are tranſplanted ſhould be plunged into another moderate hot-bed, ſhading them from the ſun till they have taken root, and gradually inuring them to the open air, into which they ſhould be removed in the beginning of June, and placed in a ſheltered ſituation with other exotic plants.

The ſhrubby African geraniums are commonly propagated by cuttings, which, planted in a ſhady border in June or July, will take good root in five or ſix weeks; and they may then be taken up and planted in ſeparate pots, placing them in the ſhade till they have taken new root; after which they may be removed into a ſheltered ſituation, and treated like the ſeedling plants.

GERAR, or GERARA, the ſouth boundary of Canaan near Berſeba, ſituated between Cades and Sur, two deſerts well known, the former facing Egypt, the latter Arabia Petræa.

GERARD (John), a learned Lutheran divine, was profeſſor of divinity, and rector of the academy of Jena, the place of his birth. He wrote, 1. The Harmony of the Eaſtern Languages; 2. A Treatiſe on the Coptic Church; and other works which are eſteemed. He died in 1668.

GERARDE (John), a ſurgeon in London, and the greateſt botaniſt of his time, was many years chief gardener to Lord Burleigh, who was himſelf a great lover of plants, and had the beſt collection of any nobleman in the kingdom, among which were a great number of exotics introduced by Gerarde. In 1597 he publiſhed his *Herbal*, which was printed at the expence of J. Norton, who procured the figures from Francfort. In 1663 Thomas Johnſon, an apothecary, publiſhed an improved edition of Gerarde's book, which met with ſuch approbation by the Univerſity of Oxford, that they conferred on him the degree of doctor of phyſic; and it is ſtill much eſteemed. The deſcriptions in the herbal are plain and familiar; and both theſe authors have laboured more to make their readers underſtand the characters of the plants, than to inform them that they themſelves underſtood Greek and Latin.

GERARDIA, in botany; a genus of the angioſpermia order, belonging to the didynamia claſs of plants, and in the natural method ranking under the 40th order, *Perſonatæ*. The calyx is quinquefid, the corolla bilabiate; the under lip tripartite; the ſide lobes emarginated, and the middle one bipartite; the capſule bilocular and gaping.

GERAW, a town of Germany, in Heſſe-Darmſtadt, capital of a diſtrict of the ſame name, 10 miles N. W. of Darmſtadt. E. lon. 8. 29. N. lat. 49. 45.

GERBEROY, a town of France, in the department of Oiſe, and late province of the Iſle of France, with a handſome chapter-houſe, 10 miles from Beauvais, and 50 N. of Paris. E. lon. 2. 54. N. lat. 49. 32.

GERBES, GERBI, or *Zerbi*, an iſland of Africa, on the coaſt of the kingdom of Tunis. It bears no corn but barley; though there are large quantities of figs, olives, and grapes, which when dried form their principal trade. It depends on the dey of Tripoli. E. lon. 10. 30. N. lat. 33. 56.

GERBEVILLERS, a town of France, in the department of Meurthe and late province of Lorrain, with a handſome caſtle. The church of the late Carmelites is very elegant. It is ſeated on the river Agen, five miles from Luneville.

GERBIER (Sir Balthazar), a painter of Antwerp, born in the year 1592, diſtinguiſhed himſelf by painting ſmall figures in diſtemper. King Charles I. was ſo pleaſed with his performances, that he invited him to his court, where he obtained the eſteem of the duke of Buckingham, and grew into great favour. He was not only knighted, but ſent to Bruſſels, where he long reſided as agent for the king of Great Britain.

GERFALCON. See FALCO.

GERGENTI, a town of Sicily, with a caſtle and a biſhop's ſee. It is ſeated near the river St. Blaiſe, 50 miles S. of Palermo. E. lon. 13. 24. N. lat. 47. 24.

GERGESA, a Transjordan town, no otherwiſe known than by the *Gergeſeni* of St. Matthew, and *Gergeſæi* of Moſes; ſuppoſed to have ſtood in the neighbourhood of Gadara and near the ſea of Tiberias. The *Gergeſæi*, one of the ſeven ancient people of Canaan, leſs frequently mentioned than the reſt, appear to have been leſs conſiderable and more obſcure: their name is from *Girgaſi*, one of Canaan's ſons.

GERM, among gardeners. See GERMEN.

St. GERMAIN, a town of France, in the department of Seine and Oiſe and late province of the Iſle of France, with a magnificent palace, embelliſhed by ſeveral kings, particularly by Lewis XIV. who was born in it. It is one of the moſt beautiful ſeats in France, as well on account of the apartments and gardens, as of the fine foreſt that is near it. Here James II. found an aſylum when he fled to France. It is ſeated on the river Seine, 10 miles N. W. of Paris. E. lon. 2. 15. N. lat. 48. 52.

GERMAN, in a genealogical ſenſe, ſignifies whole, entire, or own. *Germani, quaſi eadem ſtirpe geniti*; (Feſt.). Hence, *brother-german*, denotes a brother both by the father's and mother's ſide, in contradiſtinction to uterine brothers, &c. who are only ſo by the mother's ſide. *Couſins-german*, are thoſe in the firſt or neareſt degree, being the children of brothers or ſiſters. Among the Romans we have no inſtance of marriage between couſins-german before the time of the emperor Claudius, when they were very frequent. Theodoſius prohibited them under very ſevere penalties, even fine and proſcription. See CONSANGUINITY.

GERMAN, or *Germanic*, alſo denotes any thing belonging to Germany; as the German empire, German flute, &c.

GERMANDER, in botany. See the article TEUCRIUM.

GERMANICUS CÆSAR, the ſon of Druſus, and paternal nephew to the emperor Tiberius, who adopted him; a renowned general, but ſtill more illuſtrious for his virtues. He took the title of *Germanicus* from his conqueſts in that country; and though he had the moderation to refuſe the empire offered to him by his army, Tiberius, jealous of his ſucceſs, and of the univerſal eſteem he acquired, cauſed him to be poiſoned, A. D. 29, aged 34. He was a protector of learning, and compoſed ſome Greek comedies and Latin poems, ſome of which are ſtill extant.

GERMANY, a country of Europe, bounded on the E. by Hungary and Poland, on the N. by the Baltic Sea and Denmark, on the W. by France and the Netherlands, and on the S. by the Alps, Swiſſerland, and Italy; being about 640 miles in length, and 550 in breadth. The air is temperate and wholeſome; but as to the particular productions, they will be taken notice of where the circles are deſcribed. Germany contains a great many princes, ſecular and eccleſiaſtic, who are independent of each other; and there are a great number of free imperial cities, which are ſo many little republics, governed by their own laws, and united by a head who has the title of emperor. The weſtern Roman empire which had terminated in the year 475, in the perſon of Auguſtulus, the laſt Roman emperor, and which was ſucceeded by the reign of the Huns, the Oſtrogoths, and the Lombards, was revived by Charlemagne, king of France, on Chriſtmas Day in the year 800. This prince being then at Rome, pope Leo III. crowned him emperor, in St. Pe-

ter's church, amid the acclamations of the clergy and the people. Nicephorus, who was at that time emperor of the East, consented to this coronation. After the death of Charlemagne, and of Lewis le Debonnaire, his son and successor, the empire was divided between the four sons of the latter. Lothario, the first, was emperor; Pepin was king of Aquitaine; Lewis king of Germany; and Charles le Chauve (the Bald) king of France. This partition was the source of incessant feuds. The French kept the empire, under eight emperors, till the year 912, when Lewis III. the last prince of the line of Charlemagne, died without issue male. Conrad, count of Franconia, the son-in-law of Lewis, was then elected emperor. Thus the empire went to the Germans, and became elective; for it had been hereditary under the French emperors, its founders. The emperor was chosen by the princes, the lords, and the deputies of cities, till toward the end of the 13th century, when the number of the electors was fixed. Rodolphus, count of Hapsburgh, was elected emperor in 1273. He is the head of the house of Austria, which is descended from the same stock as the house of Lorrain, re-united to it in the person of Francis I. father of the two late emperors, Joseph and Leopold. On the death of Charles VI. of Austria in 1740, an emperor was chosen from the house of Bavaria, by the name of Charles VII. On the death of this prince in 1745, the above-mentioned Francis, grand duke of Tuscany, was elected emperor; whose grandson, Francis, now enjoys the imperial dignity; the prerogatives of which were formerly much more extensive than they are at present. At the close of the Saxon race in 1024, they exercised the right of conferring all the ecclesiastical benefices in Germany; of receiving their revenues during a vacancy; of succeeding to the effects of intestate ecclesiastics; of confirming or annulling the elections of the popes; of assembling councils, and of appointing them to decide concerning the affairs of the church; of conferring the title of king on their vassals; of granting vacant fiefs; of receiving the revenues of the empire; of governing Italy as its proper sovereigns; of erecting free cities, and establishing fairs; of assembling the diets of the empire, and fixing the time of their duration; of coining money, and conferring the same privilege on the states of the empire; and of administering justice within the territories of the different states; but in 1437 they were reduced to the right of conferring all dignities and titles, except the privilege of being a state of the empire; of appointing once during their reign a dignitary in each chapter, or religious house; of granting dispensations with respect to the age of majority; of erecting cities, and conferring the privilege of coining money; of calling the meetings of the diet, and presiding in them. To this some have added, 1. That all the princes and states of Germany are obliged to swear fidelity to them. 2. That they or their generals have a right to command the forces of all the princes of the empire when united together. 3. That they receive a kind of tribute from all the princes and states of the empire, for carrying on a war which concerns the whole empire, which is called the Roman Month. But, after all, there is not a foot of land, or territory, annexed to this title: for, ever since the reign of Charles IV. the emperors have depended entirely on their hereditary dominions, as the only source of their power, and even of their subsistence. The electors of the empire are three ecclesiastical, namely, the archbishops of Treves, Cologne, and Mentz; and five secular, namely, the king of Prussia, as elector of Brandenburg; the king of Great Britain, as elector of Hanover; the present emperor, as archduke of Austria; the elector of Saxony, and the elector palatine of the Rhine. Each elector bears the title of one of the principal officers of the empire; the elector of Hanover, for instance, being "arch-treasurer and elector of the holy Roman empire." To prevent the calamities of a contested election, a king of the Romans has been often chosen in the lifetime of the emperor, on whose death he succeeds to the imperial dignity, as a circumstance of course. The emperor always assumes the title of august, of Cæsar, and of sacred majesty. Although he is chief of the empire, the supreme authority resides in the diets, which are composed of three colleges; the first that of the electors, the second that of the princes, and the third that of the imperial towns. The electors and princes send their deputies, as well as the imperial towns. When the college of the electors and that of the princes disagree, that of the towns cannot decide the difference; but they are obliged to give their consent when they are of the same opinion. The diets have the power of making peace or war, of settling general impositions, and of regulating all the important affairs of the empire: but their decisions have not the force of law till the emperor gives his consent. All the sovereigns of Germany have an absolute authority in their own dominions, and can lay taxes, levy troops, and make alliances, provided they do not prejudice the empire. They determine all civil causes definitively, unless in some particular cases in which an appeal may be made. These appeals are to two courts, called the Imperial Chamber, and the Aulic Council. The three principal religions are, the Roman Catholic, the Lutheran, and the Calvinist. The first prevails in the dominions of the emperor, in the ecclesiastical electorates, and in Bavaria; the second, in the circles of Upper and Lower Saxony, great part of Westphalia, Franconia, Suabia, the Upper Rhine, and in most of the Imperial towns; the third, in the dominions of the landgrave of Hesse-Cassel, and of some other princes. But Christians of almost every denomination are tolerated in many parts of the empire, and there is a multitude of Jews in all the great towns. The principal rivers of Germany are, the Danube, Rhine, Elbe, Weser, Maine, and Oder. Germany is divided into nine circles, each of which comprehends several other states; the princes, prelates, and counts of which, with the deputies of the imperial towns, meet together about their common affairs. Each circle has one or two directors, and a colonel: the directors have a power of convoking the assembly of the states of their circle, and the colonel commands the army. The nine circles are those of Austria, Bavaria, Suabia, Franconia, Upper and Lower Rhine, Westphalia, and Upper and Lower Saxony. The language of Germany is a dialect of the Teutonic, which succeeded that called the Celtic.

GERMEN, the seed-bud; defined by Linnæus to be the base of the pistillum, which contains the rudiments of the seed, and, in the progress of vegetation, swells and becomes the seed-vessel. In assimilating the vegetable and animal kingdoms, Linnæus denominates the seed-bud the *ovarium* or *uterus* of plants, and affirms its existence to be chiefly at the time of the dispersion of the male-dust by the antheræ; as, after its impregnation, it becomes a seed-vessel. See Botany. Germen, by Pliny and the ancient botanists, is used to signify a bud containing the rudiments of the leaves. See Gemma.

GERMINATION, among botanists, comprehends the precise time which the seeds take to rise after they have been committed to the soil. The different species of seeds are longer or shorter in rising according to the degree of heat which is proper to each. Millet, wheat, and several of the grasses, rise in one day; blite, spinach, beans, mustard, kidney-beans, turnips, and rocket, in three days; lettuce and dill, in four; cucumber, gourd, melon, and cress, in five; radish and beet, in six; barley, in seven; orach, in eight; purslane, in nine; cabbage, in ten; hyssop, in thirty; parsley, in forty or fifty days; peach, almond, walnut, chesnut, pæony, horned-poppy, hypecoum, and ranunculus falcatus, in one year; rose-bush, cornel-tree, hawthorn, medlar, and hazel-nut, in two. The seeds of some species of orchis, and of some liliaceous plants, never rise at all. Of seeds, some require to be sown almost as soon as they

are ripe, otherwife they will not fprout or germinate. Of this kind are the feeds of coffee and fraxinella. Others, particularly thofe of the pea-bloom flowers, preferve their germinating faculty for a feries of years. Mr. Adanfon afferts, that the fenfitive plant retains that virtue for 30 or 40 years.

Air and water are the agents of germination. The humidity of the air alone makes feveral feeds to rife when expofed to it. Seeds too are obferved to vegetate in water without the intervention of earth; but water without air is infufficient. Mr. Homberg's experiments on this head are decifive. He put feveral feeds under the exhaufted receiver of an air-pump, with a view to eftablifh fomething certain on the caufes of germination. Some of them did not rife at all; and the greateft part of thofe which did made very weak and feeble productions. Thus it is for want of air that feeds which are buried at a very great depth in the earth, either thrive but indifferently, or do not rife at all. They frequently preferve, however, their germinating virtue for many years within the bowels of the earth; and it is not unufual, upon a piece of ground being newly dug to a confiderable depth, to obferve it foon after covered with feveral plants, which had not been feen there in the memory of man. Were this precaution frequently repeated, it would doubtlefs be the means of recovering certain fpecies of plants which are regarded as loft; or which perhaps, never coming to the knowledge of botanifts, might hence appear the refult of a new creation. Some feeds require a greater quantity of air than others. Thus purflane, which does not rife till after lettuce in the free air, rifes before it *in vacuo*; and both profper but little, or perifh altogether, while creffes vegetate as freely as in the open air.

GERONTES, in antiquity, a kind of judges or magiftrates in ancient Sparta, anfwering to what the Areopagites were at Athens. See Areopagus. The word is formed of the Greek γερων, which fignifies "old man." Whence all the words *gerontic*, fomething belonging to an old man, and *Geronicon*, a famous book among the modern Greeks, containing the lives of ancient monks. The fenate of *gerontes* was called *gerufia*, that is, affembly or council of old men. The *gerontes* were originally inftituted by Lycurgus: their number, according to fome, was 28; and, according to others, 32. They governed in conjunction with the king, whofe authority they were intended to balance, and to watch over the interefts of the people. Polybius defines their office in a few words, when he fays, *per ipfos & cum ipfis omnia adminiftrari.* None were to be admitted into this office under 60 years of age, and they held it for life. They were fucceeded by the ephori.

GEROPOGON, in botany, a genus of the polygamia æqualis order, belonging to the fyngenefia clafs of plants, and in the natural method ranking under the 49th order, *Compofitæ*. The receptacle is paleaceous, with the points of the paleæ fharp or briftly; the calyx is fimple; the feeds of the difc have a feathered pappus; thofe of the radius have a pappus of five awns.

GERRETZ. See Rembrandt.

GERVAISE (or Gervase), of Tilbury, a famous Englifh writer of the 13th century; thus named from his being born at Tilbury on the Thames. He was nephew to Henry II. king of England, and was in great credit with Otho IV. emperor of Germany, to whom he dedicated a Defcription of the World, and a Chronicle. He alfo compofed a Hiftory of England, that of the Holy Land, and other works.

GERUND, in grammar, a verbal noun of the neuter gender, partaking of the nature of a participle, declinable only in the fingular number, through all the cafes except the vocative; as nom. *amandum*, gen. *amandi*, dat. *amando*, accuf. *amandum*, abl. *amando*. The word is formed of the Latin *gerundivus*, and that from the verb *gerere*, "to bear." The *gerund* expreffes not only the *time*, but alfo the *manner*, of an action; as, "he fell in running poft." It differs from the participle, in that it expreffes the *time*, which the participle does not; and from the tenfe properly fo called, in that it expreffes the *manner*, which the tenfe does not. See Grammar.

GERUNDA, anciently a town of the Aufetani, in the Hither Spain, on the fouth or right fide of the river Sambroca. *Gerundenfes*, the people. Now *Gironne* in Catalonia, on the Ter. E. lon. 2. 35. Lat. 42.

GESNER (Conrad), a celebrated phyfician and naturalift, was born at Zurich in 1516. Having finifhed his ftudies in France, he travelled into Italy, and taught medicine and philofophy in his own country with extraordinary reputation. He was acquainted with the languages, and excelled fo much in natural hiftory, that he was furnamed the *Pliny of Germany*. He died in 1564, leaving many works behind him, the principal of which are, 1. A hiftory of animals, plants, and foffils; 2. *Bibliotheca Univerfalis.* A Greek and Latin lexicon. This author is by Boerhaave emphatically ftyled *Monftrum Eruditionis*, a prodigy of learning. Thofe indeed (as Mr. Coxe obferves in his Letters on Switzerland) "who are converfant with the works of this great fcholar and naturalift, cannot reprefs their wonder and admiration at the amplitude of his knowledge in every fpecies of erudition, and the variety of his difcoveries in natural hiftory, which was his peculiar delight. Their wonder and admiration are ftill further augmented, when they confider the grofs ignorance of the age which he helped to enlighten, and the fcanty fuccours he poffeffed to aid him in thus extending the bounds of knowledge; that he compofed his works, and made thofe difcoveries which would have done honour to the moft enlightened period, under the complicated evils of poverty, ficknefs, and domeftic uneafinefs."

GESNER (Solomon), the celebrated author of the Death of Abel, and many other admired works in the German language, was born at Zurich in the year 1730. In his early years he fhowed very few figns of fuperior abilities; and his progrefs in the rudiments of education was fo flow, that his mafter gave him up as incapable of any greater attainments than writing and the four firft rules of arithmetic. Upon this he was placed under a clergyman in the neighbourhood, a relation of his father's, and who fhowed himfelf better acquainted with the art of difcovering the natural inclinations of his pupils. This gentleman often carried young Gefner with him into the fields, where he made him obferve the beauties of nature; and finding that he took great pleafure in fuch leffons, and feemed to liften to them with peculiar attention, he occafionally repeated fome of the moft ftriking paffages of the ancient authors who have written on thefe fubjects in the moft agreeable and pleafing manner. By this ingenious artifice, the mind of young Gefner began to open, and its powers to expand; and it is, perhaps, owing to this circumftance, that he became fo fond of the language of Virgil and Theocritus. When he arrived at a proper age to think of purfuing fome line of bufinefs, Mr. Gefner made choice of that of a bookfeller, which was the profeffion of his father, and in fome meafure of his family. Of five houfes at Zurich in the printing and bookfelling bufinefs, two were occupied by Gefners: one belonged to two brothers of that name; and the other, that in which our poet had a fhare, was known by the firm of *Orel, Gefner, and Company.* It was known alfo by the extent of its correfpondence, and by the choice and elegance of the works which it gave to the public.

Though Mr. Gefner was a bookfeller, he did not, however, damp his genius by fubmitting to the drudgery of bufinefs. He indulged himfelf freely in purfuing his favourite object, and his partners never envied him that time which he devoted to meditation and to ftudy. In 1752 he made a tour through Germany, not fo much for the purpofe of extending his commerce

as to fee and be acquainted with thofe authors who have done honour to their country. The following circumftance, which occurred during this tour, deferves to be mentioned, as it is ftrikingly characteriftic of that timidity which often accompanies true genius. When Mr. Gefner was at Berlin, he was admitted into a literary fociety, of which Gleim and Leffing were members. Each of the authors who compofed it ufed to read in turn fome piece of their own compofition, and Mr. Gefner was very defirous of fubmitting to thefe able critics a fmall work, which was his firft attempt; but it was far from refembling thofe poets whom Horace, and other fatirifts have ridiculed, and who ftun every one they meet by reciting their verfes before them. As each of thefe members had done reading, Gefner was obferved to move his hand with a kind of tremor to his pocket, and to draw it back again without the manufcript which he ought to have produced. Having not as yet publifhed any thing, none of the company could guefs the caufe of a motion which his modefty prevented him from explaining. The work which he had not the courage to fhow was his fmall poem entitled *Night*, which he publifhed on his return to Zurich in 1753. It was confidered as an original, of which no model is to be found among the moderns; but in the opinion of the author, it was only a piece of imaginary painting, or, to ufe an expreffion of his own in one of his letters to Mr. Huber, who has tranflated his works, "A caricature compofed in the moments of folly or intoxication." In this little poem he has introduced a fhort epifode on the origin of the glow-worm, containing a poetical explanation of this natural phofphorus, which has all the beauty of Ovid's Metamorphofes without their prolixity. The fuccefs of this effay emboldened the too timid mufe of our young bookfeller, and he publifhed a paftoral romance called *Daphnis*, in three cantos. The applaufe that was defervedly beftowed upon this performance induced the author to publifh, fome time after, his Idylls and fome other rural poems in imitation of thofe of Theocritus. Paftoral poetry, which at this time was little known in Germany but by tranflations from foreign poets, began to find many partifans, and to be preferred to every other kind. Defirous, therefore, of tracing out a new path for himfelf, our poet thought that he could not do a more acceptable fervice to his countrymen, than to paint the felicity of innocence and rural life, and the tender emotions of love and gratitude. The only author worthy of notice who had preceded Mr. Gefner in this career was Mr. Roft of Leipfick, whofe paftoral poems appeared for the firft time in 1744. This writer polifhed the language of the German fhepherds; he had addrefs enough to unite fpirit and fimplicity in a kind of writing which appears infipid without the former, and which becomes unnatural and difgufting if it is too abundant. He fometimes throws a delicate veil over thofe images which are deficient in decency, but it is to be regretted that it is often too flight. Such was the antagonift againft whom Gefner had to contend. Our poet, however, purfued a different courfe. Inftead of placing, like Roft, his fcenes in modern times, he goes back with Theocritus to the golden age—that happy age which we are fond of reviewing when our paffions are calm, and when, freed from thofe anxious cares which hurry us beyond ourfelves, we contemplate amidft tranquillity the beauties and fertility of the country. The characters of Gefner's Idylls, therefore, are taken from thofe focieties which exift no longer but in the remembrance or rather the imagination. His fhepherds are fathers, children, and hufbands, who blufh not at thefe titles fo dear to nature, and to whom generofity, beneficence, and refpect for the Deity, are fentiments no lefs familiar than love. Thefe Idylls were the principal and favourite object of his purfuit, and that part of his works which acquired him the greateft reputation, efpecially among his countrymen. His Death of Abel, which is well known, was publifhed for the firft time in 1758. It is written, like the reft of his pieces, in poetical profe; and was fo much fought after, that it went through no lefs than three editions in the fpace of a year, without fpeaking of the fpurious ones which appeared in Holland, at Berlin, and in France. The French edition was followed by feveral others. One came out in Italian; another in the Dutch language; a fourth in the Danifh; and, laftly, two in Englifh, one of them in profe and the other in verfe. Among the pieces which Mr. Gefner publifhed after the Death of Abel, was his Firft Navigator, a poem in three cantos, which many people in Germany confider as his mafterpiece. He made an attempt alfo in the paftoral drama, but not with the fame fuccefs as in other kinds of rural poetry. He produced likewife, in the fame ftyle, Evander and Alcimne, in three acts; and Eraftus, a fmall piece of one act, which was reprefented with fome applaufe in feveral focieties both at Leipfick and Vienna.

But though poetry was Gefner's darling purfuit, and though he enriched the literature of his country with works which will render his name immortal, he did not confine himfelf to one manner of imitating nature; he by turns took up the pencil and the pen, and his active genius equally directed them both. In his infancy he had received a few leffons in drawing, and he had afterwards purfued this ftudy, but without any intention of becoming an artift. At the age of thirty, he felt that violent defire which may be confidered as the voice of genius; and this was in fome meafure excited by the fight of a beautiful collection formed by Mr. Heidegger, whofe daughter he had married. To pleafe his father-in-law, he ftudied this treafure, compofed principally of the beft pieces of the Flemifh fchool; and to this new tafte he had almoft facrificed every other. Mr. Gefner at firft ventured only to delineate fome decorations for the frontifpieces of curious books printed in his office; but by little and little he had the courage to make other attempts. In 1765 he publifhed 10 landfcapes etched and engraved by himfelf, and dedicated them to his friend Mr. Watelet. Mr. Gefner owed him this mark of refpect for the care which he took to ornament with beautiful vignettes Mr. Hubert's tranflation of his Idylls. Twelve other pieces appeared in 1769; and after thefe attempts, Mr. Gefner executed ornaments for many works which came from his prefs, among which were his own works, a German tranflation of Swift, and feveral others.

Were we to judge from Mr. Gefner's enthufiafm for his favourite purfuits, and from the time and attention which he beftowed upon them, we fhould be apt to conclude, that he found little leifure for difcharging his duty as a citizen. The contrary, however, was the cafe; for he paffed almoft the half of his life in the firft employments of the ftate. In 1765 he was called to the grand council, in 1767 to the leffer. In 1768 he was appointed bailiff of Eilibach, that of the four guards in 1776, and in 1781 fuperintendant of waters, which office in 1787 was continued to him for fix years. In all thefe ftations Mr. Gefner difcharged his duty with the moft fcrupulous fidelity; and died of a paralytical diforder, lamented by his countrymen and by thofe who had the pleafure of his acquaintance, on the 2d of March 1788, at the age of 56.

As a paftoral poet, Gefner undoubtedly is entitled to a very diftinguifhed rank. His paftoral romance of Daphnis is not inferior in natural fimplicity to the celebrated work of Longus; but it furpaffes it far in variety of images and incident. Eraftus and Evander are inftructive and interefting poems, on account of the contraft between the world and nature which reigns throughout them; and his Firft Navigator unites the mildeft philofophy to all the fplendor and imagery of fairy-land. If we analyfe his dramatic poems, we fhall find in them interefting fictions, characters well delineated, and fituations replete with novelty. His language is that of the Graces, and the

chaſteſt ears might liſten to the love which he has created. If he has ſometimes the humour of Sterne and Fontaine, it is without their licentiouſneſs. Geſner's character as a huſband, a father, a friend, a magiſtrate, or a citizen, was equally exemplary. He was naturally of a melancholy turn, but he was no enemy to rational and well-timed mirth. His language was lively and animated; but his reſerve before ſtrangers reſembled timidity, and it was only in the preſence of thoſe with whom he was acquainted that his real character could be obſerved.

Mr. Geſner's reputation and virtues were known even to the remoteſt parts of Europe. The empreſs of Ruſſia, Catherine II. preſented him with a gold medal as a mark of her eſteem. Strangers of all nations gave him no leſs flattering teſtimonies of their admiration; and travellers thought they had ſeen only the half of Switzerland, if they had not been in the company of Geſner, or procured ſome of his landſcapes or drawings. In this laſt way he had acquired ſo much reputation, that he was ranked among the beſt artiſts of Germany; and Mr. Fueſlin, his countryman, who was himſelf a painter, in the preface to the third volume of the new edition which he publiſhed of his "Hiſtorical eſſay on the painters, engravers, architects, and ſculptors, who have done honour to Switzerland," gives a diſtinguiſhed place to Mr. Geſner, though then living.

GESNERIA, in botany; a genus of the angioſpermia order, belonging to the didynamia claſs of plants, and in the natural method ranking under the 40th order, *Perſonatæ*. The calyx is quinquefid, and placed on the germen; the corolla incurvated and then recurvated; the capſule inferior and bilocular.

GESSORIACUM, anciently a port and ſtation for ſhips of the Morini in Belgica. In Cæſar's time, according to Dio, there was no town; but Florus ſpeaks of it as one; and the Geſoriacenſes Muri are mentioned by Eumenius in his Panegyric. The author of Tabula Theodoſiana, commonly called *Peutinger's map*, ſays expreſsly, that Geſſoriacum was in his time called *Bononia*. Now *Boulogne* in France. E. lon. 1. 30. N. lat. 50. 40.

GESTATION, among accoucheurs. See PREGNANCY.

GESTRICIA, a province of Sweden, bounded by Helſingia on the north, by the Bothnic gulph on the eaſt, by Upland on the ſouth, and by Dalecarlia on the weſt.

GESTURE, a motion of the body, intended to ſignify ſome idea or paſſion of the mind. It conſiſts principally in the action of the hands and face; and may be defined, a ſuitable conformity of the motions of the countenance, and of ſeveral parts of the body, in ſpeaking to the ſubject matter of the diſcourſe. See DECLAMATION and ORATORY.

GETA (SEPTIMIUS), a ſon of the emperor Severus, brother to Caracalla. In the eighth year of his age, he was moved with compaſſion at the fate of ſome of the partiſans of Niger and Albinus who were to be executed, and his father, ſtruck with his humanity, retracted the ſentence. After Severus's death, he reigned at Rome conjointly with his brother; but Caracalla, who envied his virtues and was jealous of his popularity, ordered him to be poiſoned; and when this could not be effected, he murdered him in the arms of his mother Julia, who, in the attempt of defending the fatal blows from his body, received a wound in her arm, from the hand of her ſon, A. D. 212. Geta had not yet reached the 23d year of his age, and the Romans had reaſon to lament the death of ſo virtuous a prince, while they groaned under the cruelties and oppreſſion of Caracalla.

GETHIN (Lady Grace), an Engliſh lady of uncommon parts, was the daughter of Sir George Norton of Abbots-Leigh in Somerſetſhire, and born in the year 1676. She had all the advantages of a liberal education, and became the wife of Sir Richard Gethin, of Gethin Grott in Ireland. She was miſtreſs of great accompliſhments, natural and acquired, but did not live long enough to diſplay them to the world; for ſhe died in the 21ſt year of her age. She was buried in Weſtminſter-abbey, where a beautiful monument with an inſcription is erected over her; and, for perpetuating her memory, proviſion was made for a ſermon to be preached in Weſtminſter-abbey, yearly, on Aſh-Wedneſday for ever. She wrote, and left behind her in looſe papers, a work which ſoon after her death was methodized and publiſhed under the title of "*Reliquiæ Gethinianæ*; or, Some remains of the moſt ingenious and excellent lady, Grace lady Gethin, lately deceaſed. Being a collection of choice diſcourſes, pleaſant apophthegms, and witty ſentences. Written by her, for the moſt part, by way of eſſay, and at ſpare hours." Lond. 1700, 4to; with her picture before it.

GETHSEMANE, anciently a village in the mount of Olives, whither Jeſus Chriſt ſometimes retreated in the night-time. It was in a garden belonging to this village that he ſuffered the agony in which he ſweated drops of blood; and here he was arreſted by Judas and the reſt who were conducted by this traitor. The place is by Maundrel deſcribed as an even plot of ground, not above 57 yards ſquare, lying between the foot of Mount Olivet and the brook Cedron.

GETHYLLIS, in botany; a genus of the monogynia order, belonging to the dodecandria claſs of plants, and in the natural method ranking under the ninth order, *Spathaceæ*. The corolla is ſix-cleft, and the ſtamina are in ſix different directions; the capſule is trilocular.

GEUM, AVENS, or *Herb-Bennet*; a genus of the polygamia order, belonging to the icoſandria claſs of plants, and in the natural method ranking under the 35th order, *Senticoſæ*. The calyx is cleft into ten parts; there are five petals, and each of the ſeeds has a jointed awn. There are five ſpecies; of which the moſt remarkable are, 1. The *urbanum*, with thick fibrous roots of an aromatic taſte; rough, ſerrated leaves; and upright, round, hairy ſtalks terminated by large yellow flowers, ſucceeded by globular fruit. 2. The *rivale*, with a very thick, fleſhy, and fibrous root, hairy leaves, and upright ſtalks 10 or 12 inches high, terminated by purple flowers nodding on one ſide. Of this there are varieties with red and with yellow flowers. Both theſe are natives of Britain, and are eaſily propagated either by the root or ſeed. The roots of the firſt, gathered in the ſpring before the ſtem comes up, and infuſed in ale, give it a pleaſant flavour, and prevent its growing ſour: infuſed in wine, they have a ſtomachic virtue. The taſte is mildly auſtere and aromatic, eſpecially when the plant grows in warm dry ſituations; but in moiſt ſhady places it has little virtue. Cows, goats, ſheep, and ſwine, eat the plant; horſes are not fond of it. The powdered root of the ſecond ſpecies will cure tertian agues, and is daily uſed for that purpoſe by the Canadians. Sheep and goats eat the plant; cows, horſes, and ſwine, are not fond of it.

GHENT, the capital of Auſtrian Flanders, with a ſtrong caſtle and a biſhop's ſee. It contains 70,000 inhabitants; but it is not populous in proportion to its extent, which is ſo great, that Charles V. ſaid to the French king, Francis I. "I have a *glove* (the French name for Ghent is *Gand*, a glove) in which I can put your whole city of Paris." Here is ſtill ſhown the houſe in which that emperor was born. There are ſeveral ſilk and woollen manufactures here, which are in a flouriſhing condition, and they have a great trade in corn. The city is cut by ſeveral canals, which divide it into 26 iſles, and over the canal are 300 bridges. The cathedral is a noble ancient ſtructure, dedicated to St. Buvon. Beſide this, there are only ſix parochial churches. The Benedictine abbey of St. Peter is a magnificent edifice. In this abbey, as well as in the churches, are ſome capital paintings by the beſt maſters. There is a large canal from Ghent to

Bruges, and thence to Oſtend. Ghent was taken by the French in 1792, but retaken the next year. It is ſeated at the confluence of the rivers Scheld, Lis, Lieve, and Moeve, 26 miles N. W. of Bruſſels. Lon. 3. 49. E. Lat. 51. 3. N.

GHILAN, a province of Perſia, lying on the S. W. ſide of the Caſpian Sea. It is ſuppoſed to be the Hyrcania of the ancients. It is very agreeably ſituated, having the ſea on one ſide, and high mountains on the other; and there is no entering it but through narrow paſſes, which may be eaſily defended. The ſides of the mountains are covered with many ſorts of fruit-trees; and in the higheſt parts of them are deer, bears, wolves, leopards, and tigers; which laſt the Perſians have the art of taming, and hunt with them, as we do with dogs. It is one of the moſt fruitful provinces of all Perſia, and produces abundance of ſilk, oil, wine, rice, and tobacco, beſide excellent fruits. The inhabitants are brave, and the women are accounted extremely handſome. Reſht is the capital.

St. Ghilan, a town of France, in the department of the North and late province of French Hainault, ſeated on the river Haina, five miles W. of Mons. Lon. 3. 53. E. Lat. 50. 28. N.

GHOST, an apparition, or ſpirit of a perſon deceaſed. The ancients ſuppoſed every man to be poſſeſſed of three different ghoſts, which after the diſſolution of the human body were differently diſpoſed of. Theſe three ghoſts are diſtinguiſhed by the names of *Manes*, *Spiritus*, *Umbra*. The *manes*, they fancied, went down into the infernal regions; the *ſpiritus* aſcended to the ſkies; and the *umbra* hovered about the tomb, as being unwilling to quit its old connections. Thus Dido (Virg. Æn. iv. 384.) threatens Æneas after death that ſhe will haunt him with her umbra, whilſt her manes rejoice in his torments below. This idea of a threefold ſoul is very clearly expreſſed in theſe lines, which have been attributed to Ovid.

> *Bis duo ſunt homini:* Manes, Caro, Spiritus, Umbra:
> *Quatuor iſta loci bis duo ſuſcipiunt.*
> *Terra tegit* Carnem, *tumulum circumvolat* Umbra,
> *Orcus habet* Manes, Spiritus *aſtra petit.*

The moſt ſtriking outlines of the popular ſuperſtitions reſpecting ghoſts among us are thus humorouſly collected by Captain Groſe in his Provincial Gloſſary: "A ghoſt is ſuppoſed to be the ſpirit of a perſon deceaſed, who is either commiſſioned to return for ſome eſpecial errand, ſuch as the diſcovery of a murder, to procure reſtitution of lands or money unjuſtly withheld from an orphan or widow; or, having committed ſome injuſtice whilſt living, cannot reſt till that is redreſſed. Sometimes the occaſion of ſpirits reviſiting this world is to inform their heir in what ſecret place, or private drawer in an old trunk, they had hidden the title-deeds of the eſtate; or where, in troubleſome times, they buried their money or plate. Some ghoſts of murdered perſons, whoſe bodies have been ſecretly buried, cannot be at eaſe until their bones have been taken up, and depoſited in conſecrated ground with all the rites of Chriſtian burial. Sometimes ghoſts appear in conſequence of an agreement made, whilſt living, with ſome particular friend, that he who firſt died ſhould appear to the ſurvivor. Glanvil tells us of the ghoſt of a perſon who had lived but a diſorderly kind of life, for which it was condemned to wander up and down the earth, in the company of evil ſpirits, till the day of judgment.

"In moſt of the relations of ghoſts, they are ſuppoſed to be mere aerial beings without ſubſtance, and that they can paſs through walls and other ſolid bodies at pleaſure. A particular inſtance of this is given, in relation the 27th, in Glanvil's collection, where one David Hunter, neat-herd to the biſhop of Down and Connor, was for a long time haunted by the apparition of an old woman, whom he was by a ſecret impulſe obliged to follow whenever ſhe appeared, which he ſays he did for a conſiderable time, even if in bed with his wife: and becauſe his wife could not hold him in his bed, ſhe would go too, and walk after him till day, though ſhe ſaw nothing; but his little dog was ſo well acquainted with the apparition, that he would follow it as well as his maſter. If a tree ſtood in her walk, he obſerved her always to go through it. Notwithſtanding this ſeeming immateriality, this very ghoſt was not without ſome ſubſtance; for, having performed her errand, ſhe deſired Hunter to lift her from the ground; in the doing of which, he ſays, ſhe felt juſt like a bag of feathers. We ſometimes alſo read of ghoſts ſtriking violent blows; and that, if not made way for, they overturn all impediments, like a furious whirlwind. Glanvil mentions an inſtance of this, in relation 17th, of a Dutch lieutenant who had the faculty of ſeeing ghoſts; and who, being prevented making way for one which he mentioned to ſome friends as coming towards them, was, with his companions, violently thrown down, and ſorely bruiſed. We further learn, by relation 16th, that the hand of a ghoſt is 'as cold as a clod.'

"The uſual time at which ghoſts make their appearance is midnight, and ſeldom before it is dark; though ſome audacious ſpirits have been ſaid to appear even by day-light: but of this there are few inſtances, and thoſe moſtly ghoſts who have been laid, perhaps in the Red Sea (of which more hereafter), and whoſe times of confinement were expired: theſe, like felons confined to the lighters, are ſaid to return more troubleſome and daring than before. No ghoſts can appear on Chriſtmas eve; this Shakeſpeare has put into the mouth of one of his characters in Hamlet.

"Ghoſts commonly appear in the ſame dreſs they uſually wore whilſt living, though they are ſometimes clothed all in white; but that is chiefly the church-yard ghoſts, who have no particular buſineſs, but ſeem to appear *pro bono publico*, or to ſcare drunken ruſtics from tumbling over their graves.

"I cannot learn that ghoſts carry tapers in their hands, as they are ſometimes depicted, though the room in which they appear, if without fire or candle, is frequently ſaid to be as light as day. Dragging chains is not the faſhion of Engliſh ghoſts; chains and black veſtments being chiefly the accoutrements of foreign ſpectres ſeen in arbitrary governments: dead or alive, Engliſh ſpirits are free. One inſtance, however, of an Engliſh ghoſt dreſſed in black, is found in the celebrated ballad of William and Margaret, in the following lines:

> *And clay-co'd was her lily hand,*
> *That held her* ſable ſhrowd.

This, however, may be conſidered as a poetical licence, uſed in all likelihood for the ſake of the oppoſition of *lily* to *ſable*.

"If, during the time of an apparition, there is a lighted candle in the room, it will burn extremely blue: this is ſo univerſally acknowledged, that many eminent philoſophers have buſied themſelves in accounting for it, without once doubting the truth of the fact. Dogs too have the faculty of ſeeing ſpirits, as is inſtanced in David Hunter's relation above quoted: but in that caſe they uſually ſhow ſigns of terror, by whining and creeping to their maſter for protection: and it is generally ſuppoſed that they often ſee things of this nature when their owner cannot; there being ſome perſons, particularly thoſe born on a Chriſtmas eve, who cannot ſee ſpirits.

"The coming of a ſpirit is announced ſome time before its appearance, by a variety of loud and dreadful noiſes; ſometimes rattling in the old hall like a coach and ſix, and rumbling up and down the ſtair-caſe like the trundling of bowls or cannon balls. At length the door flies open, and the ſpectre ſtalks ſlowly up the bed's foot, and, opening the curtains, looks ſtedfaſtly at the perſon in bed by whom it is ſeen; a ghoſt being very

rarely viſible to more than one perſon, although there are ſeveral in company. It is here neceſſary to obſerve, that it has been univerſally found by experience, as well as affirmed by diverſe apparitions themſelves, that a ghoſt has not the power to ſpeak till it has been firſt ſpoken to; ſo that, notwithſtanding the urgency of the buſineſs on which it may come, every thing muſt ſtand ſtill till the perſon viſited can find ſufficient courage to ſpeak to it: an event that ſometimes does not take place for many years. It has not been found that female ghoſts are more loquacious than thoſe of the male ſex, both being equally reſtrained by this law.

"The mode of addreſſing a ghoſt is by commanding it, in the name of the Three Perſons of the Trinity, to tell you who it is, and what is its buſineſs: this it may be neceſſary to repeat three times; after which it will, in a low and hollow voice, declare its ſatisfaction at being ſpoken to, and deſire the party addreſſing it not to be afraid, for it will do him no harm. This being premiſed, it commonly enters into its narrative; which being completed, and its requeſt or commands given, with injunctions that they be immediately executed, it vaniſhes away, frequently in a flaſh of light; in which caſe, ſome ghoſts have been ſo conſiderate as to deſire the party to whom they appeared to ſhut their eyes: ſometimes its departure is attended with delightful muſic. During the narration of its buſineſs, a ghoſt muſt by no means be interrupted by queſtions of any kind; ſo doing is extremely dangerous: if any doubts ariſe, they muſt be ſtated after the ſpirit has done its tale. Queſtions reſpecting its ſtate, or the ſtate of any of their former acquaintance, are offenſive, and not often anſwered; ſpirits perhaps being reſtrained from divulging the ſecrets of their priſon houſe. Occaſionally ſpirits will even condeſcend to talk on common occurrences, as is inſtanced by Glanvil in the apparition of Major George Sydenham to Captain William Dyke, relation 10th, wherein the major reproved the captain for ſuffering a ſword he had given him to grow ruſty; ſaying, 'Captain, captain, this ſword did not uſe to be kept after this manner when it was mine.' This attention to the ſtate of arms was a remnant of the major's profeſſional duty when living.

"It is ſomewhat remarkable that ghoſts do not go about their buſineſs like the perſons of this world. In caſes of murder, a ghoſt, inſtead of going to the next juſtice of the peace, and laying its information, or to the neareſt relation of the perſon murdered, appears to ſome poor labourer who knows none of the parties, draws the curtains of ſome decrepit nurſe or alms-woman, or hovers about the place where his body is depoſited. The ſame circuitous mode is purſued with reſpect to redreſſing injured orphans or widows; when it ſeems as if the ſhorteſt and moſt certain way would be, to go to the perſon guilty of the injuſtice, and haunt him continually till he be terrified into a reſtitution. Nor is the pointing out loſt writings generally managed in a more ſummary way; the ghoſt commonly applying to a third perſon, ignorant of the whole affair, and a ſtranger to all concerned. But it is preſumptuous to ſcrutinize too far into theſe matters: ghoſts have undoubtedly forms and cuſtoms peculiar to themſelves.

"If, after the firſt appearance, the perſons employed neglect, or are prevented from, performing the meſſage or buſineſs committed to their management, the ghoſt appears continually to them, at firſt with a diſcontented, next an angry, and at length with a furious countenance, threatening to tear them in pieces if the matter is not forthwith executed; ſometimes terrifying them, as in Glanvil's relation 26th, by appearing in many formidable ſhapes, and ſometimes even ſtriking them a violent blow. Of blows given by ghoſts there are many inſtances, and ſome wherein they have been followed with an incurable lameneſs.

"It ſhould have been obſerved, that ghoſts, in delivering their commiſſions, in order to enſure belief, communicate to the perſons employed ſome ſecret, known only to the parties concerned and themſelves, the relation of which always produces the effect intended. The buſineſs being completed, ghoſts appear with a cheerful countenance, ſaying they ſhall now be at reſt, and will never more diſturb any one; and, thanking their agents, by way of reward communicate to them ſomething relative to themſelves, which they will never reveal.

"Sometimes ghoſts appear, and diſturb a houſe, without deigning to give any reaſon for ſo doing: with theſe, the ſhorteſt and only way is to exorciſe, and eject them; or, as the vulgar term is, *lay* them. For this purpoſe there muſt be two or three clergymen, and the ceremony muſt be performed in *Latin*; a language that ſtrikes the moſt audacious ghoſt with terror. A ghoſt may be laid for any term leſs than 100 years, and in any place or body, full or empty; as, a ſolid oak—the pommel of a ſword—a barrel of beer, if a yeoman or ſimple gentleman—or a pipe of wine, if an eſquire or a juſtice. But of all places the moſt common, and what a ghoſt leaſt likes is the Red Sea; it being related, in many inſtances, that ghoſts have moſt earneſtly beſought the exorciſts not to confine them in that place. It is nevertheleſs conſidered as an indiſputable fact, that there are an infinite number laid there, perhaps from its being a ſafer priſon than any other nearer at hand; though neither hiſtory nor tradition gives us any inſtance of ghoſts eſcaping or returning from this kind of tranſportation before their time.

"Another ſpecies of human apparition may be here noticed, though it does not come under the ſtrict deſcription of a ghoſt. Theſe are the exact figures and reſemblances of perſons then living, often ſeen not only by their friends at a diſtance, but many times by themſelves; of which there are ſeveral inſtances in Aubery's Miſcellanies: one of Sir Richard Napier, a phyſician of London, who, being on the road from Bedfordſhire to viſit a friend in Berkſhire, ſaw at an inn his own apparition lying on his bed as a dead corpſe; he nevertheleſs went forward, and died in a ſhort time: another of Lady Diana Rich, daughter of the Earl of Holland, who met her own apparition walking in a garden at Kenſington, and died a month after of the ſmall-pox. Theſe apparitions are called *fetches*; in Cumberland, *ſwarths*; and in Scotland, *wraiths*: they moſt commonly appear to diſtant friends and relations, at the very inſtant preceding the death of the perſon whoſe figure they put on. Sometimes, as in the inſtances above mentioned, there is a greater interval between the appearance and death." This ludicrous account, it is to be hoped, will contribute not a little to the expulſion of theſe troubleſome gentry from the infatuated imaginations of the feeble-minded and credulous of every claſs of ſociety; though the ſatire is ſcarcely obvious enough to ſtrike the uneducated, among whom a belief in the exiſtence of *ghoſts* and *hobgoblins* is moſt prevalent.

GIAGH, in chronology, a cycle of 12 years, in uſe among the Turks and Cathayans. Each year of the *giagh* bears the name of ſome animal: the firſt that of a mouſe; the ſecond that of a bullock; the third of a lynx or leopard; the fourth of a hare; the fifth of a crocodile; the ſixth of a ſerpent; the ſeventh of a horſe; the eighth of a ſheep; the ninth of a monkey; the tenth of a hen; the eleventh of a dog; and the twelfth of a hog. They alſo divide the day into twelve parts, which they call *giaghs*, and diſtinguiſh them by the name of ſome animals. Each giagh contains two of our hours, and is divided into eight kehs, being as many as there are quarters in two hours.

GIALLOLINO, in natural hiſtory, a fine yellow pigment much uſed under the name of Naples Yellow.

GIANT, a perſon of extraordinary bulk and ſtature. The romances of all ages have furniſhed us with ſo many extravagant accounts of giants of incredible bulk and ſtrength, that the ex-

iſtence of ſuch people is now generally diſbelieved. It is commonly thought, that the ſtature of a man has been the ſame in all ages; and ſome have even pretended to *demonſtrate* the impoſſibility of the exiſtence of giants mathematically. Of theſe Mr. M'Laurin has been the moſt explicit, yet his arguments are by no means concluſive. In the ſcriptures we are told of *giants*, who were produced from the marriages of the *ſons of God* with the *daughters of men*. This paſſage indeed has been differently interpreted, ſo as to render it doubtful whether the word tranſlated *giants* does there imply any extraordinary ſtature. In other parts of ſcripture, however, giants with their dimenſions are mentioned in a manner that we cannot poſſibly doubt; as in the caſe of Og king of Baſan, and Goliath. In a memoir read before the Academy of Sciences at Rouen, M. Le Cat gives the following account of giants that are ſaid to have exiſted in different ages.

"Profane hiſtorians have given ſeven feet of height to Hercules their firſt hero; and in our days we have ſeen men eight feet high. The giant who was ſhown in Rouen in 1735 meaſured eight feet ſome inches. The emperor Maximin was of that ſize; Shenkius and Platerus, phyſicians of the laſt century, ſaw ſeveral of that ſtature; and Goropius ſaw a girl who was ten feet high. The body of Oreſtes, according to the Greeks, was eleven feet and a half; the giant Galbara, brought from Arabia to Rome under Claudius Cæſar, was near ten feet; and the bones of Secondilla and Puſio, keepers of the gardens of Salluſt, were but ſix inches ſhorter. Funnam, a Scotſman, who lived in the time of Eugene II. king of Scotland, meaſured eleven feet and a half: and Jacob le Maire, in his voyage to the ſtraits of Magellan, reports, that on the 17th of December 1615 they found at Port Deſire ſeveral graves covered with ſtones; and having the curioſity to remove the ſtones, they diſcovered human ſkeletons of ten and eleven feet long. The chevalier Scory, in his voyage to the peak of Teneriffe, ſays, that they found in one of the ſepulchre caverns of that mountain the head of a Guanche which had 80 teeth, and that the body was not leſs than 15 feet long. The giant Ferragus, ſlain by Orlando nephew of Charlemagne, was 18 feet high. Rioland, a celebrated anatomiſt, who wrote in 1614, ſays, that ſome years before, there was to be ſeen in the ſuburbs of St. Germain the tomb of the giant Iſoret, who was 20 feet high. In Rouen in 1509, in digging in the ditches near the Dominicans, they found a ſtone tomb containing a ſkeleton whoſe ſkull held a buſhel of corn, and whoſe ſhin-bone reached up to the girdle of the talleſt man there, being about four feet long, and conſequently the body muſt have been 17 or 18 feet high. Upon the tomb was a plate of copper, whereon was engraved, "In this tomb lies the noble and puiſſant lord, the chevalier Ricon de Vallemont, and his bones." Platerus, a famous phyſician, declares, that he ſaw at Lucerne the true human bones of a ſubject which muſt have been at leaſt 19 feet high. Valence in Dauphiné boaſts of poſſeſſing the bones of the giant Bucart, tyrant of the Vivarais, who was ſlain by an arrow by the count De Cabillon his vaſſal. The Dominicans had a part of the ſhin-bone, with the articulation of the knee, and his figure painted in freſco, with an inſcription, ſhowing that this giant was 22 feet and a half high, and that his bones were found in 1705 near the banks of the Morderi, a little river at the foot of the mountain of Cruſſol, upon which (tradition ſays) the giant dwelt.

"January 11, 1613, ſome maſons digging near the ruins of a caſtle in Dauphiné, in a field which (by tradition) had long been called *the giant's field*, at the depth of 18 feet diſcovered a brick-tomb 30 feet long, 12 feet broad, and 8 feet high; on which was a grey ſtone, with the words *Theutobochus Rex* cut thereon. When the tomb was opened, they found a human ſkeleton entire, 25 feet and a half long, 10 feet wide acroſs the ſhoulders, and five feet deep from the breaſt-bone to the back. His teeth were about the ſize each of an ox's foot, and his ſhin-bone meaſured four feet. Near Mazarino in Sicily, in 1516, was found a giant 30 feet high; his head was the ſize of an hogſhead, and each of his teeth weighed five ounces. Near Palermo, in the valley of Mazara, in Sicily, a ſkeleton of a giant 30 feet long was found, in the year 1548; and another of 33 feet high, in 1550; and many curious perſons have preſerved ſeveral of theſe gigantic bones.

"The Athenians found near their city two famous ſkeletons, one of 34 and the other of 36 feet high.

"At Totu in Bohemia, in 758, was found a ſkeleton, the head of which could ſcarce be encompaſſed by the arms of two men together, and whoſe legs, which they ſtill keep in the caſtle of that city, were 26 feet long. The ſkull of the giant found in Macedonia, September 1691, held 210 pounds of corn.

"The celebrated Sir Hans Sloane, who treated this matter very learnedly, does not doubt theſe facts; but thinks the bones were thoſe of elephants, whales, or other enormous animals.

"Elephants' bones may be ſhown for thoſe of giants; but they can never impoſe on connoiſſeurs. Whales, which, by their immenſe bulk, are more proper to be ſubſtituted for the largeſt giants, have neither arms nor legs; and the head of that animal hath not the leaſt reſemblance to that of a man. If it be true, therefore, that a great number of the gigantic bones which we have mentioned have been ſeen by anatomiſts, and by them have been reputed real human bones, the exiſtence of giants is proved."

With regard to the credibility of all or any of theſe accounts, it is difficult to determine any thing. If, in any caſtle of Bohemia, the bones of a man's leg 26 feet in length are preſerved, we have indeed a deciſive proof of the exiſtence of a giant, in compariſon of whom moſt others would be but pigmies. Nor indeed could theſe bones be ſuppoſed to belong to an elephant; for an elephant itſelf would be but a dwarf in compariſon of ſuch an enormous monſter. But if theſe bones were really kept in any part of Bohemia, it ſeems ſtrange that they have not been frequently viſited, and particular deſcriptions of them given by the learned who have travelled into that country. It is certain, however, that there have been nations of men conſiderably exceeding the common ſtature. Thus all the Roman hiſtorians inform us, that the Gauls and Germans exceeded the Italians in ſize; and it appears that the Italians in thoſe days were of much the ſame ſtature with the people of the preſent age. Among theſe northern nations, it is alſo probable, that there would be as great differences in ſtature as there are among the preſent race of men. If that can be allowed, we may eaſily believe that ſome of theſe barbarians might be called *giants*, without any great impropriety. Of this ſuperiority of ſize, indeed, the hiſtorian Florus gives a notable inſtance in Teutobochus, above mentioned, king of the Teutones; who, being defeated and taken priſoner by Marius, was carried in triumph before him at Rome, when his head reached above the trophies that were carried in the ſame proceſſion.

But whether theſe accounts are credited or not, we are very certain that the ſtature of the human body is by no means abſolutely fixed. We are ourſelves a kind of giants in compariſon of the Laplander; nor are theſe the moſt diminutive people to be found upon the earth. The abbe La Chappe, in his journey into Siberia in order to obſerve the laſt tranſit of Venus, paſſed through a village inhabited by people called *Wotiacks*, neither men nor women of whom were above four feet high. The accounts of the Patagonians alſo, which cannot be entirely diſcredited, render it very probable, that ſomewhere in South America there is a race of people very conſiderably exceeding

the common ſize of mankind, and conſequently that we cannot altogether diſcredit the relations of giants handed down to us by ancient authors; though what degree of credit we ought to give them, is not eaſy to be determined. See PATAGONIA.

Rebel GIANTS, in ancient mythology, were the ſons of Cœlus and Terra. According to Heſiod, they ſprang from the blood of the wound which Cœlus received from his ſon Saturn, and Hyginus calls them ſons of Tartarus and Terra. They are repreſented as men of uncommon ſtature, with ſtrength proportioned to their gigantic ſize. Some of them, as Cottus, Briareus, and Gyges, had each 50 heads and 100 arms, and ſerpents inſtead of legs. They were of a terrible aſpect, their hair hung looſe about their ſhoulders, and their beard was ſuffered to grow unmoleſted. Pallene and its neighbourhood was the place of their reſidence. The defeat of the Titans, to whom they were nearly related, incenſed them againſt Jupiter, and they all conſpired to dethrone him. Accordingly they reared Mount Oſſa upon Pelion, and Olympus upon Oſſa; and from thence attacked the gods with huge rocks, ſome of which fell into the ſea and became iſlands, and others fell on the earth and formed mountains. Jupiter ſummoned a council of the gods; when being informed that it was neceſſary to obtain the aſſiſtance of ſome mortal, he by the advice of Pallas called up his ſon Hercules; and with the aid of this hero he exterminated the giants Enceladus, Polybotes, Alcyon, Porphyrion, the two ſons of Aloeus, Ephialtus, Othus, Eurytus, Clytius, Tythyus, Pallas, Hippolitus, Agrius, Thoon, and Typhon, the laſt of whom it was more difficult to vanquiſh than all the others. Jupiter, having thus gained a complete victory, caſt the rebels down to Tartarus, where they were to receive the full puniſhment of their enormous crimes: according to the accounts of ſome of the poets, he buried them alive under Mount Etna and different iſlands.

GIANT's-*Cauſeway*, a vaſt collection of baſaltic pillars in the county of Antrim in Ireland. See the article BASALTES. The principal or grand cauſeway (for there are ſeveral leſs conſiderable and ſcattered fragments of ſimilar workmanſhip) conſiſts of a moſt irregular arrangement of many hundred thouſands of columns of a black kind of rock, hard as marble: almoſt all of them are of a pentagonal figure, but ſo cloſely and compactly ſituated on their ſides, though perfectly diſtinct from top to bottom, that ſcarce any thing can be introduced between them. The columns are of an unequal height and breadth; ſome of the higheſt, viſible above the ſurface of the ſtrand, and at the foot of the impending angular precipice, may be about 20 feet; they do not exceed this height, at leaſt none of the principal arrangement. How deep they are fixed in the ſtrand was never yet diſcovered. This grand arrangement extends nearly 200 yards, viſible at low water; how far beyond is uncertain: from its declining appearance, however, at low water, it is probable it does not extend under water to a diſtance any thing equal to what is ſeen above. The breadth of the principal cauſeway, which runs out in one continued range of columns, is, in general, from 20 to 30 feet; at one place or two it may be nearly 40 for a few yards. In this account are excluded the broken and ſcattered pieces of the ſame kind of conſtruction, that are detached from the ſides of the grand cauſeway, as they do not appear to have ever been contiguous to the principal arrangement, though they have frequently been taken into the width; which has been the cauſe of ſuch wild and diſſimilar repreſentations of this cauſeway, which different accounts have exhibited. The higheſt part of this cauſeway is the narroweſt, at the very ſpot of the impending cliff from whence the whole projects, where, for four or five yards, it is not above ten or fifteen wide The columns of this narrow part incline from a perpendicular a little to the weſtward, and form a ſlope on their tops, by the very unequal height of the columns on the two ſides, by which an aſcent is made at the foot of the cliff, from the head of one column to the next above, *gradatim*, to the top of the great cauſeway, which, at the diſtance of half a dozen yards from the cliff, obtains a perpendicular poſition, and, lowering in its general height, widens to about 20 or between 20 and 30 feet, and for 100 yards nearly is always above water. The tops of the columns for this length being nearly of an equal height, they form a grand and ſingular parade that may be eaſily walked on, rather inclining to the water's edge. But from high-water mark, as it is perpetually waſhed by the beating ſurges on every return of the tide, the platform lowers conſiderably, and becomes more and more uneven, ſo as not to be walked on but with the greateſt care. At the diſtance of 150 yards from the cliff, it turns a little to the eaſt for 20 or 30 yards, and then ſinks into the ſea. The figure of theſe columns is almoſt unexceptionably pentagonal, or compoſed of five ſides; there are but very few of any other figure introduced: ſome few there are of three, four, and ſix ſides, but the generality of them are five-ſided, and the ſpectator muſt look very nicely to find any of a different conſtruction: yet what is very extraordinary, and particularly curious, there are not two columns in ten thouſand to be found, that either have their ſides equal among themſelves, or whoſe figures are alike. Nor is the compoſition of theſe columns or pillars leſs deſerving the attention of the curious ſpectator. They are not of one ſolid ſtone in an upright poſition, but compoſed of ſeveral ſhort lengths, curiouſly joined, not with flat ſurfaces, but articulated into each other like ball and ſocket, or like the joints in the vertebræ of ſome of the larger kind of fiſh, the one end at the joint having a cavity, into which the convex end of the oppoſite is exactly fitted. This is not viſible, but by disjoining the two ſtones. The depth of the concavity or convexity is generally about three or four inches. And what is ſtill farther remarkable of the joint, the convexity, and the correſpondent concavity, is not conformed to the external angular figure of the column, but exactly round, and as large as the ſize or diameter of the column will admit; and conſequently as the angles of theſe columns are in general extremely unequal, the circular edges of the joint are ſeldom coincident with more than two or three ſides of the pentagonal, and from the edge of the circular part of the joint to the exterior ſides and angles they are quite plain. It is ſtill farther very remarkable likewiſe, that the articulations of theſe joints are frequently inverted; in ſome the concavity is upwards, in others the reverſe. This occaſions that variety and mixture of concavities and convexities on the tops of the columns, which is obſervable throughout the platform of this cauſeway, yet without any diſcoverable deſign or regularity with reſpect to the number of either. The length alſo of theſe particular ſtones, from joint to joint, is various: in general, they are from 18 to 24 inches long; and, for the moſt part, longer toward the bottom of the columns than nearer the top, and the articulation of the joints ſomething deeper. The ſize or diameter likewiſe of the columns is as different as their length and figure; in general, they are from 15 to 20 inches in diameter. There are really no traces of uniformity or deſign diſcovered throughout the whole combination, except in the form of the joint, which is invariably by an articulation of the convex into the concave of the piece next above or below it; nor are there any traces of a finiſhing in any part, either in height, length, or breadth, of this curious cauſeway. If there is here and there a ſmooth top to any of the columns above water, there are others juſt by, of equal height, that are more or leſs convex or concave, which ſhow them to have been joined to pieces that have been waſhed or by other means taken off. And undoubtedly thoſe parts that are always above water have, from time to time, been made as even as might be; and

the remaining surfaces of the joints must naturally have been worn smoother by the constant friction of weather and walking, than where the sea, at every tide, is beating upon it and continually removing some of the upper stones and exposing fresh joints. And farther, as these columns preserve their diameters from top to bottom, in all the exterior ones, which have two or three sides exposed to view, the same may with reason be inferred of the interior columns whose tops only are visible. Yet, what is very extraordinary and equally curious in this phenomenon is, that notwithstanding the universal dissimilitude of the columns, both as to their figure and diameter, and though perfectly distinct from top to bottom, yet is the whole arrangement so closely combined at all points, that hardly a knife can be introduced between them either upon the sides or angles. And it is really a most curious piece of entertainment to examine the close contexture and nice insertion of such an infinite variety of angular figures as are exhibited on the surface of this grand parade. From the infinite dissimilarity of the figure of these columns, this will appear a most surprising circumstance to the curious spectator; and would incline him to believe it a work of human art, were it not, on the other hand, inconceivable that the wit or invention of man should construct and combine such an infinite number of columns, which should have a general apparent likeness, and yet be so universally dissimilar in their figure, as that, from the minutest examination, not two in ten or twenty thousand should be found whose angles and sides are equal among themselves, or of the one column to those of the other. That it is the work of nature, there can be no doubt to an attentive spectator, who carefully surveys the general form and situation, with the infinitely various figuration of the several parts of this causeway. There are no traces of regularity or design in the outlines of this curious phenomenon; which, including the broken and detached pieces of the same kind of workmanship, are extremely scattered and confused, and, whatever they might originally, do not at present appear to have any connection with the grand or principal causeway, as to any supposable design or use in its first construction, and as little design can be inferred from the figure or situation of the several constituent parts. The whole exhibition is, indeed, extremely confused, disuniform, and destitute of every appearance of use or design in its original construction. But what, beyond dispute, determines its original to have been from nature is, that the very cliffs, at a great distance from the causeway, especially in the bay to the eastward, exhibit at many places the same kind of columns, figured and jointed in all respects like those of the grand causeway: some of them are seen near to the top of the cliff, which in general, in these bays to the east and west of the causeway, is near 300 feet in height; others again are seen about midway, and at different elevations from the strand. A very considerable exposure of them is seen in the very bottom of the bay to the eastward, near a hundred roods from the causeway, where the earth has evidently fallen away from them upon the strand, and exhibits a most curious arrangement of many of these pentagonal columns, in a perpendicular position, supporting, in appearance, a cliff of different strata of earth, clay, rock, &c. to the height of 150 feet or more, above. Some of these columns are between 30 and 40 feet high, from the top of the sloping bank below them; and, being longest in the middle of the arrangement, shortening on either hand in view, they have obtained the appellation of *organs*, from a rude likeness in this particular to the exterior or frontal tubes of that instrument; and as there are few broken pieces on the strand near it, it is probable that the outside range of columns that now appears is really the original exterior line, to the seaward, of this collection. But how far they extend internally into the bowels of the incumbent cliff is unknown. The very substance, indeed, of that part of the cliff which projects to a point, between the two bays on the east and west of the causeway, seems composed of this kind of materials; for, besides the many pieces that are seen on the sides of the cliff that circulate to the bottom of the bays, particularly the eastern side, there is, at the very point of the cliff, and just above the narrow and highest part of the causeway, a long collection of them seen, whose heads or tops just appearing without the sloping bank plainly show them to be in an oblique position, and about halfway between the perpendicular and horizontal. The heads of these, likewise, are of mixed surfaces, convex and concave, and the columns evidently appear to have been removed from their original upright, to their present inclining or oblique position, by the sinking or falling of the cliff.

GIBBET, or Gibet, a machine in manner of a gallows, whereon notorious criminals, after execution, are hung in irons or chains, as spectacles *in terrorem*. See Gallows.—The word in French, *gibet*, properly denotes what we call gallows: it is supposed to come originally from the Arabic *gibel*, " mount or elevation of ground;" by reason *gibets* are usually placed on hills or eminences.

GIBBOUS, a term in surgery, denoting any protuberance or convexity of the body, by which a person becomes hunched or hump-backed. An incurvated state of the spine, arising from a preternatural softness of the bones, is very common in scrofulous and rickety children. Little can be done to remedy or prevent this deformity by machines, though many have been contrived for that purpose. The cure must be attempted by all those means which counteract scrofula, particularly by sea-bathing. Mr. Pott recommends the application of a caustic on each side of the projecting vertebræ, to be afterwards converted into issues. See Surgery.

Gibbous, in astronomy, a term used in reference to the enlightened parts of the moon, whilst she is moving from the first quarter to the full, and from the full to the last quarter: for all that time the dark part appears horned or falcated, and the light one hunched out, convex, or gibbous.

GIBEAH, a city in the tribe of Benjamin, lying north of Jerusalem about 20 or 30 furlongs, and built upon a hill, as its name imports. This city gave birth to Saul, the first king of Israel, for which reason it is frequently called Gibeah of Saul, or Gibeah the native country of Saul.

GIBELINS, or Gibellins, a famous faction in Italy, opposed to another called the Guelphs. Those two factions ravaged and laid waste Italy for a long series of years; so that the history of that country, for the space of two centuries, is no more than a detail of their mutual violences and slaughters. The Gibelins stood for the emperor against the pope: but concerning their origin and the reason of their names we have but a very obscure account. According to the generality of authors, they rose about the year 1240, upon the emperor Frederick II.'s being excommunicated by pope Gregory IX. Other writers maintain, that the two factions arose ten years before, though still under the same pope and emperor. But the most probable opinion is that of Maimburg, who says, that the two factions of Guelphs and Gibelins arose from a quarrel between two ancient and illustrious houses on the confines of Germany, that of the Henries of Gibeling, and that of the Guelphs of Adorf.

GIBEON, a city seated on an eminence about 40 furlongs from Jerusalem northward, and not far from the city of Gibeah. This was the capital city of the Gibeonites, who took the advantage of Joshua's oath, and of that which the elders of Israel likewise swore to them, upon an artificial representation which they made of their belonging to a very remote country, and their desire of making an alliance with the Hebrews. Joshua (ix. 3, 4, *&* *seq.*) and the elders inconsiderately entered into a league with these people, but soon discovered their mis-

take. Upon this, ſending for the Gibeonites, they reproached them with their fraud; and, without revoking the promiſe which they had made to them of giving them their lives, they condemned them to carry wood and water to the tabernacle of the Lord, as ſlaves and captives taken in war; in which ſtate of ſervitude they remained till the ruin and entire diſperſion of the Jewiſh nation. The *Gibeonites* were deſcended from the Hivites, the old inhabitants of that country, and poſſeſſed four cities, whereof Gibeon was the capital. The cities were Cephira, Beeroth, Kirjathjearim, and Gibeon, Joſh. ix. 17. Theſe cities were afterwards given to the tribe of Benjamin, except Kirjathjearim, which fell to the tribe of Judah. The Gibeonites continued ever after ſubject to thoſe burdens which Joſhua had impoſed on them, and were very faithful to the Iſraelites.

GIBLETS, the offals or entrails of a gooſe; including the heart and liver, with the feet, gizzard, &c. The word is ſuppoſed to be formed of *goblets*; from the French *gobeau*, "mouthful." Giblets make a conſiderable article in cookery: they boil giblets, ſtew giblets, make ragouts of giblets, giblet-pies, &c.

GIBRALTAR, a town of Spain, in Andaluſia, near a mountain of the ſame name, formerly called Calpe, which, and Mount Abyla on the oppoſite ſhore of Africa, were called the pillars of Hercules. Tarick, a general of the Moors, built a fortreſs here, which he called Gibel-Tarick, that is to ſay, Mount Tarick. Since that time a town has been built at the foot of this rock, which is ſtrongly fortified. It can be approached only by a narrow paſſage between the mountain and the ſea, acroſs which the Spaniards have drawn a line, and fortified it, to prevent the garriſon from having any communication with the country. It was formerly thought to be impregnable; but in 1704 it was taken by the confederate fleet, commanded by ſir George Rooke. The French and Spaniards attempted to retake it the following year, and 500 of them crept up the rock which covers the town, in the night time, but were driven down headlong the next morning. In 1727 the Spaniards beſieged it again, and attempted to blow up the rock, which they found impracticable, and were at length obliged to raiſe the ſiege. In the laſt war it underwent an ever-memorable ſiege, which laſted from the 16th of July 1779, when the blockade commenced, to the beginning of February 1783, when the ſiege was finally raiſed, on advice being received that the preliminaries of peace were ſigned. But the ſiege may be properly conſidered as terminated on the 13th of September 1782, on the failure of the grand attack then made by the Spaniards, whoſe dreadful floating batteries were all deſtroyed by the red-hot ſhot of the garriſon. This ſiege well deſerved a diſtinct account; and an excellent one has been written of it by capt. Drinkwater. The governor, general Elliott, whoſe defence was the admiration of all Europe, was created in 1787 a peer of Great Britain, by the title of baron Heathfield of Gibraltar; an annuity of 1200l. a year was ſettled on himſelf and two lives; and in his arms he was allowed to bear thoſe of Gibraltar. On the ſummit of the rock is a plain, whence there is a fine proſpect of the ſea on each ſide the ſtrait, of Barbary, Fez, and Morocco, beſide Seville and Granada in Spain. The garriſon here are cooped up in a very narrow compaſs, and have no proviſions but what are brought from Barbary and England. The ſtrait of Gibraltar is 24 miles in length, and 15 in breadth, and a ſtrong current always runs through it from the ocean to the Mediterranean. Gibraltar is 25 miles N. of Ceuta, and 45 S. E. of Cadiz. W. lon. 5. 17. N. lat. 36. 6.

GIBSON (Richard), an Engliſh painter, commonly called the *Dwarf*, was originally page to a lady at Mortlake; who, obſerving that his genius led him to painting, had the generoſity to get him inſtructed in the rudiments of that art. He devoted himſelf to Sir Peter Lely's manner, and copied his pictures to admiration, eſpecially his portraits: his paintings in water-colours were alſo eſteemed. He was in great favour with Charles I. who made him his page of the back-ſtairs; and he had the honour to inſtruct in drawing queen Mary and queen Anne when they were princeſſes. He married one Mrs. Anne Shepherd, who was alſo a dwarf; on which occaſion king Charles I. honoured their marriage with his preſence, and gave away the bride. Mr. Waller wrote a poem on this occaſion, intitled "The marriage of the Dwarfs;" in which are theſe lines:

"Deſign or chance makes others wive,
"But nature did this match contrive;
"Eve might as well have Adam fled,
"As ſhe deny'd her little bed
"To him, for whom heav'n ſeem'd to frame
"And meaſure out this only dame."

Mr. Fenton, in his notes on this poem, obſerves that he had ſeen this couple painted by Sir Peter Lely; and that they were of an equal ſtature, each being three feet ten inches high. However, they had nine children, five of whom arrived at maturity; theſe well-proportioned, and of the uſual ſtandard of mankind. But what nature denied this couple in ſtature, ſhe gave them in length of days: for Mr. Gibſon died in the 75th year of his age; and his wife, having ſurvived him almoſt 20 years, died in 1709, aged 89.

Gibson (Dr. Edmund), biſhop of London, was born in Weſtmoreland in 1669. He applied himſelf early and vigorouſly to learning, and diſplayed his knowledge in ſeveral writings and tranſlations, which recommended him to the patronage of archbiſhop Tenniſon. He was appointed domeſtic chaplain to his Grace; and we ſoon after find him rector of Lambeth, and archdeacon of Surry. Becoming thus a member of the convocation, he engaged in a controverſy which was carried on with great warmth by the members of both houſes, and defended his patron's rights, as preſident, in eleven pamphlets; he then formed and completed his more comprehenſive ſcheme of the legal duties and rights of the Engliſh clergy, which was at length publiſhed under the title of *Codex Juris Eccleſiaſtici Anglicani*, in folio. Archbiſhop Tenniſon dying in 1715, and Dr. Wake, biſhop of Lincoln, being made archbiſhop of Canterbury, Dr. Gibſon ſucceeded the latter in the ſee of Lincoln, and in 1720 was promoted to the biſhoprick of London. He now not only governed his dioceſe with the moſt exact regularity, but by his great care promoted the ſpiritual affairs of the church of England colonies in the Weſt Indies. He was extremely jealous of the leaſt of the privileges belonging to the church; and therefore, though he approved of the toleration of the Proteſtant Diſſenters, he continually guarded againſt all the attempts made to procure a repeal of the corporation and teſt acts; in particular, his oppoſition to thoſe licentious aſſemblies called *maſquerades* gave great umbrage at court, and effectually excluded him from all further favours. He ſpent the latter part of his life in writing and printing paſtoral letters, viſitation-charges, occaſional ſermons, and tracts againſt the prevailing immoralities of the age. His paſtoral letters are juſtly eſteemed as the moſt maſterly productions againſt infidelity and enthuſiaſm. His moſt celebrated work, the *Codex*, has been already mentioned. His other publications are, 1. An edition of Drummond's *Polemo-Middiana*, and James V. of Scotland's *Cantilena Ruſtica*, with notes. 2. The *Chronicum Saxonicum*, with a Latin tranſlation, and notes. 3. *Reliquiæ Spelmannianæ*, the poſthumous works of Sir Henry Spelman, relating to the laws and antiquities of England. 4. An edition of *Quintilian de Arte Oratoria*, with notes. 5. An Engliſh tranſlation of Camden's *Britannia*, with additions, two volumes folio; and, 6. A number of ſmall pieces,

that have been collected and printed in three volumes folio.—His intenſe application to ſtudy impaired his health; notwithſtanding which, he attained the age of 79. He expired in September 1748, after an epiſcopate of near 33 years.—With regard to biſhop Gibſon's private life and character, he was in every reſpect a perfect economiſt. His abilities were ſo well adapted to diſcharge the duties of his ſacred function, that, during the incapacity of archbiſhop Wake, the tranſaction of eccleſiaſtical affairs was committed to the biſhop of London. He was a true friend to the eſtabliſhed church and government, and as great an enemy to perſecution. He was uſually conſulted by the moſt learned and exalted perſonages in church and ſtate, and the greateſt deference was paid to his judgment. He poſſeſſed the ſocial virtues in an eminent degree; his beneficence was very extenſive; and ſuch was his generoſity, that he freely gave two thouſand five hundred pounds, left him by Dr. Crow, who was once his chaplain, to Crow's own relations, who were very poor.

GIDEON, the ſon of Joaſh, of the tribe of Manaſſeh. He dwelt in the city of Ophrah, and had a very extraordinary call to deliver the Iſraelites from the oppreſſion of the Midianites, to which they had become ſubject after the death of Barak and Deborah. Having effected their deliverance by ſupernatural aid, he was choſen judge of Iſrael in the year of the world 2759, and died in 2768. See Judges, chap. vi, vii, and viii.

GIFT, *Donum*, in law, is a conveyance which paſſeth either lands or goods, and is of a larger extent than a grant, being applied to things moveable and immoveable; yet as to things immoveable when taken ſtrictly, it is applicable only to lands and tenements given in tail; but *gift* and *grant* are too often confounded.

New-Year's GIFTS, preſents made on new-year's day, as a token of the giver's good will, as well as by way of preſage of a happy year. This practice is very ancient, the origin of it among the Romans being referred to Tatius king of the Sabines, who reigned at Rome conjointly with Romulus, and who having conſidered as a good omen a preſent of ſome ſprigs of vervain gathered in a wood conſecrated to Strenia the goddeſs of ſtrength, which he received on the firſt day of the new year, authoriſed this cuſtom afterwards, and gave to theſe preſents the name of Strenæ. However this may be, the Romans on that day celebrated a feſtival in honour of Janus, and paid their reſpects at the ſame time to Juno; but they did not paſs it in idleneſs, leſt they ſhould become indolent during the reſt of the year. They ſent preſents to one another of figs, dates, honey, &c. to ſhow their friends that they wiſhed them a happy and agreeable life. Clients, that is to ſay thoſe who were under the protection of the great, carried preſents of this kind to their patrons, adding to them a ſmall piece of ſilver. Under Auguſtus, the ſenate, the knights, and the people, preſented ſuch gifts to him, and in his abſence depoſited them in the Capitol. Of the ſucceeding princes ſome adopted this cuſtom, and others aboliſhed it, but it always continued among the people. The early Chriſtians condemned it, becauſe it appeared to be a relique of Paganiſm, and a ſpecies of ſuperſtition; but when it began to have no other object than that of being a mark of veneration and eſteem, the church ceaſed to diſapprove of it.

GIGG, GIGA, or JIG, in muſic and dancing, a gay, briſk, ſprightly compoſition, and yet in full meaſure as well as the allemand, which is more ſerious. Menage takes the word to ariſe from the Italian *giga*, a muſical inſtrument mentioned by Dante. Others ſuppoſe it to be derived from the Teutonic *gieg*, or *ghiighe*, "a fiddle." This is a favourite air in moſt nations of Europe: its characteriſtic is duple time, marked $\frac{6}{8}$, or $\frac{12}{8}$; it conſiſts of two ſtrains, without any determinate number of bars.

GIGGLEWICK, a town in the Weſt Riding of Yorkſhire, half a mile from Settle, ſtands on the river Ribble; where, at the foot of a mountain, is a ſpring, the moſt noted in England for ebbing and flowing ſometimes thrice in an hour; and the water ſubſides three quarters of a yard at the reflux, though the ſea is 30 miles off.

GIGLIO, a ſmall iſland of Italy, on the coaſt of Tuſcany, with a caſtle. It makes part of the ſtate of Sienna, and is 15 miles W. of Porto Hercole. E. lon. 11. 16. N. lat. 42. 1.

GIHON, in ancient geography, one of the rivers of Paradiſe; according to Wells, the eaſtern branch of the Euphrates, into which it divides after its conjunction with the Tigris.

GILBERT, or GILBERD, (William), a phyſician, was born at Colcheſter in the year 1540, the eldeſt ſon of the recorder of that borough. Having ſpent ſome time in both univerſities, he went abroad; and at his return ſettled in London, where he practiſed with conſiderable reputation. He became a member of the college of phyſicians, and phyſician in ordinary to queen Elizabeth, who, we are told, gave him a penſion to encourage him in his ſtudies. From his epitaph it appears that he was alſo phyſician to King James I. He died in the year 1603, aged 63, and was buried in Trinity-church in Colcheſter, where a handſome monument was erected to his memory. His books, globes, inſtruments, and foſſils, he bequeathed to the college of phyſicians, and his picture to the ſchool-gallery at Oxford. He wrote, 1. *De magnete, magneticiſque corporibus, et de magno magnete tellure, phyſiologia nova*; London 1600, folio. 2. *De mundo noſtro ſublunari, philoſophia nova*; Amſterdam 1651, 4to. He was alſo the inventor of two mathematical inſtruments for finding the latitude at ſea without the help of ſun, moon, or ſtars. A deſcription of theſe inſtruments was afterwards publiſhed by Thomas Blondeville in his *Theoriques of the planets*.

GILBERT (Sir Humphrey), a brave officer and ſkilful navigator, was born about the year 1539, in Devonſhire, of an ancient and honourable family. Though a ſecond ſon, he inherited a conſiderable fortune from his father. He was educated at Eton, and afterwards at Oxford; where he probably did not continue long, as he hath eſcaped the induſtrious Anthony Wood. It ſeems he once intended to finiſh his ſtudies in the Temple; but being introduced at court by his aunt Mrs. Catherine Aſhley, then in the queen's ſervice, he was diverted from the ſtudy of the law, and commenced ſoldier. Having diſtinguiſhed himſelf in ſeveral military expeditions, particularly that to Newhaven in 1563, he was ſent over to Ireland to aſſiſt in ſuppreſſing a rebellion; where, for his ſignal ſervices, he was made commander in chief and governor of Munſter, and knighted by the lord deputy, Sir Henry Sidney, on the firſt day of the year 1570. He returned ſoon after to England, where he married a rich heireſs. Neverthleſs in 1572 he ſailed with a ſquadron of nine ſhips to reinforce colonel Morgan, who at that time meditated the recovery of Fluſhing. Probably on his return to England he reſumed his coſmographical ſtudies, to which he was naturally inclined: for in the year 1576 he publiſhed his book on the north-weſt paſſage to the Eaſt Indies; and as Martin Frobiſher ſailed the ſame year, probably it was in conſequence of this treatiſe. In 1578 he obtained from the queen a very ample patent, empowering him to diſcover and poſſeſs in North America any lands then unſettled. He ſailed to Newfoundland, but ſoon returned to England without ſucceſs: nevertheleſs in 1583 he embarked a ſecond time with five ſhips, the largeſt of which put back on account of a contagious diſtemper on board. Our general landed on Newfoundland on the third of Auguſt, and on the fifth took poſſeſſion of the harbour of St. John's. By virtue of his patent he granted leaſes to ſeveral people; but though none of them remained there at that time, they ſettled afterwards in conſequence of theſe leaſes: ſo that Sir Humphrey deſerves to be remembered as the real founder of the vaſt American empire. On the 20th of Auguſt

he put to ſea again, on board a ſmall ſloop, which on the 29th foundered in a hard gale of wind. Thus periſhed Sir Humphrey Gilbert; a man of quick parts, a brave ſoldier, a good mathematician, a ſkilful navigator, and of a very enterpriſing genius. We learn alſo, that he was remarkable for his eloquence, being much admired for his patriotic ſpeeches both in the Engliſh and Iriſh parliaments. He wrote "A diſcourſe to prove a paſſage by the north-weſt to Cathaia and the Eaſt Indies, printed Lond. 1576." This treatiſe, which is a maſterly performance, is preſerved in Hakluyt's collection of voyages, vol. iii. p. 11. The ſtyle is ſuperior to moſt, if not to all, the writers of that age; and ſhows the author to have been a man of conſiderable reading. He mentions, at the cloſe of this work, another treatiſe on navigation, which he intended to publiſh: it is probably loſt.

GILBERTINES, an order of religious, thus called from St. Gilbert of Sempringham in the county of Lincoln, who founded the ſame about the year 1148; the monks of which obſerved the rule of St. Auguſtine, and were accounted canons: and the nuns that of St. Benedict. The founder of this order erected a double monaſtery, or rather two different ones, contiguous to each other, the one for men, the other for women, but parted by a very high wall. St. Gilbert himſelf founded 13 monaſteries of this order, viz. four for men alone, and nine for men and women together, which had in them 700 brethren and 1500 ſiſters. At the diſſolution there were about 25 houſes of this order in England and Wales.

GILBOA, mountains of Samaria, ſtretching out from weſt to eaſt, on the confines of the half tribe of Manaſſeh, and of the tribe of Iſſachar; and to the ſouth part of the valley of Jezreel, beginning weſtward at the city of Jezreel, ſituated at the foot of theſe mountains, reaching almoſt quite to the Jordan, lying at the diſtance of ſix miles from Scythopolis: famous for the death of Saul and his ſon Jonathan, and the defeat of the Iſraelites by the Philiſtines.

GILD, or GUILD. See GUILD.

GILDAS, ſurnamed *the Wiſe*, was born in Wales in the year 511. Where he was educated is uncertain; but it appears from his own writings that he was a monk. Some writers ſay that he went over to Ireland; others, that he viſited France and Italy. They agree however in aſſerting, that after his return to England he became a celebrated and moſt aſſiduous preacher of the goſpel. Du Pin ſays he founded a monaſtery at Venetia in Britain. Gildas is the only Britiſh author of the ſixth century whoſe works are printed; they are therefore valuable on account of their antiquity, and as containing the only information we have concerning the times of which he wrote. His Hiſtory of Britain is, however, a very flimſy performance, and his ſtyle obſcure and inelegant.

GILDING, the art of ſpreading or covering a thing over with gold, either in leaf or liquid. The art of gilding was not unknown among the ancients, though it never arrived among them at the perfection to which the moderns have carried it. Pliny aſſures us, that the firſt gilding ſeen at Rome was after the deſtruction of Carthage, under the cenſorſhip of Lucius Mummius, when they began to gild the ceilings of their temples and palaces; the Capitol being the firſt place on which this enrichment was beſtowed. But he adds, that luxury advanced on them ſo haſtily, that in a little time you might ſee all, even private and poor perſons, gild the very walls, vaults, &c. of their houſes. We need not doubt but they had the ſame method with us, of *beating gold*, and reducing it into leaves; though it ſhould ſeem they did not carry it to the ſame height, if it be true which Pliny relates, that they only made 750 leaves of four fingers ſquare out of a whole ounce. Indeed he adds, that they could make more; that the thickeſt were called *bracteæ Prænestinæ*, by reaſon of a ſtatue of the goddeſs Fortune at Præneſte gilt with ſuch leaves; and that the thinner ſort were called *bracteæ quæſtoriæ*.

The modern gilders do alſo make uſe of gold leaves of different thickneſſes; but there are ſome ſo fine, that a thouſand do not weigh above four or five drachms. The thickeſt are uſed for gilding on iron and other metals; and the thinneſt on wood. But we have another advantage over the ancients in the manner of uſing or applying the gold: the ſecret of painting in oil, diſcovered in the later ages, furniſhes us with means of gilding works that ſhall endure all the injuries of time and weather, which to the ancients was impracticable. They had no way to lay the gold on bodies that would not endure the fire but with whites of eggs or ſize, neither of which will reſiſt the water; ſo that they could only gild ſuch places as were ſheltered from the moiſture of the weather.

The Greeks called the compoſition on which they applied their gilding on wood *leucophæum* or *leucophorum*; which is deſcribed as a ſort of glutinous compound earth, ſerving in all probability to make the gold ſtick and bear poliſhing. But the particulars of this earth, its colour, ingredients, &c. the antiquaries and naturaliſts are not agreed upon.

The durable luſtre and beauty of gold have occaſioned ſeveral inquiries and diſcoveries concerning the different methods of applying it to different ſubſtances. Hence the art of gilding is very extenſive, and contains many particular operations and various management. A colour of gold may be given without employing gold; but this is a falſe kind of gilding. Thus, by applying upon ſilver or copper leaf a gold-coloured tranſparent varniſh, all the brilliancy of the metals will appear from beneath. Many ornaments of braſs are varniſhed in this manner, which is called *gold laquering*, to diſtinguiſh them from thoſe which are really gilt. Silver-leaves thus varniſhed are put upon leather, which is then called *gilt leather*. See LAQUER. Amongſt the falſe gilding may alſo be reckoned thoſe which are made with thin leaves of copper or braſs, called *Dutch-leaf*. In this manner are made all the kinds of what is called *gilt paper*.

In the *true* gilding, gold is applied to the ſurface of bodies. The gold intended for this purpoſe ought in general to be beat into thin leaves, or otherwiſe divided into very fine parts. As metals cannot adhere well merely by contact to any but to other metallic ſubſtances, when gold is to be applied to the ſurface of ſome unmetallic body, that ſurface muſt be previouſly covered with ſome gluey and tenacious ſubſtance, by which the gold ſhall be made to adhere. Theſe ſubſtances are in general called *ſizes*. Some of them are made of vegetable and animal glues, and others of oily, gluey, and drying matters; but the ſize moſt univerſally employed in water-gilding is a weak one prepared with common glue and water. Upon the ſize firſt laid on and dried, and moiſtened at the time of gilding with a bruſh dipped in cold water, the leaves of gold are applied, and preſſed down with a little cotton or a hare's foot; and when the whole is dry, the work is finiſhed and burniſhed with a hard inſtrument called a *dog's tooth*, to give it luſtre.

When the work is required to be capable of reſiſting rain or moiſture, it ought to be previouſly covered with a compoſition of drying oil and yellow ochre ground together. Laſtly, another mixture, called *gold ſize*, is to be applied above theſe; upon which the gold-leaves are to be fixed. This gold ſize is only a kind of paint made with ochre, which, when laid on, ſhould be ſuffered ſo far to dry as to prove *ſticky* when touched with the finger. Whilſt it is in this ſtate, the leaf gold, after being cut into ſquare bits upon a leather cuſhion, is applied and preſſed gently down with cotton.

The method of applying gold upon *metals* is entirely different. The ſurface of the metal to be gilt is firſt to be cleaned; and then leaves are to be applied to it, which, by means of rubbing with a poliſhed blood-ſtone, and a certain degree of heat, are made to adhere perfectly well. In this manner ſilver-leaf is

fixed and burnifhed upon brafs in the making of what is called *French plate*, and fometimes alfo gold-leaf is burnifhed upon copper and upon iron. Gold is alfo applied to metals in feveral other manners. One of thefe is by previoufly forming the gold into a pafte or amalgam with mercury. In order to obtain a fmall amalgam of gold and mercury, the gold is firft to be reduced into thin plates or grains, which are heated red-hot, and thrown into mercury previoufly heated till it begins to fmoke. Upon ftirring the mercury with an iron rod, the gold totally diffolves. The proportion of mercury to gold is generally as fix or eight to one. With this amalgam the furface of the metal to be gilded is to be covered; then a fufficient heat is to be applied to evaporate the mercury; and the gold is laftly to be burnifhed with a blood-ftone.

This method of gilding by amalgamation is chiefly ufed for gilding copper, or an allay of copper, with a fmall portion of zinc, which more readily receives the amalgam, and is alfo preferable for its colour, which more refembles that of gold than the colour of copper. When the metal to be gilt is wrought or chafed, it ought to be previoufly covered with quickfilver before the amalgam is applied, that this may be eafier fpread: but when the furface of the metal is plain, the amalgam may be applied directly to it. The quickfilver or amalgam is made to adhere to the metal by means of a little aquafortis, which is rubbed on the metallic furface at the fame time, by which this furface is cleanfed from any ruft or tarnifh which might prevent the union or adhefion of the metals. But the ufe of the nitrous acid in this operation is not, as is generally fuppofed, confined merely to cleanfe the furface of the metal to be gilt from any ruft or tarnifh it may have acquired; but it alfo greatly facilitates the application of the amalgam to the furface of that metal, probably in the following manner: It firft diffolves part of the mercury of the amalgam; and when this folution is applied to the copper, this latter metal, having a ftronger difpofition to unite with the nitrous acid than the mercury has, precipitates the mercury upon its furface, in the fame manner as a polifhed piece of iron precipitates upon its furface copper from a folution of blue vitriol. When the metal to be gilt is thus covered over with a thin precipitated coat of mercury, it readily receives the amalgam. In this folution and precipitation of mercury, the principal ufe of the nitrous acid in the procefs of gilding appears to confift. The amalgam being equally fpread over the furface of the metal to be gilt by means of a brufh, the mercury is then to be evaporated by a heat juft fufficient for that purpofe; for if it be too great, part of the gold may alfo be expelled, and part of it will run together, and leave fome of the furface of the metal bare. While the mercury is evaporating, the piece is to be from time to time taken from the fire, that it may be examined, that the amalgam may be fpread more equally by means of a brufh, that any defective parts of it may be again covered, and that the heat may not be too fuddenly applied to it. When the mercury is evaporated, which is known by the furface being entirely become of a dull yellow colour, the metal muft then undergo other operations, by which the fine gold colour is given to it. Firft, the gilded piece of metal is rubbed with a fcratch-brufh (which is a brufh compofed of brafs wire) till its furface is made fmooth; then it is covered over with a compofition called *gilding wax*, and is again expofed to the fire till the wax be burnt off. This wax is compofed of bees-wax, fometimes mixed with fome of the following fubftances; red ochre, verdigrife, copper-fcales, alum, vitriols, borax: but, according to Dr. Lewis, the faline fubftances alone are fufficient without any wax. By this operation the colour of the gilding is heightened; and this effect feems to be produced by a perfect diffipation of fome mercury remaining after the former operation. This diffipation is well effected by this equable application of heat. The gilt furface is then covered over with a faline compofition, confifting of nitre, alum, or fome vitriolic falt, ground together, and mixed up into a pafte with water or urine. The piece of metal thus covered is expofed to a certain degree of heat, and then quenched in water. By this method its colour is further improved, and brought nearer to that of gold. This effect feems to be produced by the acid of nitre (which is difengaged by the vitriolic acid of the alum or other vitriolic falt during the expofure to heat) acting upon any particles of copper which may happen to lie on the gilded furface. Laftly, fome artifts think that they give an additional luftre to their gilt-work by dipping it in a liquor prepared by boiling fome yellow materials, as fulphur, orpiment, or turmeric. The only advantage of this operation is, that a part of the yellow matter, as the fulphur or turmeric, remains in fome of the hollows of the carved work, in which the gilding is apt to be more imperfect, and to which it gives a rich and folid appearance.

Iron cannot be gilt by amalgamation, unlefs, as it is faid, it be previoufly coated with copper by dipping in a folution of blue vitriol. Iron may alfo receive a golden coat from a faturated folution of gold in aqua-regia mixed with fpirit of wine, the iron having a greater affinity with the acid, from which it therefore precipitates the gold. Whether any of thefe two methods be applicable to ufe is uncertain: but the method commonly employed of fixing gold upon iron is that above-mentioned, of burnifhing gold-leaf upon this metal when heated fo as to become blue; and the operation will be more perfect if the furface has been previoufly fcratched or graved.

Another method is mentioned by authors of gilding upon metals, and alfo upon earthen ware, and upon glafs; which is, to fufe gold with regulus of antimony, to pulverize the mafs which is fufficiently brittle to admit that operation, to fpread this powder upon the piece to be gilt, and expofe it to fuch a fire that the regulus may be evaporated while the gold remains fixed. The inconveniencies of this method, according to Dr. Lewis, are, that the powder does not adhere to the piece, and cannot be equally fpread; that part of the gold is diffipated along with the regulus; that glafs is fufible with the heat neceffary for the evaporation of regulus of antimony; and that copper is liable to be corroded by the regulus, and to have its furface rendered uneven.

On the fubject of gilding by amalgamation Dr. Lewis has the following remarks: "There are two principal inconveniencies in this bufinefs: One, that the workmen are expofed to the fumes of the mercury, and generally, fooner or later, have their health greatly impaired by them: the other, the lofs of the mercury; for though part of it is faid to be detained in cavities made in the chimney for that purpofe, yet the greateft part of it is loft. From fome trials I have made, it appeared that both thefe inconveniencies, particularly the firft and moft confiderable one, might in good meafure be avoided, by means of a furnace of a due conftruction. If the communication of a furnace with its chimney, inftead of being over the fire, is made under the grate, the afh-pit door or other apertures beneath the grate clofed, and the mouth of the furnace left open; the current of air, which otherwife would have entered beneath, enters now at the top, and, paffing down through the grate to the chimney, carries with it completely both the vapour of the fuel and the fumes of fuch matters as are placed upon it: the back part of the furnace fhould be raifed a little higher above the fire than the fore part, and an iron plate laid over it, that the air may enter only at the front, where the workman ftands, who will be thus effectually fecured from the fumes, and from being incommoded by the heat, and at the fame time have full liberty of introducing, infpecting, and removing the work. If fuch a furnace is made of ftrong forged (not milled) iron plate, it will be fufficiently durable; the upper end of the chimney may reach above a foot and a half higher than the level of the fire: over

this is to be placed a larger tube, leaving an interval of an inch or more all round between it and the chimney, and reaching to the height of 10 or 12 feet, the higher the better. The external air paſſing up between the chimney and the outer pipe prevents the latter from being much heated; ſo that the mercurial fumes will condenſe againſt its ſides into running quickſilver, which, falling down to the bottom, is there catched in a hollow rim, formed by turning inwards a portion of the lower part, and conveyed by a pipe at one ſide into a proper receiver.

Some metals, particularly ſilver, may be gilt in the following manner: Let gold be diſſolved in aqua-regia. In this ſolution pieces of linen are to be dipt, and burnt to black aſhes. Theſe aſhes being rubbed on the ſurface of the ſilver by means of a wet linen rag, apply the particles of gold which they contain, and which by this method adhere very well. The remaining part of the aſhes is to be waſhed off; and the ſurface of the ſilver, which in this ſtate does not ſeem to be gilt, is to be burniſhed with a blood-ſtone till it acquire a fine colour of gold. This method of gilding is very eaſy, and conſumes a very ſmall quantity of gold. Moſt gilt ornaments upon fans, ſnuff-boxes, and other toys of much ſhow and little value, are nothing but ſilver gilt in this manner.

Gold may alſo be applied to glaſs, porcelain, and other vitrified bodies. As the ſurface of theſe matters is very ſmooth, and conſequently is capable of a very perfect contact with gold leaves, theſe leaves adhere to them with ſome force, although they are not of a metallic nature. This gilding is ſo much more perfect, as the gold is more exactly applied to the ſurface of the glaſs. The pieces are then to be expoſed to a certain degree of heat, and burniſhed ſlightly to give them luſtre. A more ſubſtantial gilding is fixed upon glaſs, enamel, and porcelain, by applying to thoſe ſubſtances powder of gold mixed with a ſolution of gum arabic, or with ſome eſſential oil, and a ſmall quantity of borax; after which a ſufficient heat is to be applied to ſoften the glaſs and the gold, which is then to be burniſhed. With this mixture any figures may be drawn. The powder for this purpoſe may be made, 1. By grinding gold-leaf with honey, which is afterwards to be waſhed away with water. 2. By diſtilling to dryneſs a ſolution of gold in aqua-regia. 3. By evaporating the mercury from an amalgam of gold, taking care to ſtir well the maſs near the end of the proceſs. 4. By precipitating gold from its ſolution in aqua-regia, by applying to it a ſolution of vitriolated iron in water, or ſome copper, and perhaps other metallic ſubſtances.

Balm of GILEAD. See AMYRIS.

GILL (John), D. D. a Proteſtant diſſenting miniſter of the Baptiſt denomination, and the ſon of Edward and Elizabeth Gill, was born at Kettering in Northamptonſhire, November 23, 1697. His ſentiments, as a divine, were throughout Calviniſtic: "And perhaps no man (ſays the Reverend Mr. Toplady, a miniſter in the church of England), ſince the days of Auſtin, has written ſo largely in defence of the ſyſtem of grace; and certainly no man has treated that momentous ſubject, in all its branches, more cloſely, judiciouſly, and ſucceſsfully." He died at Camberwell, October 14, 1771, aged 73 years 10 months and 10 days. In 1718 the Doctor married Mrs. Elizabeth Negus, by whom he had many children, two of whom only ſurvived him. Mrs. Gill died in 1764. His works are, A Commentary on the Old and New Teſtament, in 9 vols. folio. A Body of Divinity, in 3 vols. quarto. The Cauſe of God and Truth, 4 vols. octavo. A Treatiſe concerning the Prophecies of the Old Teſtament reſpecting the Meſſiah. A Diſſertation on the Antiquity of the Hebrew Language, Letters, Vowel-Points, and Accents. Sermons on the Canticles, folio; beſides a great number of ſermons and controverſial pieces on different ſubjects.

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GILL, a meaſure of capacity, containing a quarter of an Engliſh pint.

GILLS, or BRANCHIÆ, of fiſhes. See COMPARATIVE *Anatomy*, page 656.

GILLINGHAM, a pariſh in the county of Dorſetſhire, on the river Stour, near the foreſt of its own name; where, *anno* 1016, king Edmund Ironſide vanquiſhed the Danes. It is one of the largeſt pariſhes in the county, being 41 miles in circuit, containing 64,000 acres. It lies on the borders of Wilts and Somerſet, 4 miles N. W. of Shaftſbury. It has a manufacture of linen, but the chief product is grazing and the dairies. Near it are the traces of an ancient reſidence of Norman or Saxon kings, 320 feet long and 240 broad, ſurrounded by a rampart of earth. Henry I. reſided here, and king John repaired it at the expence of the county. Edward I. ſpent his Chriſtmas here in 1270; but the whole of the materials are removed, and the foundation of the houſe only can be traced, which was in the form of the letter L, in length 180 feet by 80 broad, and the foot of the letter 48 by 40. The area of the houſe contained 168,000 ſquare feet. It ſtood half a mile from the church, on the road to Shaſton, encompaſſed by a moat, now dry, in ſome places 9 feet deep and 20 broad. The rampart appears to have been 30 feet thick. Here is a free ſchool, a large old building, and a workhouſe, as well as two ſtone bridges. In 1694 it received damage of near 400l. by a fire. Near it is Gillingham foreſt, four miles long and one mile broad. The church is a large ancient fabric.

GILLINGHAM, a pariſh of Kent, three miles below Chatham, and on the ſame ſide of the Medway. Part of Chatham-dock is in this pariſh; and here is a caſtle well furniſhed with guns that commands the river, there being no leſs than 170 embraſures for cannon; which would ſtop the progreſs of any enemy that ſhould happen to make way by Sheerneſs-fort, before they could reach Chatham. Here are alſo copperas works. At this place 600 Norman gentlemen, who came over in the retinue of the two princes Alfred and Edward, were all barbarouſly murdered by earl Godwin. It was in remote times the property of the archbiſhop of Canterbury, who had here an elegant palace, the old hall of which is now converted to a barn: it is built principally of flint, but the windows are filled up with brick. Near it are the remains of the chapel, &c.; and a great part of the whole of its original outer walls may be traced.

GILOLO, a large iſland of the Pacific Ocean, lying between 1° S. lat. and 2° N. lat. and between 125° and 128° E. long. It belongs to the Dutch, but does not produce any of the fine ſpices, though it lies in the neighbourhood of the ſpice-iſlands. The natives are fierce and cruel ſavages.

GILPIN (Bernard), an Engliſh divine, was deſcended from an ancient family in Weſtmoreland, and born at Kentmire in that county, 1517. After paſſing through a grammar-ſchool, he was ſent to Oxford, and admitted a ſcholar on the foundation of Queen's-College in 1533. Here he ſtuck cloſe to his ſtudy, and made himſelf maſter of logic, philoſophy, the Latin, Greek, and Hebrew tongues; in which laſt he was inſtructed by Thomas Neale, then fellow of New-College, who afterwards became Hebrew profeſſor. In March 1541 he became M. A. having taken his bachelor's degree at the uſual term before. He was now alſo choſen fellow of his college, being much beloved for ſweetneſs of diſpoſition and unaffected ſincerity of manners. At the ſame time, his eminence for learning was ſuch, that he was choſen one of the firſt maſters to ſupply Chriſt-Church College, after the completing of its foundation by Henry VIII.

As he had been bred in the Roman Catholic religion, ſo he had continued hitherto ſteady to that church; and in defence thereof, while he reſided at Oxford, held a diſputation againſt

Hooper, afterwards Bifhop of Worcefter, and martyr for the Proteftant faith. But in Edward VI's time, being prevailed upon to difpute with Peter Martyr, againft fome pofitions maintained by him in his divinity lecture at Oxford, and being ftaggered a little therein, he began more ferioufly to read over the Scriptures and writings of the fathers, expecting to confirm himfelf in his opinions by ftronger arguments: on the contrary, the refult of his inquiries was the cooling of his zeal for Popery, and kindling a defire towards the new religion: in which temper he applied for further inftruction to Tonftall, bifhop of Durham, who was his mother's uncle. After this he confulted other private friends, and at the fame time, continuing his diligence in fearching the Scriptures and the fathers, he began to obferve many abufes and fome enormities in Popery, and to think reformation neceffary.

Whilft he was going on in this courfe, having taken orders, he was over-ruled by his friends to accept, againft his will, the vicarage of Norton in the diocefe of Durham. This was in 1552; and being a grant from Edward VI, before he went to refide he was appointed to preach before his majefty, who was then at Greenwich. His fermon was greatly approved, and recommended him to the notice of Sir Francis Ruffel and Sir Robert Dudley, afterwards earls of Bedford and Leicefter, and to fecretary Cecil, afterwards lord-treafurer Burleigh, who obtained for him the king's licence for a general preacher during his majefty's life, which, however, happened to be not much above half a year after. Thus honoured, he repaired to his parifh: but he foon grew uneafy here; for, however refolved he was againft Popery, he was fcarcely fettled in fome of his religious opinions; and he found the country overfpread with Popifh doctrines, the errors of which he was unable to oppofe. In this unhappy ftate he applied to bifhop Tonftall, then in the Tower; who advifed him to provide a trufty curate for his parifh, and to fpend a year or two abroad, in converfing with fome of the moft eminent profeffors on both fides the queftion. The propofal to travel was quite agreeable to Gilpin; who, after refigning his living from a fcruple of confcience, fet out for London, to receive the bifhop's laft orders, and embark. The bifhop promifed to fupport him abroad: and at parting put into his hands a treatife upon the Eucharift, which the times not fuiting to be printed here, he defired might be done under his infpection at Paris. With this charge he embarked for Holland; and, on landing, went immediately to Malin to vifit his brother George, who was then a ftudent there. After a few weeks he went to Louvain, which he pitched on for his refidence: propofing to make occafional excurfions to Antwerp, Ghent, Bruffels, and other places in the Netherlands. Gilpin made the beft ufe of his time, and foon began to have jufter notions of, and greater fatisfaction in, the doctrine of the Reformed, when he was alarmed with the news of Edward's death and the acceffion of Mary to the throne. However, this bad news came attended with an agreeable account of bifhop Tonftall's releafe from the Tower, and re-eftablifhment in his bifhoprick: but the confequence of this was not fo agreeable; for afterwards he received a letter from his brother George, inviting him to Antwerp upon a matter of great importance. Coming thither, he found that the bufinefs was a requeft of the bifhop's, to perfuade him to accept of a living of confiderable value, which was become vacant in his diocefe. George ufed all his endeavours for the purpofe, but in vain; Bernard was too well pleafed with his prefent fituation to think of a change, and excufed himfelf to his patron on the fame fcruple of confcience as before, againft taking the profits while another did the duty. Meanwhile, he was greatly affected with the misfortune of the Englifh exiles from queen Mary's perfecution, and not a little pleafed to find, that though unable perfonally to affift them, yet his large acquaintance in the country furnifhed him with the means of ferving many of them by recommendations. He had now been two years in Flanders, and made himfelf mafter of the controverfy, as it was then handled. He left Louvain, therefore, and went to Paris, where his firft care was to print his patron's book; which he performed entirely to his lordfhip's fatisfaction the fame year, 1554, and received his thanks for it.

After three years abfence, Gilpin returned to England in 1556, a little before the death of queen Mary, and foon after received from his uncle the archdeaconry of Durham, to which the rectory of Eafington was annexed. He immediately repaired to his parifh; where, notwithftanding the perfecution, which was then in its height, he preached boldly againft the vices, errors, and corruptions of the times, efpecially in the clergy. This could not fail to draw vengeance upon himfelf: and accordingly a charge confifting of thirteen articles was drawn up againft him, and prefented in form to the bifhop; but Tonftall found a method of difmiffing the caufe in fuch a manner, as to protect his nephew without endangering himfelf. The malice of Gilpin's enemies could not, however, reft: his character, at leaft, was in their power; and they created him fo much trouble, that, not able to undergo the fatigue of both his places, he begged leave of the bifhop to refign either the archdeaconry or his parifh; and the rich living of Houghton le Spring becoming vacant, the bifhop prefented him to it, on his refignation of the archdeaconry. He now lived retired, and gave no immediate offence to the clergy; the experience he had of their temper made him more cautious not to provoke them. Notwithftanding, he was foon formally accufed to the bifhop a fecond time, and again protected by him. His enemies, enraged at this fecond defeat, delated him to Bonner, bifhop of London, who, being the reverfe of Tonftall, immediately gave orders to apprehend him. Gilpin had no fooner notice of it than, being no ftranger to this prelate's BURNING zeal, he prepared for martyrdom; and commanding his houfe-fteward to provide him a long garment, that he might go the more comely to the ftake, he fet out for London. It is faid, that he happened to break his leg in the journey, which delayed him; be that as it may, it is certain that the news of queen Mary's death met him on the road, which proved his delivery.

Upon his return to Houghton, he was received by his parifhioners with the fincereft joy; and though he foon after loft his patron, bifhop Tonftall, yet he quickly experienced that worth like his could never be left friendlefs. When the Popifh bifhops were deprived, the earl of Bedford recommended him to the queen for the bifhopric of Carlifle, and took care that a congé d'elire fhould be fent down to the dean and chapter for that purpofe: but Mr. Gilpin declined this promotion. He refufed alfo an offer the following year, which feems to have been more to his tafte. Queen Elizabeth, at her acceffion to the throne, had procured one Dr. Francis, a Proteftant phyfician, to be chofen provoft of Queen's-College. Francis was received with great reluctance by the fellows, who were attached to Popery; and, finding his fituation uneafy among them, determined to refign, and made an offer of his fituation to Gilpin. But though he loved the univerfity well, and this college in particular, of which he had been fellow, and was affured likewife that the prefent fellows had a very great efteem for him, yet all was not able to move him from his parfonage. Here he fpent the remainder of his days; abounding in hofpitality, charity, and all good works. Towards the latter part of his life, his health was much impaired; and there happened a very unfortunate affair which entirely deftroyed it. As he was croffing the market-place at Durham, an ox ran at him, and threw him down with fuch violence, that it was imagined he had received his death's wound. He lay long confined; and though he got abroad again, he never recovered even the little

ſtrength he had before, and continued lame as long as he lived. He died in 1583, in his 66th year.

GILTHEAD, in ichthyology. See Sparus.

GIN. See Geneva.

Gin, in mechanics, a machine for driving piles, fitted with a windlaſs and winches at each end, where eight or nine men heave, and round which a rope is reeved that goes over the wheel at the top: one end of this rope is faſtened to an iron-monkey, that hooks to a beetle of different weights, according to the piles they are to drive, being from eight to thirteen hundred weight; and when hove up to a croſs-piece near the wheel, it unhooks the monkey, and lets the beetle fall on the upper end of the pile, and forces the ſame into the ground: then the monkey's own weight overhauls the windlaſs, in order for its being hooked again to the beetle.

GINGEE, a town of Aſia, in the peninſula of Hindooſtan, and on the coaſt of Coromandel. It is a large town, well peopled, and ſtrong both by art and nature, being ſeated on a mountain, whoſe top is divided into three points, on each of which is a caſtle. The Great Mogul in 1690 began a ſiege, which continued three years, to no purpoſe. It is 33 miles W. of Pondicherry. Lon. 79. 25. E. Lat. 11.42. N.

GINGEN, a free imperial town of Germany, in Suabia, 16 miles N. of Ulm. Lon. 10. 13. E. Lat. 48. 39. N.

GINGER, the root of a ſpecies of amomum. See Amomum.

GINGIDIUM, in botany; a genus of the digynia order, belonging to the pentandria claſs of plants. The calyx is an involucrum, with about ſix linear leaves; the corolla conſiſts of five oval-lanceolated petals; the ſtamina are five filaments; the antheræ roundiſh; the pericarpium an ovato-truncated fruit, with eight ſtriæ; there are two ſtriated ſeeds, in ſome places plane, and in others convex.

GINGIRO, or Zindero, a ſmall territory of Africa, to the ſouth of Abyſſinia; being ſeparated from it by the river Zebee, by which it is alſo almoſt entirely ſurrounded. This river is extremely large, having more water than the Nile, and being much more rapid; ſo that during the rainy ſeaſon it would be altogether impaſſable, were it not for the large rocks which are in its channel. The extreme difficulty which occurs in paſſing this river, however, is the means of preſerving the kingdom of Gingiro, which would otherwiſe be conquered in a ſingle ſeaſon by the Galla.

The moſt remarkable particular with regard to this kingdom is, that the ſovereign is a profeſſed votary of the devil. "This ſuperſtition (ſays Mr. Bruce) reaches down all the weſtern ſide of the continent on the Atlantic ocean, in the countries of Congo, Angola, and Benin. In ſpite of the firmeſt foundation in true philoſophy, a traveller who decides from the information and inveſtigation of facts will find it very difficult to treat theſe appearances as abſolute fictions, or as owing to the ſuperiority of cunning of one man in over-reaching another. For my own part, I confeſs, I am equally at a loſs to aſſign reaſons for diſbelieving the fiction on which their pretenſions to ſome preternatural information are founded, as to account for them by the operation of ordinary cauſes."

In this kingdom every thing is conducted, or pretended to be conducted, by magic; and all thoſe ſlaves, which in other African countries are ſold to Europeans, are here ſacrificed to the devil, human blood being a neceſſary part in all their accurſed ſolemnities. "How far (ſays Mr. Bruce) this reaches to the ſouthward, I do not know; but I look upon this to be the geographical bounds of the reign of the devil on the north ſide of the equator in the peninſula of Africa."

With regard to this country, very little farther is known than ſome of the cuſtoms of the people, tranſiently picked up by the Jeſuit miſſionaries in Abyſſinia. From them we learn, that the kingdom is hereditary in one family, though it does not regularly deſcend to the eldeſt ſon, the king being choſen by the nobles: in which they reſemble their neighbours the Abyſſinians. When the king dies, his body is wrapped in a fine cloth, and a cow is killed. The body ſo wrapped up is next incloſed in the cow's ſkin; and all the princes of the royal family fly and hide themſelves in the buſhes, while thoſe who are entruſted with the election enter the thickets, beating about every where as if for game. At laſt a bird of prey, called in their language *liber*, appears, and hovers over the perſon deſtined to be the king; crying and making a great noiſe without quitting his ſtation. By this means the perſon deſtined to be elected is found out, ſurrounded, as is reported, by lions, tigers, panthers, and other wild beaſts; all which are ſuppoſed to be brought by the power of magic or of the devil.—After the king is found, he flies upon thoſe who came in queſt of him in great fury, killing and wounding as many as he can reach, until he is at laſt dragged to the throne whether he will or not. One particular family have the privilege of conducting him to the throne; and if they ſhould not happen to find him at firſt, they have a right to take him out of the hands of thoſe who did ſo; and thus another battle enſues before the vacant throne can be filled. Laſtly, before he enters his palace, two men muſt be killed; one at the foot of a tree by which the houſe is ſupported, and the other at the threſhold of the door, which is beſmeared with the blood of the victim. It is the particular privilege of one family to afford theſe victims; and ſo far are they from ſeeking to avoid this fate, that they glory in the occaſion, and willingly offer themſelves to meet it. This laſt particular Mr. Bruce ſaid he had in Abyſſinia, from people coming from Gingiro.

GINGIVÆ, the gums. See Gums.

GINGLYMUS, in anatomy, one of the ſpecies of articulation. It is that jointure of the bones where, as in the knee, each bone mutually receives the other. See Anatomy, Part I.

GINKGO, the maiden-hair-tree. See Mauritia.

GINORA, in botany; a genus of the monogynia order, belonging to the dodecandria claſs of plants, and in the natural method ranking with thoſe of which the order is doubtful. The calyx is cleft into ſix parts; the petals ſix; the capſule unilocular, quadrivalved, coloured, and polyſpermous.

GINSENG. See Panax.

GIOIA (Flavio), of Amalfi in the kingdom of Naples, the celebrated mathematician; who, from his knowledge of the magnetic powers, invented the mariner's compaſs, by which the navigation of the Europeans was extended to the moſt diſtant regions of the globe: before this invention, navigation was confined to coaſting. The king of Naples being a younger branch of the royal family of France, he marked the north point with a fleur de lis, in compliment to that country. It is ſaid the Chineſe knew the compaſs long before; be this as it may, the Europeans are indebted to Gioia for this invaluable diſcovery. He flouriſhed A. D. 1300.

GIORDANO (Luca). See Jordano.

GIORGIONE, ſo called from his comely aſpect, was an illuſtrious Venetian painter, born in 1478. He received his firſt inſtructions from Giovanni Bellino; but ſtudying afterwards the works of Leonardo da Vinci, he ſoon ſurpaſſed them both, being the firſt among the Lombards who found out the admirable effects of ſtrong lights and ſhadows. Titian became his rival in this art, and was ſo careful in copying the life, that he excelled Giorgione in diſcovering the delicacies of nature, by tempering the boldneſs of his colouring. The moſt valuable piece of Giorgione in oil is that of Chriſt carrying his croſs, now in the church of San Rovo in Venice; where it is held in great veneration. He died young of the plague in 1511.

GIOSEPPINO, an eminent painter, fo called by way of contraction from *Giofeppe d'Arpino*, the town of Naples where he was born, in 1560. Being carried to Rome very young, and employed by painters then at work in the Vatican to grind their colours, he foon made himfelf mafter of the elements of defign, and by degrees grew very famous. His wit and humour gained him the favour of popes and cardinals, who found him bufinefs in plenty. Gregory XIII. alfo fhewed him great refpect, and Louis XIII. of France made him a knight of the order of St. Michael. By the force of a happy genius he acquired a light and agreeable manner of defigning; though it is remarked by De Piles, that he degenerated into a ftyle which neither partook of true nature nor of the antique. His battles in the Capitol are the moft efteemed of all his pieces. He died at Rome in 1640

GIOTTO, an ingenious painter, fculptor, and architect of Florence, born in 1276. He was the difciple of Cimabue, but far fuperior to his mafter in the air of his heads, the attitude of his figures, and in the tone of his colouring; but could not exprefs livelinefs in the eyes, tendernefs in the flefh, or ftrength in the mufcles of his naked figures. He was principally admired for his works in mofaic, the beft of which is over the grand entrance of St. Peter's church at Rome. The obfervation of Alberti on that piece is, that in the fhip of Giotto the expreffion of fright and amazement of the difciples at feeing St. Peter walk upon the water is fo excellent, that each of them exhibits fome characteriftic fign of his terror. His death happened in 1336, and the city of Florence honoured his memory with a ftatue of marble over his tomb.

GIRAFFE, in zoology. See Cervus.

GIRALDI (Lilio Gregorio), an ingenious critic, and one of the moft learned men that modern Italy has produced; was born at Ferrara in 1479. He was at Rome when it was plundered by the emperor Charles V.; and having thus loft all he had, and being tormented by the gout, he ftruggled through life with ill fortune and bad health. He wrote, neverthelefs, 17 performances, which were collected and publifhed at Bafil in 2 vols. folio in 1580, and at Leyden in 1696. Authors of the firft rank have beftowed the higheft eulogies on Giraldus; particularly Cafaubon and Thuanus.

Giraldi (John Baptift Cintio), an Italian poet of the fame family with the foregoing Lilio, was born in 1504. He was fecretary to the Duke of Ferrara, and afterwards became profeffor of rhetoric at Pavia. He died in 1573. His works, which confift chiefly of tragedies, were collected and publifhed at Venice by his fon, Celfo Giraldi, in 1583; and fome fcruple not to rank him among the beft tragic writers Italy has produced.

GIRARDON (Francis), a celebrated French architect and fculptor, born at Troyes in 1627. Louis XIV. being informed of his great talents, fent him to Rome with a penfion of 1000 crowns. On his return into France, he laboured for the royal palaces, and the gardens of Verfailles and Trianon, where there are many of his works executed in bronze and in marble, from the defigns of Charles le Brun. The maufoleum of cardinal de Richelieu in the Sorbonne, and the equeftrian ftatue of Louis XIV. at the Place de Vendome, where the ftatue and horfe are caft in one piece, pafs for his moft excellent performances. Girardon was profeffor, rector, and chancellor, of the Academy of Painting and Sculpture, and had the poft of infpector-general of all the works done in fculpture. He died in 1715.

GIRDERS, in architecture, the largeft pieces of timber in a floor. Their ends are ufually faftened into the fummers, or breftfummers; and the joifts are framed in at one end to the girders. By the ftatute for rebuilding London, no girder is to lie lefs than ten inches into the wall, and their ends to be always laid in loam, &c.

GIRDLE *(Cingulus* or *Zona)*, a belt or band of leather or other matter, tied about the waift to keep that part more firm and tight. It was anciently the cuftom for bankrupts and other infolvent debtors to put off and furrender their girdle in open court. The reafon of this was, that our anceftors ufed to carry all their neceffary utenfils, as purfe, keys, &c. tied to the girdle; whence the girdle became a fymbol of the eftate. Hiftory relates, that the widow of Philip I. duke of Burgundy, renounced her right of fucceffion by putting off her girdle upon the duke's tomb. The Romans always wore a girdle to tuck up the tunica when they had occafion to do any things: this cuftom was fo general, that fuch as went without girdles, and let their gowns hang loofe, were reputed idle, diffolute perfons.

Maidens' or *Virgins'* Girdle. It was the cuftom among the Greeks and Romans for the hufband to untie his bride's girdle. Homer, lib. xi. of his Odyffey, calls the girdle παρθενιην ζωνην, *maid's girdle*. Feftus relates that it was made of fheep's wool, and that the hufband untied it in bed: he adds that it was tied in the Herculanean knot, and that the hufband unloofed it, as a happy prefage of his having as many children as Hercules, who at his death left feventy behind him. The poets attribute to Venus a particular kind of girdle called *ceftus*, to which they annexed a faculty of infpiring the paffion of love.

GIRGASHITES, or Gergesenes, an ancient people of the land of Canaan, whofe habitation was beyond the fea of Tiberias, where we find fome footfteps of their name in the city of *Gergefa*, upon the lake of Tiberias. The Jewifh doctors inform us, that, when Jofhua firft came into the land of Canaan, the Girgafhites took a refolution rather to forfake their country than fubmit to the Hebrews, and accordingly retired into Africa. Neverthelefs, it is certain that a good many of them ftaid behind, fince Jofhua (xxiv. 11.) informs us that he fubdued the Girgafhites; and they whom he overcame were certainly on this fide Jordan.

GIRGENTI, a town of Sicily, which occupies part of the fite of the ancient *Agrigentum*. It has only one ftreet fit for carriages. It is inhabited by 15,000 perfons, but has no remarkable buildings or works of art that deferve mention: the only antiquities to be feen were a Latin infcription of the time of the Antonines, as is pretended, relative to fome affociation between Agrigentum and Lilybæum; and a piece of ancient mafonry in the foundations of a church pretended to be the remains of a temple of Jupiter. At fome diftance, on the old ground in the vale, ftands the cathedral, a clumfy building patched up by barbarous architects with various difcordant parts. This church is enriched with no works of modern painters or fculptors that claim any title to praife; but the baptifmal font is made out of an ancient farcophagus faced with very beautiful baffo-relievo. This fee is the richeft in Sicily, but has the character of being lefs enlightened and polifhed than the reft of the ifland. Among the curiofities belonging to the cathedral is an Etrufcan vafe of rare fize and prefervation. There are alfo fome golden pateras of extreme rarity. The monaftery of San Nicolo ftands on a little eminence in the centre of the old city, admirably fituated. The range of hills towards the fouth-eaft finks gradually, fo as to admit a noble reach of fea and of plain, terminated on each fide by thick groves of fruit-trees. Above appear the remains of ancient grandeur, wonderfully contrafted with the humble ftraw cottages built at their feet. In the orchard of this convent is a fquare building with pilafters, which is fuppofed to have been part of the palace of the Roman prætor.

Girgenti has the convenience of a port; for which, how-

ever, it is leſs indebted to its natural ſituation than to the recent aſſiſtance of art. The harbour is formed by means of a pier carried out in three ſides of an octagon, with a battery at the head; the light-houſe is to be erected on the cliffs on ſhore, as there is no poſſibility of raiſing it high enough on the mole without danger of ſinking. The work is admirable as to ſtrength and neatneſs, but the intention of creating a ſafe and complete haven has not been fully anſwered; the Scirocco commands it entirely, and drives in great quantities of ſand, which it is feared will in time choak up the port; even now ſhips of burden find it difficult to get in, but the Caricatore is conſiderable, and the magazines in the rocks along the ſhore are very ſpacious.

GIRONDE, a department of France, which includes part of the late province of Guienne. It lies on both ſides of the Garonne, and has its name from the part of that river which, below its junction with the Dordogne, is called the Gironde. Bourdeaux is the capital.

St. GIRON, a town of France, in the department of Arriege and late province of Couſerans, ſeated on the river Sarat, three miles S. of St. Liſier. Several fairs are kept here for cattle and mules. E. lon. 1. 16. N. lat. 42. 53.

GIRONNA, an ancient, ſtrong, and conſiderable town of Spain, in Catalonia, with a biſhop's ſee. It is ſeated on a hill on the ſide of the river Onhal, which falls into the Ter, 17 miles from the ſea, and 45 miles N. E. of Barcelona. E. lon. 2. 52. N. lat. 42. 0.

GIRONNE, or GIRONNY, in heraldry, a coat of arms divided into girons, or triangular figures, meeting in the centre of the ſhield, and alternately colour and metal.

GISCO, ſon of Himilco the Carthaginian general, was baniſhed from Carthage by the influence of his enemies. Being afterwards recalled, he was made general in Sicily againſt the Corinthians about 309 years before the Chriſtian era, and by his ſucceſs and intrepidity he obliged the enemies of his country to ſue for peace

GISBOROUGH, a town in the N. riding of Yorkſhire, with a market on Monday. It is four miles from the mouth of the Tees, and is noted for being the firſt place where alum was made, as it was formerly for its abbey. It is 22 miles N. W. by W. of Whitby, and 155 N. by W. of London. W. lon. 0. 55. N. lat. 54. 35.

GITTITH, a Hebrew word occurring frequently in the Pſalms, and generally tranſlated *wine preſſes*. The conjectures of interpreters are various concerning this word. Some think it ſignifies a ſort of muſical inſtrument; others, that the pſalms with this title were ſung after the vintage; laſtly, others, that the hymns of this kind were invented in the city of Gath. Calmet is rather of opinion, that it was given to the claſs of young women or ſongſtreſſes of Gath to be ſung by them; Pſal. viii. 1. lxxxi. 1. lxxxiv. 1. Dr. Hammond thinks that the pſalms with this title were all ſet to the ſame tune, and made on Goliah the Gittite.

GIULA, a ſtrong town of Upper Hungary, on the frontiers of Tranſylvania. It was taken by the Turks in 1566, and retaken by the Imperialiſts in 1695. It is ſeated on the river Kereſblan, 30 miles N. W. of Arad. E. lon. 20. 40. N. lat. 46. 40.

GIUSTANDEL, a large and ſtrong town of Turkey in Europe, in Macedonia, with a Greek archbiſhop's ſee. It is ſeated near the Lake Ochrida, 60 miles S. E. of Durazzo. E. lon. 20. 36. N. lat. 41. 40.

GLACIERS, a name given to ſome very extenſive fields of ice among the Alps. "If any perſon," ſays Mr. Coxe, "could be conveyed to ſuch an elevation as to embrace at one view the Alps of Swiſſerland, Savoy, and Dauphiny, he would behold a vaſt chain of mountains, interſected by numerous valleys, and compoſed of many parallel chains, the higheſt occupying the centre, and the others gradually diminiſhing in proportion to their diſtance from that centre. The moſt elevated or central chain would appear briſtled with pointed rocks, and covered, even in ſummer, with ice and ſnow in all parts that are not abſolutely perpendicular. On each ſide of this chain he would diſcover deep valleys clothed with verdure, peopled with numerous villages, and watered by many rivers. In conſidering theſe objects with greater attention, he would remark that the central chain is compoſed of elevated peaks and diverging ridges, whoſe ſummits are overſpread with ſnow; that the declivities of the peaks and ridges, excepting thoſe parts that are extremely ſteep, are covered with ſnow and ice; and that the intermediate depths and ſpaces between them are filled with immenſe fields of ice, terminating in thoſe cultivated valleys which border the great chain. The branches moſt contiguous to the central chain would preſent the ſame phenomena, only in a leſſer degree. At greater diſtances no ice would be obſerved, and ſcarcely any ſnow, but upon ſome of the moſt elevated ſummits; and the mountains, diminiſhing in height and ruggedneſs, would appear covered with herbage, and gradually ſink into hills and plains. In this general ſurvey the Glaciers may be divided into two ſorts: the firſt occupying the deep valleys ſituated in the boſom of the Alps, and termed by the natives Valley of Ice, but which I ſhall diſtinguiſh by the name of Lower Glaciers; the ſecond, which clothe the ſummits and ſides of the mountains, I ſhall call Upper Glaciers. 1. The Lower Glaciers are by far the moſt conſiderable in extent and depth. Some ſtretch ſeveral leagues in length: that of des Bois, in particular, is more than fifteen miles long, and above three in its greateſt breath. The Lower Glaciers do not, as is generally imagined, communicate with each other, and but few of them are parallel to the central chain: they moſtly ſtretch in a tranſverſe direction, are bordered at the higher extremity by inacceſſible rocks, and on the other extend into the cultivated valleys. The thickneſs of the ice varies in different parts. M. de Sauſſure found its general depth in the glacier des Bois from eighty to a hundred feet, but queſtions not the information of thoſe who aſſert that in ſome places its thickneſs exceeds even ſix hundred feet. Theſe immenſe fields of ice uſually reſt on an inclined plain. Being puſhed forward by the preſſure of their own weight, and but weakly ſupported by the rugged rocks beneath, they are interſected by large tranſverſe chaſms, and preſent the appearance of walls, pyramids, and other fantaſtic ſhapes, obſerved at all heights and in all ſituations wherever the declivity exceeds thirty or forty degrees. But in thoſe parts where the plain on which they reſt is horizontal, or only gently inclined, the ſurface of the ice is nearly uniform; the chaſms are but few and narrow, and the traveller croſſes on foot without much difficulty. The ſurface of the ice is not ſo ſlippery as that of frozen ponds or rivers: it is rough and granulated, and is only dangerous to the paſſenger in ſteep deſcents. It is not tranſparent, is extremely porous and full of ſmall bubbles, which ſeldom exceed the ſize of a pea, and conſequently is not ſo compact as common ice: its perfect reſemblance to the congelation of ſnow impregnated with water, in its opacity, roughneſs, and in the number and ſmallneſs of the air-bubbles, led M. de Sauſſure to conceive the following ſimple and natural theory on the formation of the Glaciers. An immenſe quantity of ſnow is continually accumulating in the elevated valleys which are incloſed within the Alps, as well from that which falls from the clouds during nine months in the year, as from the maſſes which are inceſſantly rolling from the ſteep ſides of the circumjacent mountains. Part of this ſnow which is not diſſolved during ſummer, impregnated with rain and ſnow-water, is frozen during winter, and forms that opaque and porous ice of which

the Lower Glaciers are compofed. 2. The Upper Glaciers may be fubdivided into thofe which cover the fummits, and thofe which extend along the fides of the Alps. Thofe which cover the fummits of the Alps owe their origin to the fnow that falls at all feafons of the year, and which remains nearly in its original ftate, being congealed into a hard fubftance, and not converted into ice. For although, according to the opinion of fome philofophers, the fummit of Mont Blanc and of other elevated mountains is, from the gliftening of the furface, fuppofed to be covered with pure ice, yet it appears, both from theory and experience, that it is not ice but fnow. For in fo elevated and cold a region there cannot be melted a quantity of fnow fufficient to impregnate with water the whole mafs which remains undiffolved. Experience alfo juftifies this reafoning. M. de Sauffure found the top of Mont Blanc only encrufted with ice, which, though of a firm confiftence, was yet penetrable with a ftick; and on the declivities of the fummit he difcovered beneath the furface a foft fnow without coherence. The fubftance which clothes the fides of the Alps is neither pure fnow like that of the fummits, nor ice which forms the Lower Glaciers, but is an affemblage of both. It contains lefs fnow than the fummits, becaufe the fummer heat has more power to diffolve it, and becaufe, the liquefied fnow defcending from above, the mafs is penetrated with a larger quantity of water. It contains more fnow than the Lower Glaciers, becaufe the diffolution of the fnow is comparatively lefs. Hence the ice is even more porous, opaque, and lefs compact than the ice of the Lower Glaciers, and is of fo doubtful a texture as renders it in many parts difficult to decide, whether it may be called ice or frozen fnow. In a word, there is a regular gradation from the fnow on the fummits to the ice of the Lower Glaciers, formed by the intermediate mixture of fnow and ice, which becomes more compact and lefs porous in proportion as it approaches the Lower Glaciers, until it unites and affimilates with them. And it is evident, that the greater or leffer degree of denfity is derived from the greater or leffer quantity of water with which the mafs is impregnated." Concerning thefe Glaciers a queftion has arifen among philofophers; namely, Whether they are in a ftate of increafe or diminution? Referring to Mr. Coxe for a copious difcuffion of this fubject, we fhall only obferve here, that he feems to adopt the opinion of an occafional increafe and diminution of the Glaciers; contrary to that of fome philofophers, who maintain that they continue always the fame, and of others, who affert that they are continually increafing.

GLACIS, in building, an eafy infenfible flope or declivity. The *defcent* of the glacis is lefs fteep than that of the talus. In gardening, a defcent fometimes begins in talus, and ends in glacis. The glacis of the *corniche* is an eafy imperceptible flope in the cymatium, to promote the defcent and draining off the rain-water.

GLACIS, in fortification, denotes that mafs of earth which ferves as a parapet to the covered way, floping eafily towards the field. See FORTIFICATION.

GLADE, in gardening and agriculture, an opening and light paffage made through a wood, by lopping off the branches of trees along that way.

GLADIATORS, in antiquity, perfons who fought, generally in the arena at Rome, for the entertainment of the people. The gladiators were ufually flaves, and fought out of neceffity; though fometimes freemen made profeffion of it, like our prize fighters, for a livelihood. The Romans borrowed this cruel diverfion from the Afiatics: fome fuppofe that there was policy in the practice, the frequent combats of gladiators tending to accuftom the people to defpife dangers and death.

The origin of fuch combats feems to be as follows. From the earlieft times with which we have any acquaintance in profane hiftory, it had been the cuftom to facrifice captives or prifoners of war to the manes of the great men who had died in the engagement: thus Achilles, in the Iliad, lib. xxiii. facrifices twelve young Trojans to the manes of Patroclus; and in Virgil, lib. xi ver. 81. Æneas fends captives to Evander, to be facrificed at the funeral of his fon Pallas. In courfe of time they came alfo to facrifice flaves at the funerals of all perfons of condition: this was even efteemed a neceffary part of the ceremony; but as it would have appeared barbarous to have maffacred them like beafts, they were appointed to fight with each other, and endeavour to fave their own lives by killing their adverfary. This feemed fomewhat lefs inhuman, becaufe there was a poffibility of avoiding death by an exertion of fkill and courage. This occafioned the profeffion of gladiator to become an art: hence arofe mafters of the art, and men learned to fight and exercife it. Thefe mafters, whom the Latins called *laniftæ*, bought them flaves to be trained up to this cruel trade, whom they afterwards fold to fuch as had occafion to prefent the people with fo horrible a fhow. Thefe exhibitions were at firft performed near the fepulchre of the deceafed, or about the funeral pile; but were afterwards removed to the circus and amphitheatres, and became ordinary amufements.

The firft fhow of gladiators, called *munus gladiatorum*, was exhibited at Rome, according to Valerius Maximus, by M. and D. Brutus, on the death of their father, in the year of the city 490. On this occafion there were probably only three pair of gladiators. In 537 the three fons of M. Æmilius Lepidus the augur, who had been three times conful, entertained the people with the cruel pleafure of feeing 22 gladiators fight in the forum. In 547 the firft Africanus diverted his army at New Carthage with a fhow of gladiators, which he exhibited in honour of his father and uncle, who had begun the reduction of Spain. In procefs of time the Romans became fo fond of thefe bloody entertainments, that not only the heir of any great and rich citizen lately deceafed, but all the principal magiftrates, prefented the people with fhows of this nature, to procure their affection. The ædiles, prætors, confuls, and, above all, the candidates for offices, made their court to the people, by entertaining them frequently with thefe fights: and the priefts were fometimes the exhibitors of the barbarous fhows; for we meet with the *ludi pontificales* in Suetonius, Auguft. cap. 44. and with the *ludi facerdotales*, in Pliny, Epift. lib. vii. As for the emperors, it was fo much their intereft to ingratiate themfelves with the populace, that they obliged them with combats of gladiators almoft upon all occafions; and as thefe increafed, the number of combatants increafed likewife. Accordingly Julius Cæfar, in his ædilefhip, diverted the people with 320 couple. Titus exhibited a fhow of gladiators, wild beafts, and reprefentations of fea-fights, which lafted 100 days; and Trajan continued a folemnity of this nature for 123 days; during which time he brought out 1000 pair of gladiators. Before this time, under the republic, the number of gladiators was fo great, that, when the confpiracy of Catiline broke out, the fenate ordered them to be difperfed into the garrifon and fecured, left they fhould have joined the difaffected party. See GLADIATORS' *War*.

Thefe fports were become fo common, and their confequences in a variety of refpects fo dangerous, that Cicero propofed a law that no perfon fhould exhibit a fhow of gladiators within two years before he appeared candidate for any office. Julius Cæfar ordered, that only a certain number of men of this profeffion fhould be in Rome at a time; Auguftus decreed, that only two fhows of gladiators fhould be prefented in a year, and never above fixty couple of combatants in a fhow; and Tiberius provided, by an order of fenate, that no perfon fhould have the privilege of gratifying the people with fuch a folemnity unlefs he was worth 400,000 fefterces. They were alfo confiderably regulated by Nerva. The emperor Claudius reftrained them to certain occafions: but he foon afterwards annulled

the restriction, and private persons began to exhibit them at pleasure as usual; and some carried the brutal satisfaction so far as to have them at their ordinary feasts. And not slaves only, but other persons, would hire themselves to this infamous office.

The master of the gladiators made them all first swear that they would fight to death; and if they failed, they were put to death either by fire, or swords, clubs, whips, &c. It was a crime for the wretches to complain when they were wounded, or to ask for death or seek to avoid it when overcome; but it was usual for the emperor or the people to grant them life when they gave no signs of fear, but waited the fatal stroke with courage and intrepidity: Augustus even decreed that it should always be granted them.

From slaves and freedmen the inhuman sport at length spread to people of rank and condition; so that Augustus was obliged to issue a public edict that none of the senatorian order should become gladiators; and soon after he laid the same restraint on the knights: nevertheless Nero is related to have brought upwards of 400 senators and 600 Roman knights upon the arena; though Lipsius takes both these numbers to be falsified, and, not without reason, reduces them to 40 senators and 60 knights: yet Domitian, that other monster of cruelty, refined upon Nero, exhibiting combats of women in the night-time.

Constantine the Great is said to have first prohibited the combats of gladiators in the East. At least he forbad those who were condemned to death for their crimes to be employed; there being an order still extant to the *præfectus prætorii* rather to send them to work in the mines in lieu thereof: it is dated at Berytus in Phœnicia the 1st of October 325. The emperor Honorius forbad them at Rome on occasion of the death of Telemachus, who, coming out of the East into Rome at the time of one of these spectacles, went down into the arena, and used all his endeavours to prevent the gladiators from continuing the sport; upon which the spectators of that carnage, fired with anger, stoned him to death. It must be observed, however, that the practice was not entirely abolished in the West before Theodoric king of the Ostrogoths. Honorius, on the occasion first mentioned, had prohibited them; but the prohibition does not seem to have been executed. Theodoric in the year 500 abolished them finally.

Some time before the day of combat, the person who presented the people with the shows gave them notice thereof by programmas or bills, containing the names of the gladiators, and the marks whereby they were to be distinguished: for each had his distinctive badge; which was most commonly a peacock's feather, as appears from the scholiast of Juvenal on the 158th verse of the third satire, and Turnebus, Advers. lib. ii. cap. 8. They also gave notice how long the shows would last, and how many couples of gladiators there were; and it even appears, from the 52d verse of the seventh satire of the second book of Horace, that they sometimes made representations of these things in painting, as is practised among us by those who have any thing to show at fairs. The day being come, they began the entertainment by bringing two kinds of weapons; the first were staves of wooden files, called *rudes*; and the second were effective weapons, as swords, poniards, &c. The first were called *arma lusoria*, or *exercitatoria*; the second *decretoria*, as being given by decree or sentence of the prætor, or of him at whose expence the spectacle was exhibited. They began to fence or skirmish with the first, which was to be the prelude to the battle; and from these, when well warmed, they advanced to the second at the sound of trumpets, with which they fought naked. Then they were said *vertere arma*. The terms of striking were *petere & repetere*; of avoiding a blow, *exire*; and when one of the combatants received a remarkable wound, his adversary or the people cried out, *Habet*, or *Hoc habet*. The first part of the engagement was called *ventilare*, *præludere*; and the second, *dimicare ad certum*, or *versis armis pugnare*: and some authors think, with much probability, that it is to these two kinds of combat that St. Paul alludes in the passage 1 Cor. ix. 26, 27. "I fight, not as one that beateth the air; but I keep my body, and bring it into subjection."

If the vanquished surrendered his arms, it was not in the victor's power to grant him life: it was the people during the time of the republic, and the prince or people during the time of the empire, that were alone empowered to grant the boon. The reward of the conqueror was a branch of palm-tree, and a sum of money, probably collected among the spectators: sometimes they gave him his congé, or dismissed him by putting one of the wooden files or *rudis* in his hand; and sometimes they even gave him his freedom, putting the pileus on his head. The sign or indication whereby the spectators showed that they granted the favour was, *premere pollicem*, which M. Dacier takes to be a clenching of the fingers of both hands between one another, and so holding the two thumbs upright close together; and, when they would have the combat finished and the vanquished slain, *verterunt pollicem*, they bent back the thumb; which we learn from Juvenal, Sat. iii. ver. 36. The gladiators challenged or defied each other by showing the little finger; and by extending this or some other during the combat, they owned themselves vanquished, and begged mercy from the people: *Victi ostensam digiti veniam à populo postulabant*, says the old scholiast on Persius.

There were various kinds of gladiators, distinguished by their weapons, manner, and time of fighting, &c. as, the ANDABATÆ. The *catervarii*, who always fought in troops or companies, number against number; or, according to others, who fought promiscuously without any certain order. The *dimachæ*, who fought armed with two poniards or swords, or with sword and dagger. The *essedarii*, who fought in cars. The *fiscales*, or *Cæsariani*, who belonged to the emperor's company; and who, being more robust and dexterous than the rest, were frequently called for, and therefore named also *postulatitii*. Several other kinds are mentioned by ancient authors.

GLADIATORS' *War*, *bellum Gladiatorum* or *Spartacum*, called also the *servile war*, was a war which the Romans sustained about the year of their city 680. Spartacus, Crinus, and Oenomaus, having escaped, with other gladiators to the number of seventy-four, out of the place where they had been kept at Capua, gathered together a body of slaves, put themselves at their head, rendered themselves masters of all Campania, and gained several victories over the Roman prætors. At length they were defeated in the year 682, at the extremity of Italy, having in vain attempted to pass over into Sicily. This war proved very formidable to the Romans. Crassus was not able to finish it: the great Pompey was forced to be sent as general.

The Dying GLADIATOR, a most valuable monument of ancient sculpture, which is now preserved in the palace of Chighi. This man, when he had received the mortal stroke, is particularly careful *ut procumbat honestè*, that he might fall honourably. He is seated in a reclining posture on the ground, and has just strength sufficient to support himself on his right arm: and in his expiring moments it is plainly seen, that he does not abandon himself to grief and dejection, but is solicitous to maintain that firmness of aspect which the gladiators valued themselves on preserving in this season of distress, and that attitude which they had learnt of the masters of defence. He fears not death, nor seems to betray any tokens of fear by his countenance, nor to shed one tear: *quis mediocris gladiator ingemuit, quis vultum mutavit unquam, quis non modo stetit, verum etiam decubuit turpiter*, says Cicero, in that part of his Tusculan where he is describing the astonishing firmness of those persons. We see, in

this inftance, notwithftanding his remaining ftrength, that he has but a moment to live; and we view him with attention, that we may fee him expire and fall: thus the ancients knew how to animate marble, and to give it almoft every expreffion of life.

GLADIOLUS, Corn-flag; a genus of the monogynia order, belonging to the triandria clafs of plants; and in the natural method ranking under the fixth order, *Enfatæ*. The corolla is fexpartite and ringent; the ftamina afcending and bending upwards. There are ten fpecies, of which the moft remarkable is the communis, or common gladiolus. This hath a round, compreffed, tuberous root; long fword-fhaped leaves; an erect flower-ftalk, two or three feet high; the top garnifhed with feveral pretty large flowers of a red or white colour, having each fix petals. They appear in May and June, and are fucceeded by plenty of feed in Auguft. The plants are very hardy, and will thrive in any foil or fituation. They are propagated by offsets from the roots.

GLAMORGANSHIRE, a county of South Wales, bounded on the N. by Carmarthenfhire and Brecknockfhire, on the E. by Monmouthfhire, and on the S. and W. by the Briftol channel. It extends from E. to W. 48 miles, and only 26 from N. to S. It lies in the diocefe of Landaff; is divided into 10 hundreds; contains one city, eight market-towns, and 118 parifhes; and fends one member to parliament for the county, and one for the town of Cardiff. On the N. fide of this county, where it is mountainous, the long continuance of the fnow renders the air fharp; but the country being more level on the S. fide, it is there milder, more populous, and bears very large crops of corn, with very fweet grafs; whence it is called the Garden of Wales. Cattle abound in all parts, there being fruitful valleys among the mountains, that yield very good pafture. Its other commodities are lead, coal, iron, and limeftone. Its principal rivers are the Rumney, which feparates it from Monmouthfhire; the Taafe, Elwy, Neath, and Tawy. Cardiff is the principal town, and Swanfey the moft commercial; but the affizes for the county are always held at Cowbridge.

GLAMOUR, or Glamer, an old term of popular fuperftition in Scotland, denoting a kind of magical mift believed to be raifed by forcerers, and which deluded the fpectator with vifions of things which had no real exiftence, altered the appearance of thofe which really did exift, &c. The eaftern nations have a fimilar fuperftition, as we may learn from the Arabian Nights Entertainments and other works of Oriental fiction.

GLAND, in anatomy. See Anatomy, page 187.

GLANDERS. See Farriery, page 423.

GLANDORE, a town of Ireland, fituated in the county of Cork and province of Munfter. The harbour of that name is fituated two leagues weft of the Galley-head in N. lat 51. 22. W. lon. 8. 56. Between this harbour and Rofs the coaft continues high and bold, with only two fmall coves; that to the eaft called *Millcove*, and that to the weft *Cowcove*. This harbour lies three miles weft of Rofs, and, though fmall, is an exceeding good one; near it is a caftle of the fame name, and on the upper-end is a deep and dangerous glen, called the *Leap*. Glandore gives title of earl to the family of Crofbie.

GLANDORP (Matthias), a learned phyfician, born in 1595 at Cologne, in which town his father was a furgeon. He publifhed at Bremen, *Speculum chirurgorum*, *Methodus medendæ paronychiæ*, *Tractatus de polypo narium affectu graviffimo*, and *Gazophylacium polypufium fontiviffimo*; which four pieces were collected and publifhed, with his life prefixed, at London, in 4to. 1729. Glandorp died young; and it muft fuggeft a high opinion of his abilities, that, notwithftanding the great improvements in all branches of fcience, his works fhould be deemed worthy a re-publication 100 years after his death.

Glandulæ *Renales*. See Anatomy, page 208.

GLANS, in anatomy, the crown or button of the penis, or that part covered with the prepuce, called alfo *balanus*. The term Glans is alfo ufed to denote the tip or extremity of the clitoris, from its refemblance, both in form and ufe, to that of the penis. See Anatomy, p. 208.

GLANVIL (Jofeph), a learned and ingenious, but fanciful and credulous writer in the 17th century, was born at Plymouth in 1636, and bred at Oxford. He became a great admirer of Mr. Baxter, and a zealous perfon for a commonwealth. After the reftoration, he publifhed *The vanity of dogmatizing*; was chofen a fellow of the Royal Society; and, taking orders in 1662, was prefented to the vicarage of Frome-Selwood in Somerfetfhire. This fame year he publifhed his *Lux Orientalis*; in 1665, his *Scepfis Scientifica*; and in the year following, *Some philofophical confiderations touching the being of witches and witchcraft*, and other pieces on the fame fubject. In 1660 he publifhed *Plus ultra*; or, *The progrefs and advancement of knowledge fince the days of Ariftotle*. He likewife publifhed *A feafonable recommendation and defence of reafon*; and *Philofophia Pia*, or *A difcourfe of the religious temper and tendencies of the experimental philofophy*. In 1678 he was made a prebendary of Worcefter, and died in 1680.

GLARUS, one of the 13 cantons in Swifferland, bounded on the E. by the Grifons; on the S. by the fame, the canton of Uri, and that of Schweitz; and on the N. by the river Linth. It is a mountainous country; and their chief trade is in cattle, cheefe, and butter. The government is democratic: every perfon of the age of fixteen has a vote in the Landfgemeind, or General Affembly, which is held annually in an open plain. This affembly ratifies new laws, lays contributions, enters into alliances, declares war, and makes peace. The Landamman is the chief of the republic, and is alternately chofen from among the Proteftants and the Catholics; with this difference, that the former remains three years in office, the latter only two. Both fects live together in the greateft harmony: in feveral parts, they fucceffively perform divine fervice in the fame church; and all the offices of ftate are amicably adminiftered by both. The executive power is in a council of regency, compofed of 48 Proteftants and 15 Catholics; each fect has its particular court of juftice; and it is neceffary, in all lawfuits between perfons of different religions, that the perfon having the cafting voice among the five or nine judges, who are to determine the caufe, fhould be of the fame religion as the defendant. During the prefent and preceding century the Proteftants have confiderably increafed in number; and their induftry, in every branch of commerce, is greatly fuperior; "an evident proof," fays Mr. Cox, "how much the tenets of the Roman Catholic church fetter the genius, and deprefs the powers of exertion." Glarus is entirely furrounded by the Alps, except toward the N. and there is no other entrance but through this opening, which lies between the lake of Wallenftadt and the mountains feparating this canton from that of Schweitz.

Glarus, a large and handfome town of Swifferland, capital of the canton of the fame name. It is feated on the river Linth, 32 miles S. E. of Zurich. E. lon. 9. 1. N. lat. 46. 56.

GLASGOW, a city of Scotland, in the county of Lanerk, which, from its extent, and from the beauty and regularity of its buildings, may be juftly efteemed the fecond city in that kingdom. It is feated on the N. banks of the Clyde, over which it has two bridges; one of them an elegant new one of feven arches, 500 feet long, and 32 feet wide: it was completed in 1772. The ftreets are clean and well paved: and feveral of them interfecting each other at right angles produce a very agreeable effect. The four principal ftreets, thus interfecting each other, divide the city nearly into four equal parts;

and the different views of them from the crofs, or centre of interfection, have an air of great magnificence. Glafgow was once an archiepifcopal fee. The cathedral, or high church, is a magnificent ftructure, and contains three places of worfhip. St. Andrew's is the fineft piece of modern architecture in the city, and was finifhed in 1756, after the model of that of St. Martin's in the Fields in London. The Tron church, with the feffion-houfe at the W. end of it, which had been for fome time paft occupied as a guard-houfe by the town-guard, was entirely deftroyed by a fire that broke out in the latter building on the 15th of February 1793. There are four other churches, befide an Englifh chapel, an Highland church, and many places of worfhip for different denominations. There are feveral charitable eftablifhments; particularly the merchant's hofpital, and that of the town. Here is a celebrated univerfity; the fingle college belonging to which is an elegant and commodious building. A confiderable trade was formerly carried on in Glafgow, in tobacco and rum; but it has been lately on the decline. Their cotton manufactures rival thofe of Manchefter in cheapnefs and elegance; and, before the late univerfal check to that branch of our manufactures in both kingdoms, it is faid that cotton goods were manufactured in Glafgow and its vicinity, to the annual amount of 2,000,000l. fterling. A pottery is likewife carried on here that emulates in beauty and elegance the Staffordfhire ware. The printing types caft here have been long diftinguifhed for their neatnefs and regularity; and the glafs manufactory has been very fuccefsful. The inhabitants of Glafgow and its fuburbs are computed to be about 60,000. It has the advantage of two canals, befide the great canal that joins the Clyde to the Forth; and is 10 miles S. W. of Dumbarton, and 35 W. of Edinburgh. Lon. 4. 2. W. Lat. 55. 52. N.

Port-Glasgow, a town on the S. fide of the Clyde, erected in 1710, in order to ferve as the feaport of the city of Glafgow, whofe magiftrates appoint a bailiff for the government of it. It has an excellent harbour, with a noble pier; but ftill moft of the fhips that trade to the Weft Indies fail from Greenock, and return to that port. The herring fifheries in the frith of Clyde form a confiderable part of its trade. Indeed the excellence of a Glafgow herring has long been proverbial. This port is fituated 21 miles W. by N. of Glafgow.

GLASS, a tranfparent, brittle, factitious body, produced from fand melted in a ftrong fire with fixed alkaline falts, lead, flags, &c. till the whole becomes perfectly clear and fine. The word is formed of the Latin *glaftum*, a plant called by the Greeks *ifatis*, by the Romans *vitrum*, by the ancient Britons *guadum*, and by the Englifh *woad*. We find frequent mention of this plant in ancient writers, particularly Cæfar, Vitruvius, Pliny, &c. who relate, that the ancient Britons painted or dyed their bodies with glaftum, guadum, vitrum, &c. i. e. with the blue colour procured from this plant. And hence, the factitious matter we are fpeaking of came to be called *glafs*, as having always fomewhat of this blueifhnefs in it.

At what time the art of glafs-making was firft invented is altogether uncertain. Some imagine it to have been invented before the flood; but of this we have no direct proof, though there is no improbability in the fuppofition; for we know, that it is almoft impoffible to excite a very violent fire, fuch as is neceffary in metallurgic operations, without vitrifying part of the bricks or ftones wherewith the furnace is built. This indeed might furnifh the firft hints of glafs-making; though it is alfo very probable, that fuch imperfect vitrifications would be obferved a long time before people thought of making any ufe of them.

The Egyptians boaft, that this art was taught them by their great Hermes. Ariftophanes, Ariftotle, Alexander, Aphrodifeus, Lucretius, and St. John the divine, put it out of all doubt that glafs was ufed in their days. Pliny relates, that it was firft difcovered accidentally in Syria, at the mouth of the river Belus, by certain merchants driven thither by a ftorm at fea; who being obliged to continue there, and drefs their victuals by making a fire on the ground, where there was great plenty of the herb kali; that plant, burning to afhes, its falts mixed and incorporated with the fand, or ftones fit for vitrification, and thus produced glafs; and that, this accident being known, the people of Sidon in that neighbourhood effayed the work, and brought glafs into ufe; fince which time the art has been continually improving. Be this as it will, however, the firft glafshoufes mentioned in hiftory were erected in the city of Tyre, and here was the only ftaple of the manufacture for many ages. The fand which lay on the fhore for about half a mile round the mouth of the river Belus was peculiarly adapted to the making of glafs, as being neat and glittering; and the wide range of the Tyrian commerce gave an ample vent for the productions of the furnace.

Mr. Nixon, in his obfervations on a plate of glafs found at Herculaneum, which was deftroyed A. D. 80, on which occafion Pliny loft his life, offers feveral probable conjectures as to the ufes to which fuch plates might be applied. Such plates, he fuppofes, might ferve for *fpecula*, or looking-glaffes; for Pliny, in fpeaking of Sidon, adds, *fiquidem etiam fpecula excogitaverat*: the reflection of images from thefe ancient fpecula being effected by befmearing them behind, or tingeing them through with fome dark colour. Another ufe in which they might be employed was for adorning the walls of their apartments, by way of wainfcot, to which Pliny is fuppofed to refer by his *vitreæ cameræ*, lib. xxxvi. cap. 25. § 64. Mr. Nixon farther conjectures, that thefe glafs plates might be ufed for windows, as well as the lamina of lapis *fpecularis* and *phengites*, which were improvements in luxury mentioned by Seneca, and introduced in his time, Ep. xc. However, there is no pofitive authority relating to the ufing of glafs-windows earlier than the clofe of the third century: *Manifeftius eft* (fays Lactantius), *mentem effe, quæ per oculos ea quæ funt oppofita, tranfpiciat, quafi per feneftras lucente vitro aut fpeculari lapide obductas.*

The firft time we hear of glafs made among the Romans was in the reign of Tiberius, when Pliny relates that an artift had his houfe demolifhed for making glafs malleable, or rather flexible; though Petronius Arbiter and fome others affure us, that the emperor ordered the artift to be beheaded for his invention.

It appears, however, that before the conqueft of Britain by the Romans, glafs-houfes had been erected in this ifland, as well as in Gaul, Spain, and Italy. Hence in many parts of the country are to be found annulets of glafs, having a narrow perforation and thick rim, denominated by the remaining Britons *gleineu naidreedh*, or *glafs adders*, and which were probably in former times ufed as amulets by the druids. See the article Anguinum Ovum. It can fcarcely be queftioned that the Britons were fufficiently well verfed in the manufacture of glafs, to form out of it many more ufeful inftruments than the glafsbeads. Hiftory indeed affures us, that they did manufacture a confiderable quantity of glafs veffels. Thefe, like their annulets, were moft probably green, blue, yellow, or black, and many of them curioufly ftreaked with other colours. The procefs in the manufacture would be nearly the fame with that of the Gauls or Spaniards. The fand of their fhores, being reduced to a fufficient degree of finenefs by art, was mixed with threefourths of its weight of their nitre (much the fame with our kelp), and both were melted together. The metal was then poured into other veffels, where it was left to harden into a mafs, and afterwards replaced in the furnace, where it be-

came tranſparent in the boiling, and was afterwards figured by blowing or modelling in the lathe into ſuch veſſels as they wanted.

It is not probable that the arrival of the Romans would improve the glaſs manufacture among the Britons. The taſte of the Romans at that time was juſt the reverſe of that of the inhabitants of this iſland. The former preferred ſilver and gold to glaſs for the compoſition of their drinking veſſels. They made indeed great improvements in their own at Rome, during the government of Nero. The veſſels then formed of this metal rivalled the bowls of porcelain in their dearneſs, and equalled the cups of cryſtal in their tranſparency. But theſe were by far too coſtly for common uſe; and therefore, in all probability, were never attempted in Britain. The glaſs commonly made uſe of by the Romans was of a quality greatly inferior; and, from the fragments which have been diſcovered at the ſtations or towns of either, appear to have conſiſted of a thick, ſometimes white, but moſtly blue green, metal.

According to venerable Bede, artificers ſkilled in making glaſs for windows were brought over into England in the year 674 by abbot Benedict, who were employed in glazing the church and monaſtery of Weremouth. According to others, they were firſt brought over by Wilfrid, biſhop of Worceſter, about the ſame time. Till this time the art of making ſuch glaſs was unknown in Britain; though glaſs windows did not begin to be common before the year 1180: till this period they were very ſcarce in private houſes, and conſidered as a kind of luxury, and as marks of great magnificence. Italy had them firſt, next France, from whence they came into England.

Venice for many years excelled all Europe in the fineneſs of its glaſſes; and in the thirteenth century the Venetians were the only people that had the ſecret of making cryſtal looking-glaſſes. The great glaſs-works were at Muran, or Murano, a village near the city, which furniſhed all Europe with the fineſt and largeſt glaſſes.

The glaſs manufacture was firſt begun in England in 1557: the finer ſort was made in the place called Crutched Friars, in London; the fine flint glaſs, little inferior to that of Venice, was firſt made in the Savoy-houſe, in the Strand, London. This manufacture appears to have been much improved in 1635, when it was carried on with ſea-coal or pit-coal inſtead of wood, and a monopoly was granted to Sir Robert Manſell, who was allowed to import the fine Venetian flint glaſſes for drinking, the art of making which was not brought to perfection before the reign of William III. But the firſt glaſs plates, for looking glaſſes and coach windows, were made 1673, at Lambeth, by the encouragement of the duke of Buckingham; who in 1670 introduced the manufacture of fine glaſs into England, by means of Venetian artiſts, with amazing ſucceſs. So that within a century paſt, the French and Engliſh have not only come up to, but even ſurpaſſed, the Venetians; and we are now no longer ſupplied from abroad.

The French made a conſiderable improvement in the art of glaſs, by the invention of a method of caſting very large plates, till then unknown, and ſcarce practiſed yet by any but themſelves and the Engliſh. That court applied itſelf with a laudable induſtry to cultivate and improve the glaſs manufacture. A company of glaſs-men was eſtabliſhed by letters patent; and it was provided by an arret, not only that the working in glaſs ſhould not derogate any thing from nobility, but even that none but nobles ſhould be allowed to work in it.

An extenſive manufactory of this elegant and valuable branch of commerce was firſt eſtabliſhed in Lancaſhire, about the year 1773, through the ſpirited exertions of a very reſpectable body of proprietors, who were incorporated by an act of parliament. From thoſe various difficulties conſtantly attendant upon new undertakings, when they have to contend with powerful foreign eſtabliſhments, it has not, however, been conducted with any great degree of ſucceſs.

With regard to the *theory of vitrification*, we are almoſt totally in the dark. In general, it ſeems to be that ſtate in which ſolid bodies are, by the vehement action of fire, fitted for being diſſipated or carried off in vapour. In all vitrifications there is a plentiful evaporation; and if any ſolid ſubſtance is carried off in vapour by the intenſe heat of a burning ſpeculum, a vitrification is always obſerved previouſly to take place. The difference, then, between the ſtate of fuſion and vitrification of a ſolid body we may conceive to be, that in the former the element of fire acts upon the parts of the ſolid in ſuch a manner as only to disjoin them, and render the ſubſtance fluid; but in vitrification the fire not only disjoins the particles, but combines with them in a latent ſtate into a third ſubſtance; which, having now as much fire as it can contain, can receive no further change from that element except being carried off in vapour.

But though we are unable to effect this change upon ſolid bodies without a very violent heat, it is otherwiſe in the natural proceſſes. By what we call *cryſtallization*, nature produces more perfect glaſſes than we can make with our furnaces. Theſe are called *precious ſtones*; but in all trials they diſcover the eſſential properties of glaſs, and not of ſtones. The moſt diſtinguiſhing property of glaſs is its reſiſting the force of fire, ſo that this element cannot calcine or change it as it does other bodies, but can only melt it, and then carry it off in vapours. To this laſt all the precious ſtones are ſubject. The diamond (the hardeſt and moſt ponderous of them all) is diſſipable in a leſs degree of heat than what would diſſipate common glaſs. Nor can it be any objection to this idea, that ſome kinds of glaſs are capable of being converted into a kind of porcelain by a long-continued cementation with certain materials. This change happens only to thoſe kinds of glaſs which are made of alkaline ſalt and ſand; and Dr. Lewis hath ſhown that this change is produced by the diſſipation of the ſaline principle, which is the leaſt fixed of the two. Glaſs, therefore, we may ſtill conſider as a ſubſtance upon which the fire has no other effect than either to melt or diſſipate it in vapour.

The other *properties of glaſs* are very remarkable, ſome of which follow.

1. It is one of the moſt *elaſtic* bodies in nature. If the force with which glaſs balls ſtrike each other be reckoned 16, that wherewith they recede by virtue of their elaſticity will be nearly 15.

2. When glaſs is ſuddenly cooled, it becomes exceedingly *brittle*; and this brittleneſs is ſometimes attended with very ſurpriſing phenomena. Hollow bells made of annealed glaſs, with a ſmall hole in them, will fly to pieces by the heat of the hand only, if the hole by which the internal and external air communicate be ſtopped with a finger. Lately, however, ſome veſſels made of ſuch annealed glaſs have been diſcovered, which have the remarkable property of reſiſting very hard ſtrokes given from without, though they ſhiver to pieces by the ſhocks received from the fall of very light and minute bodies dropped into their cavities. Theſe glaſſes may be made of any ſhape; all that need be obſerved in making them is, that their bottom be thicker than their ſides. The thicker the bottom is, the eaſier do the glaſſes break. One whoſe bottom is three fingers breadth in thickneſs flies with as much eaſe at leaſt as the thinneſt glaſs. Some of theſe veſſels have been tried with ſtrokes of a mallet ſufficient to drive a nail into wood tolerably hard, and have held good without breaking. They have alſo reſiſted the ſhock of ſeveral heavy bodies let fall into their cavities, from the height of two or three feet; as muſket-balls, pieces of iron or other metal, pyrites, jaſper, wood, bone, &c. But this is not ſurpriſing, as other glaſſes of the ſame ſhape and ſize will

do the fame: but the wonder is, that taking a fhiver of flint of the fize of a fmall pea, and letting it fall into the glafs only from the height of three inches, in about two feconds the glafs flies, and fometimes at the very moment of the fhock; nay, a bit of flint no larger than a grain, dropped into feveral glaffes fucceffively, though it did not immediately break them, yet when fet by, they all flew in lefs than three quarters of an hour. Some other bodies produce this effect as well as flint; as fapphire, diamond, porcelain, hard-tempered fteel; alfo marbles fuch as boys play with, and likewife pearls. Thefe experiments were made before the Royal Society, and fucceeded equally when the glaffes were held in the hand, when they were refted on a pillow, put in water, or filled with water. It is alfo remarkable, that the glaffes broke upon having their bottoms flightly rubbed with the finger, though fome of them did not fly till half an hour after the rubbing. If the glaffes are every where extremely thin, they do not break in thefe circumftances.

Some have pretended to account for thefe phenomena, by faying, that the bodies dropped into the veffels caufe a concuffion which is ftronger than the cohefive force of the glafs, and confequently that a rupture muft enfue. But why does not a ball of iron, gold, filver, or copper, which are perhaps a thoufand times heavier than the flint, produce the fame effect? It is becaufe they are not elaftic. But furely iron is more elaftic than the end of one's finger. Mr. Euler has endeavoured to account for thefe appearances from his principles of percuffion. He thinks that this experiment entirely overthrows the opinion of thofe who meafure the force of percuffion by the *vis viva*, or abfolute apparent ftrength of the ftroke. According to his principles, the great hardnefs and angular figure of the flint, which makes the fpace of contact with the glafs extremely fmall, ought to caufe an impreffion on the glafs vaftly greater than lead, or any other metal; and this may account for the flint's breaking the veffel, though the bullet, even falling from a confiderable height, does no damage. Hollow cups made of green bottle-glafs, fome of them three inches thick at the bottom, were inftantly broken by a fhiver of flint, weighing about two grains, though they had refifted the fhock of a mufket-ball from the height of three feet.

That Mr. Euler's theory cannot be conclufive more than the other, muft appear evident from a very flight confideration. It is not by angular bodies alone that the glaffes are broken. The marbles with which children play are round, and yet they have the fame effect with the angular flint. Befides, if it was the mere force of percuffion which broke the glaffes, undoubtedly the fracture would always take place at the very inftant of the ftroke; but we have feen, that this did not happen fometimes till a very confiderable fpace of time had elapfed. It is evident, therefore, that this effect is occafioned by the putting in motion fome fubtile fluid with which the fubftance of the glafs is filled, and that the motions of this fluid, when once excited in a particular part of the glafs, foon propagate themfelves through the whole or greateft part of it, by which means the cohefive power becomes at laft too weak to refift them. There can be little doubt that the fluid juft now mentioned is that of electricity. It is known to exift in glafs in very great quantity; and it alfo is known to be capable of breaking glaffes, even when annealed with the greateft care, if put into too violent a motion. Probably the cooling of glafs haftily may make it more electric than is confiftent with its cohefive power, fo that it is broken by the leaft increafe of motion in the electric fluid by friction or otherwife. This is evidently the cafe when it is broken by rubbing with the finger; but why it fhould alfo break by the mere contact of flint and the other bodies above mentioned, has not yet been fatisfactorily accounted for.

A moft remarkable phenomenon alfo is produced in glafs tubes placed in certain circumftances. When thefe are laid before a fire in an horizontal pofition, having their extremities properly fupported, they acquire a rotatory motion round their axis, and alfo a progreffive motion towards the fire, even when their fupports are declining from the fire, fo that the tubes will move a little way up hill towards the fire. When the progreffive motion of the tubes towards the fire is ftopped by any obftacle, their rotation ftill continues. When the tubes are placed in a nearly upright pofture, leaning to the right hand, the motion will be from eaft to weft; but if they lean to the left hand, their motion will be from weft to eaft; and the nearer they are placed to the perfectly upright pofture, the lefs will the motion be either way. If the tube is placed horizontally on a glafs plane, the fragment, for inftance, of coach window-glafs, inftead of moving towards the fire, it will move from it, and about its axis in a contrary direction to what it had done before; nay, it will recede from the fire, and move a little up hill when the plane inclines towards the fire. Thefe experiments are recorded in the Philofophical Tranfactions. They fucceeded beft with tubes about 20 or 22 inches long, which had in each end a pretty ftrong pin fixed in cork for an axis.

The reafon given for thefe phenomena is the fwelling of the tubes towards the fire by the heat, which is known to expand all bodies. For, fay the adopters of this hypothefis, granting the exiftence of fuch a fwelling, gravity muft pull the tube down when fupported near its extremities; and a frefh part being expofed to the fire, it muft alfo fwell out and fall down, and fo on. But, without going farther in the explanation of this hypothefis, it may be here remarked, that the fundamental principle on which it proceeds is falfe: for though fire indeed makes bodies expand, it does not increafe them in weight; and therefore the fides of the tube, though one of them is expanded by the fire, muft ftill remain *in equilibrio*; and hence we muft conclude, that the caufes of thefe phenomena remain yet to be difcovered.

4. Glafs is lefs *dilatable* by heat than metalline fubftances, and folid glafs fticks are lefs dilatable than tubes. This was firft difcovered by Col. Roy (fee Phil. Tranf. vol. lxvii. p. 663), in making experiments in order to reduce barometers to a greater degree of exactnefs than hath hitherto been found practicable; and fince his experiments were made, one of the tubes 18 inches long, being compared with a folid glafs rod of the fame length, the former was found by a pyrometer to expand four times as much as the other, in a heat approaching to that of boiling oil. On account of the general quality which glafs has of expanding lefs than metal, M. de Luc recommends it to be ufed in pendulums: and he fays it has alfo this good quality, that its expanfions are always equable and proportioned to the degrees of heat; a quality which is not to be found in any other fubftance yet known.

5. Glafs appears to be more fit for the *condenfation of vapours* than metallic fubftances. An open glafs filled with water, in the fummer time, will gather drops of water on the outfide, juft as far as the water in the infide reaches; and a perfon's breath blown on it manifeftly moiftens it. Glafs alfo becomes moift with dew, when metals do not. See Dew.

6. A drinking-glafs partly filled with water, and rubbed on the brim with a wet finger, yields *mufical notes*, higher or lower as the glafs is more or lefs full, and will make the liquor frifk and leap about. See Harmonica.

7. Glafs is poffeffed of extraordinary *electrical* virtues. See Electricity, *paffim*.

Materials for Making Glass. The materials whereof glafs is made, we have already mentioned to be falt and fand or ftones.

1. The falt here ufed is procured from a fort of afhes brought from the Levant, called *polverine*, or *rochetta*; which afhes are thofe of a fort of water-plant called *kali*, cut down in fum-

mer, dried in the ſun, and burnt in heaps, either on the ground or on iron grates; the aſhes, falling into a pit, grow into a hard maſs, or ſtone, fit for uſe. It may alſo be procured from common kelp, or the aſhes of the *fucus veſiculoſus*. See Kelp and Fucus.

To obtain the ſalt, theſe aſhes or polverine are powdered and ſifted, then put into boiling water, and there kept till one third of the water be conſumed; the whole being ſtirred up from time to time, that the aſhes may incorporate with the fluid, and all its ſalts be extracted. then the veſſel is filled up with more water, and boiled over again, till one half be conſumed; what remains is a ſort of ley, ſtrongly impregnated with ſalt. This ley, boiled over again in freſh coppers, thickens in about 24 hours, and ſhoots its ſalt; which is to be ladled out, as it ſhoots, into earthen pans, and thence into wooden vats to drain and dry. This done, it is groſsly pounded, and thus put in a ſort of oven called *calcar* to dry. It may be added, that there are other plants, beſides kali and fucus, which yield a ſalt fit for glaſs: ſuch are the common way-thiſtle, bramble, hops, wormwood, woad, tobacco, fern, and the whole leguminous tribe, as peaſe, beans, &c.

Pearl-aſhes form a leading flux in the manufacture of glaſs, and moſtly ſupply the place of the Levant-aſhes, the barillas of Spain, and many other kinds, which were formerly brought here for making both glaſs and ſoap. See Pearl-*Aſhes*.

There are other fluxes uſed for different kinds of glaſs, and for various purpoſes, as calcined lead, nitre, ſea-ſalt, borax, arſenic, ſmiths' clinkers, and wood-aſhes, containing the earth and lixiviate ſalts as produced by incineration. With regard to theſe ſeveral fluxes, we may obſerve, in general, that the more calx of lead, or other metallic earth, enters into the compoſition of any glaſs, ſo much the more fuſible, ſoft, coloured, and denſe this glaſs is, and reciprocally.

The colours given to glaſs by calces of lead are ſhades of yellow; on the other hand, glaſſes that contain only ſaline fluxes partake of the properties of ſalts, they are leſs heavy, leſs denſe, harder, whiter, more brilliant, and more brittle than the former; and glaſſes containing both ſaline and metallic fluxes do alſo partake of the properties of both theſe ſubſtances. Glaſſes too ſaline are eaſily ſuſceptible of alteration by the action of air and water; eſpecially thoſe in which alkali prevails; and theſe are alſo liable to be injured by acids. Thoſe that contain too much borax and arſenic, though at firſt they appear very beautiful, quickly tarniſh and become opake when expoſed to air. By attending to theſe properties of different fluxes, phlogiſtic or ſaline, the artiſt may know how to adjuſt the proportions of theſe to ſand or powdered flints, for the various kinds of glaſs. See the article Vitrification.

2. The ſand or ſtone called by the artiſts *tarſo* is the ſecond ingredient in glaſs, and that which gives it its body and firmneſs. Theſe ſtones, Agricola obſerves, muſt be ſuch as will fuſe; and of theſe ſuch as are white and tranſparent are beſt; ſo that cryſtal challenges the precedency of all others. At Venice they chiefly uſe a ſort of *pebble*, found in the river Teſino, reſembling white marble, and called *cuogola*. Indeed Ant. Neri aſſures us, that all ſtones which will ſtrike fire with ſteel are fit to vitrify: but Dr. Morret ſhows, that there are ſome exceptions from this rule. Flints are admirable; and when calcined, powdered, and ſearced, make a pure white cryſtalline metal: but the expence of preparing them makes the maſters of our glaſs-houſes ſparing of their uſe. Where proper ſtones cannot be ſo conveniently had, ſand is uſed. The beſt for this purpoſe is that which is white, ſmall, and ſhining; examined by the microſcope, it appears to be ſmall fragments of rock cryſtal. For green glaſs, that which is of a ſoft texture, and more gritty; it is to be well waſhed, which is all the preparation it needs. Our glaſs-houſes are furniſhed with white ſand for their cryſtal glaſſes from Lynn in Norfolk, and Maidſtone in Kent, and with the coarſer for green glaſs from Woolwich.

Some mention a third ingredient in glaſs, viz. *mangaueſe*, a kind of pſeudo-loadſtone, dug up in Germany, Italy, and even in Mendip hills in Somerſetſhire. But the proportion hereof to the reſt is very inconſiderable, beſide that it is not uſed in all glaſs. Its office is to purge off the natural greeniſh colour, and give it ſome other tincture required. For this purpoſe it ſhould be choſen of a deep colour, and free from ſpecks of a metalline appearance, or a lighter caſt; mangaueſe requires to be well calcined in a hot furnace, and then to undergo a thorough levigation. The effect of mangaueſe in deſtroying the colours of glaſs, and hence called the ſoap of glaſs, is accounted for by M. Montamy, in his *Traité des Couleurs pour la Peinture en Email*, in the following manner: The manganeſe deſtroys the green, olive, and blue colours of glaſs, by adding to them a purple tinge, and by the mixture producing a blackiſh brown colour; and as blackneſs is cauſed merely by an abſorption of the rays of light, the blackiſh tinge given to the glaſs by the mixture of colours prevents the reflection of ſo many rays, and thus renders the glaſs leſs coloured than before. But the black produced by this ſubſtance ſuggeſts an obvious reaſon for uſing it very ſparingly in thoſe compoſitions of glaſs which are required to be very tranſparent. Nitre or ſaltpetre is alſo uſed with the ſame intention; for by deſtroying in a certain degree the phlogiſton which gives a ſtrong tinge of yellow to glaſs prepared with lead as a flux, it ſerves to free it from this coloured tinge; and in ſaline glaſſes, nitre is requiſite in a ſmaller proportion to render them ſufficiently tranſparent, as in the caſe of looking-glaſs and other kinds of plates.

The manufactured glaſs now in uſe may be divided into *three general kinds*; white tranſparent glaſs, coloured glaſs, and common green or bottle glaſs. Of the firſt kind there is a great variety; as the flint glaſs, as it is called with us, and the German cryſtal glaſs, which are applied to the ſame uſes; the glaſs for plates for mirrors or looking-glaſſes; the glaſs for windows and other lights; and the glaſs for phials and ſmall veſſels. And theſe again differ in the ſubſtances employed as fluxes in forming them, as well as in the coarſeneſs or fineneſs of ſuch as are uſed for their body. The flint and cryſtal, mirror, and beſt window glaſs, not only require ſuch purity in the fluxes as may render it practicable to free the glaſs perfectly from all colour, but for the ſame reaſon likewiſe, either the white Lynn ſand, calcined flints, or white pebbles, ſhould be uſed. The others do not demand the ſame nicety in the choice of the materials; though the ſecond kind of window glaſs, and the beſt kind of phial, will not be ſo clear as they ought, if either too brown ſand or impure ſalts be ſuffered to enter into their compoſition. Of *coloured* glaſs there is a great variety of ſorts, differing in their hues or other properties according to the occaſions for which they are wanted. The differences in the latter kind depend on the judicious preparation and management of the artiſts by whom they are manufactured, as will be afterwards explained.

Glass-*Furnaces*. In the manufacture of glaſs there are three ſorts of furnaces uſed; one called *calcar* is for the frit; the ſecond is for working the glaſs; the third ſerves to anneal the glaſs, and is called the *leer*. See plate 44. The calcar reſembles an oven ten feet long, ſeven feet broad, and two deep: the fuel, which in Britain is ſea-coal, is put into a trench on one ſide of the furnace; and the flame reverberating from the roof upon the frit calcines it. The glaſs-furnace, or working-furnace, is round, of three yards diameter, and two high; or thus proportioned. It is divided into three parts, each of which is vaulted. The lower part is properly called the *crown*, and is made in that form. Its uſe is to keep a briſk fire, which is never put out. The mouth is called the *bocca*. There are ti-

veral holes in the arch of this crown, through which the flame paſſes into the ſecond vault or partition, and reverberates into the ports filled with the ingredients above mentioned. Round the inſides are eight or more pots placed, and piling pots on them. The number of pots is always double that of the boccas or mouths, or of the number of workmen, that each may have one pot refined to work out of, and another for metal to refine in while he works out of the other. Through the working holes the metal is taken out of the pots, and the pots are put into the furnace; and theſe holes are ſtopped with moveable covers made of lute and brick, to ſcreen the workmen's eyes from the ſcorching flames. On each ſide of the bocca or mouth is a bocarella or little hole, out of which coloured glaſs or finer metal is taken from the piling pot. Above this oven there is the third oven or *leer*, about five or ſix yards long, where the veſſels of glaſs are annealed or cooled: this part conſiſts of a tower, beſides the leer, into which the flame aſcends from the furnace. The tower has two mouths, through which the glaſſes are put in with a fork, and ſet on the floor or bottom: but they are drawn out on iron pans, called *fraches*, through the leer, to cool by degrees; ſo that they are quite cold by the time they reach the mouth of the leer, which enters the ſaroſel or room where the glaſſes are to be ſtowed.

But the green glaſs furnace is ſquare; and at each angle it has an arch for annealing or cooling glaſſes. The metal is wrought on two oppoſite ſides, and on the other two they have their colours, into which are made linnet holes for the fire to come from the furnace to bake the frit, and to diſcharge the ſmoke. Fires are made in the arches to anneal the work, ſo that the whole proceſs is done in one furnace.

Theſe furnaces muſt not be of brick, but of hard ſandy ſtones. In France, they build the outſide of brick; and the inner part, to bear the fire, is made of a ſort of fuller's earth, or tobacco-pipe clay, of which earth they alſo make their melting pots. In Britain the pots are made of Sturbridge clay.

Mr. Blancourt obſerves, that the worſt and rougheſt work in this art is the changing the pots when they are worn out or cracked. In this caſe, the great working hole muſt be uncovered; the faulty pot muſt be taken out with iron hooks and forks, and a new one muſt be ſpeedily put in its place, through the flames, by the hands only. For this work, the man guards himſelf with a garment made of ſkins, in the ſhape of a pantaloon, that covers him all but his eyes, and is made as wet as poſſible: the eyes are defended with a proper ſort of glaſs.

Inſtruments for making of Glass. The inſtruments made uſe of in this work may be reduced to theſe that follow. A blowing-pipe, made of iron, about two feet and a half long, with a wooden handle. An iron rod to take up the glaſs after it is blown, and to cut off the former. Sciſſars to cut the glaſs when it comes off from the firſt hollow iron. Shears to cut and ſhape great glaſſes, &c. An iron-ladle, with the end of the handle caſed with wood, to take the metal out of the refining pot, to put it into the workmen's pots. A ſmall iron-ladle, caſed in the ſame manner, to ſkim the alkalic ſalt that ſwims at top. Shovels, one like a peel, to take up the great glaſſes; another, like a fire-ſhovel, to feed the furnace with coals. A hooked iron fork, to ſtir the matter in the pots. An iron rake for the ſame purpoſe, and to ſtir the frit. An iron fork, to change or pull the pots out of the furnace, &c.

Compoſitions for White and Cryſtal Glass. 1. To make *cryſtal glaſs*, take of the whiteſt tarſo, pounded ſmall, and ſearced as fine as flour, 200 pounds; of the ſalt of polverine 130 pounds; mix them together, and put them into the furnace called the *calcar*, firſt heating it. For an hour keep a moderate fire, and keep ſtirring the materials with a proper rake, that they may incorporate and calcine together; then increaſe the fire for five hours; after which take out the matter; which, being now ſufficiently calcined, is called *frit*. From the calcar put the frit in a dry place, and cover it up from the duſt for three or four months. Now to make the glaſs or cryſtal, take of this cryſtal frit, called alſo *lollito*; ſet it in pots in the furnace, adding to it a due quantity of magneſia or manganeſe: when the two are fuſed, caſt the fluor into fair water, to clear it of the ſalt called *ſandiver*, which would otherwiſe make the cryſtal obſcure and cloudy. This lotion muſt be repeated again and again, as often as needful, till the cryſtal be fully purged; or this ſcum may be taken off by means of proper ladles. Then ſet it to boil four, five, or ſix days; which done, ſee whether it have manganeſe enough; and if it be yet greeniſh, add more manganeſe, at diſcretion, by little and little at a time, taking care not to overdoſe it, becauſe the manganeſe inclines it to a blackiſh hue. Then let the metal clarify, till it becomes of a clear and ſhining colour; which done, it is fit to be blown or formed into veſſels at pleaſure.

2. *Flint glaſs*, as it is called by us, is of the ſame general kind with that which in other places is called cryſtal glaſs. It had this name from being originally made with calcined flints, before the uſe of the white ſand was underſtood, and retains the name, though no flints are now uſed in the compoſition of it. This flint glaſs differs from the other, in having lead for its flux, and white ſand for its body; whereas the fluxes uſed for the cryſtal glaſs are ſalts or arſenic, and the body conſiſts of calcined flints or white river pebbles, tarſo, or ſuch ſtones. To the white ſand and lead a proper proportion of nitre is added, to burn away the phlogiſton of the lead, and alſo a ſmall quantity of magneſia; and in ſome works they uſe a proportional quantity of arſenic to aid the fluxing ingredients. The moſt perfect kind of flint glaſs may be made by fuſing with a very ſtrong fire 120 pounds of the white ſand, 50 pounds of red lead, 40 pounds of the beſt pearl-aſhes, 20 pounds of nitre, and five ounces of magneſia. Another compoſition of flint glaſs, which is ſaid to come nearer to the kind now made, is the following: 120 pounds of ſand, 54 pounds of the beſt pearl-aſhes, 36 pounds of red-lead, 12 pounds of nitre, and 6 ounces of magneſia. To either of theſe a pound or two of arſenic may be added, to increaſe the flux of the compoſition. A cheaper compoſition of flint glaſs may be made with 120 pounds of white ſand, 35 pounds of the beſt pearl-aſhes, 40 pounds of red-lead, 13 pounds of nitre, 6 pounds of arſenic, and 4 ounces of magneſia; or inſtead of the arſenic may be ſubſtituted 15 pounds of common ſalt; but this will be more brittle than the other. The cheapeſt compoſition for the worſt kind of flint glaſs conſiſts of 120 pounds of white ſand, 30 pounds of red lead, 20 pounds of the beſt pearl-aſhes, 10 pounds of nitre, 15 pounds of common ſalt, and 6 pounds of arſenic. The beſt German cryſtal glaſs is made of 120 pounds of calcined flints or white ſand, 70 pounds of the beſt pearl-aſhes, 10 pounds of ſaltpetre, half a pound of arſenic, and five ounces of magneſia. But a cheaper compoſition is formed of 120 pounds of calcined flints or white ſand, 46 pounds of pearl-aſhes, 7 pounds of nitre, 6 pounds of arſenic, and 5 ounces of magneſia.

A glaſs much harder than any prepared in the common way may be made by the help of borax in the following method: Take four ounces of borax, and an ounce of fine ſand; reduce both to a ſubtile powder, and melt them together in a large cloſe crucible ſet in a wind furnace, keeping up a ſtrong fire for half an hour; then take out the crucible, and when cold break it, and there will be found at the bottom a pure hard glaſs capable of cutting common glaſs like a diamond. This experiment, duly varied, ſays Dr. Shaw, may lead to ſeveral uſeful improvements in the making of glaſs, enamels, and factitious gems, and ſhows an expeditious method of making glaſs without any fixed alkali, which has been generally

thought an effential ingredient in glafs; and it is not yet known whether, calcined cryftal or other fubftances being added to this falt inftead of fand, it might not make a glafs approaching to the nature of a diamond.

There are three principal kinds of glaffes, diftinguifhed by the form or manner of working them, viz. I. *Round glafs*, as thofe of our veffels, phials, drinking-glaffes, &c. II. *Table or window glafs*, of which there are various kinds; viz. crown-glafs, jealous-glafs, &c. III. *Plate glafs* or *mirror-glafs*.

I. *Working or blowing Round* GLASS. The working furnace, we have obferved, is round, and has fix boccas or apertures: at one of thefe called the *great bocca*, the furnace is heated, and the pots of frit are at this fet in the furnace; two other fmaller holes, called *bocarellas*, ferve to lade or take out the melted metal, at the end of an iron, to be worked into veffels. At the other holes they put in pots of fufible ingredients, to be prepared and at laft emptied into the lading pot. There are fix pots in each furnace, all made of tobacco-pipe clay, proper to fuftain not only the heat of the fire, but alfo the effect of the polverine, which penetrates every thing elfe. There are only two of thefe pots that work: the reft ferve to prepare the matter for them. The fire of the furnace is made and kept up with dry hard wood, caft in without intermiffion at fix apertures.

When the matter contained in the two pots is fufficiently vitrified, they proceed to blow or fafhion it. For this purpofe the workman dips his blowing-pipe into the melting-pot; and, by turning it about, the metal fticks to the iron more firmly than turpentine. This he repeats four times, at each time rolling the end of his inftrument, with the hot metal thereon, on a piece of plate-iron; over which is a veffel of water which helps to cool, and fo to confolidate and to difpofe that matter to bind more firmly with what is to be taken next out of the melting pot. But after he has dipt a fourth time, and the workman perceives there is metal enough on the pipe, he claps his mouth immediately to the other end of it, and blows gently through the iron tube, till the metal lengthens like a bladder about a foot. Then he rolls it on a marble ftone a little while to polifh it; and blows a fecond time, by which he brings it to the fhape of a globe of about 18 or 20 inches diameter. Every time he blows into the pipe, he removes it quickly to his cheek: otherwife he would be in danger, by often blowing, of drawing the flame into his mouth; and this globe may be flattened by returning it to the fire, and brought into any form by ftamp irons, which are always ready. When the glafs is thus blown, it is cut off at the collet or neck, which is the narrow part that ftuck to the iron. The method of performing this is as follows: The pipe is refted on an iron bar, clofe by the collet; then a drop of cold water being laid on the collet, it will crack about a quarter of an inch, which, with a flight blow or cut of the fhears, will immediately feparate the collet.

After this is done, the operator dips the iron rod into the melting-pot, by which he extracts as much metal as ferves to attract the glafs he has made, to which he now fixes this rod at the bottom of his work, oppofite to the opening made by the breaking of the collet. In this pofition the glafs is carried to the great bocca or mouth of the oven, to be heated and fcalded; by which means it is again put into fuch a foft ftate, that, by the help of an iron inftrument, it can be pierced, opened, and widened, without breaking. But the veffel is not finifhed till it is returned to the great bocca; where being again heated thoroughly, and turned quickly about with a circular motion, it will open to any fize, by means of the heat and motion. If there remain any fuperfluities, they are cut off with the fhears; for, till the glafs is cool, it remains in a foft flexible ftate. It is therefore taken from the bocca, and carried to an earthen bench, covered with brands, which are coals extinguifhed, keeping it turning; becaufe the motion prevents any fettling, and preferves an evennefs in the face of the glafs, where, as it cools, it comes to its confiftency; being firft cleared from the iron rod by a flight ftroke by the hand of the workman. If the veffel conceived in the workman's mind, and whofe body is already made, requires a foot, or a handle, or any other member or decoration, he makes them feparately; and now begins to join them with the help of hot metal, which he takes out of the pots with his iron-rod: but the glafs is not brought to its true hardnefs till it has paffed the leer or annealing oven defcribed above.

II. *Working or blowing of Window or Table* GLASS. The method of working round glafs, or veffels of any fort, is in every particular applicable to the working of window or table glafs, till the blowing iron has been dipt the fourth time. But then, inftead of rounding it, the workman blows, and fo manages the metal upon the iron plate, that it extends two or three feet in the form of a cylinder. This cylinder is put again to the fire, and blown a fecond time, and is thus repeated till it is extended to the dimenfions required, the fide to which the pipe is fixed diminifhing gradually till it ends in a pyramidal form; fo that, to bring both ends nearly to the fame diameter, while the glafs is thus flexible, he adds a little hot metal to the end oppofite the pipe, and draws it out with a pair of iron pincers, and immediately cuts off the fame end with the help of a little cold water, as before.

The cylinder, being now open at one end, is carried back to the bocca; and there, by the help of cold water, it is cut about eight or ten inches from the iron pipe or rod; and the whole length at another place, by which alfo it is cut off from the iron rod. Then it is heated gradually on an earthen table, by which it opens in length; while the workman, with an iron tool, alternately lowers and raifes the two halves of the cylinder; which at laft will open like a fheet of paper, and fall into the fame flat form in which it ferves for ufe. In this it is preferved by heating it over again, cooling it on a table of copper, and hardening it 24 hours in the annealing furnace, to which it is carried upon forks. In this furnace an hundred tables of glafs may lie at a time, without injury to each other, by feparating them into tens, with an iron fhiver between, which diminifhes the weight by dividing it, and keeps the tables flat and even. Of window or table glafs there are various forts, made in different places, for the ufe of building. Thofe moft known among us are given us by the author of the Builder's Dictionary, as follows:

1. *Crown*, of which, fays Neri, there are two kinds, diftinguifhed by the places where they are wrought; viz. Ratcliff crown glafs, which is the beft and cleareft, and was firft made at the Bear-garden, on the Bankfide, Southwark, but fince at Ratcliff: of this there are 24 tables to the cafe, the tables being of a circular form, about three feet fix inches in diameter. The other kind, or Lambeth crown glafs, is of a darker colour than the former, and more inclining to green.

The beft window or crown glafs is made of white fand 60 pounds, of purified pearl-afhes 30 pounds, of faltpetre 15 pounds, of borax one pound, and of arfenic half a pound. If the glafs fhould prove yellow, magnefia muft be added. A cheaper compofition for window glafs confifts of 60 pounds of white fand, 25 pounds of unpurified pearl-afhes, 10 pounds of common falt, 5 pounds of nitre, 2 pounds of arfenic, and one ounce and a half of magnefia. The common or green window glafs is compofed of 60 pounds of white fand, 30 pounds of unpurified pearl-afhes, 10 pounds of common falt, 2 pounds of arfenic, and two ounces of magnefia. But a cheaper compofition for this purpofe confifts of 120 pounds of the cheapeft

white ſand, 30 pounds of unpurified pearl-aſhes, 60 pounds of wood-aſhes, well burnt and ſifted, 20 pounds of common ſalt, and 5 pounds of arſenic.

2. *French glaſs*, called alſo *Normandy glaſs*, and formerly *Lorraine glaſs*, becauſe made in thoſe provinces. At preſent it is made wholly in the nine glaſs works; five whereof are in the foreſt of Lyons, four in the county of Eu; the laſt at Beaumont near Rouen. It is of a thinner kind than our crown glaſs, and when laid on a piece of white paper appears of a dirtyiſh green colour. There are but 25 tables of this to the caſe.

3. *German glaſs* is of two kinds, the *white* and the *green*: the firſt is of a whitiſh colour, but is ſubject to thoſe ſmall curved ſtreaks obſerved in our Newcaſtle glaſs, though free from the ſpots and blemiſhes thereof. The green, beſides its colour, is liable to the ſame ſtreaks as the white; but both of them are ſtraighter and leſs warped than our Newcaſtle glaſs.

4. *Dutch glaſs* is not much unlike our Newcaſtle glaſs either in colour or price. It is frequently much warped like that, and the tables are but ſmall.

5. *Newcaſtle glaſs* is that moſt uſed in England. It is of an aſh-colour, and much ſubject to ſpecks, ſtreaks, and other blemiſhes, and beſides is frequently warped. Leybourn ſays, there are 45 tables to the caſe, each containing five ſuperficial feet: ſome ſay there are but 35 tables, and ſix feet in each table.

6. *Phial glaſs* is a kind betwixt the flint glaſs and the common bottle or green glaſs. The beſt kind may be prepared with 120 pounds of white ſand, 50 pounds of unpurified pearl-aſhes, 10 pounds of common ſalt, 5 pounds of arſenic, and 5 ounces of magneſia. The compoſition for green or common phial glaſs conſiſts of 120 pounds of the cheapeſt white ſand, 80 pounds of wood-aſhes well burnt and ſifted, 20 pounds of pearl-aſhes, 15 pounds of common ſalt, and one pound of arſenic.

The *common bottle* or green is formed of ſand of any kind fluxed by the aſhes of burnt wood, or of any parts of vegetables; to which may be added the *ſcoriæ* or clinkers of forges. When the ſofteſt ſand is uſed, 200 pounds of wood aſhes will ſuffice for 100 pounds of ſand, which are to be ground and mixed together. The compoſition with the clinkers conſiſts of 170 pounds of wood-aſhes, 100 pounds of ſand, and 50 pounds of clinkers or *ſcoriæ*, which are to be ground and mixed together. If the clinkers cannot be ground, they muſt be broken into ſmall pieces, and mixed with the other matter without any grinding.

III. *Working of Plate or Mirror* Glass. 1. The materials of which this glaſs is made are much the ſame with thoſe of other kinds of glaſs, viz. an alkaline ſalt and ſand. The ſalt, however, ſhould not be that extracted from polverine or the aſhes of the Syrian kali, but that from barilla, growing about Alicant in Spain. It is very rare that we can have the barilla pure; the Spaniards in burning the herb make a practice of mixing another herb along with it, which alters its quality; or of adding ſand to it to increaſe the weight, which is eaſily diſcovered if the addition be only made after the boiling of the aſhes, but next to impoſſible if made in the boiling. It is from this adulteration that thoſe threads and other defects in plate-glaſs ariſe. To prepare the ſalt, they clean it well of all foreign matters, pound or grind it with a kind of mill, and finally ſift it pretty fine.

Pearl-aſhes, properly purified, will furniſh the alkaline ſalt requiſite for this purpoſe; but it will be neceſſary to add borax or common ſalt, in order to facilitate the fuſion, and prevent the glaſs from ſtiffening in that degree of heat in which it is to be wrought into plates. For purifying the pearl-aſhes, diſſolve them in four times their weight of boiling water, in a pot of caſt iron, always kept clean from ruſt. Let the ſolution be removed into a clean tub, and remain there 24 hours or longer. Having decanted the clear part of the fluid from the dregs or ſediment, put it again in the iron pot, and evaporate the water till the ſalts are left perfectly dry. Preſerve them in ſtone jars, well ſecured from air and moiſture.

Pearl-aſhes may alſo be purified in the higheſt degree, ſo as to be proper for the manufacture of the moſt tranſparent glaſs, by pulverizing three pounds of the beſt pearl-aſhes with ſix ounces of ſaltpetre in a glaſs or marble mortar, till they are well mixed: and then putting part of the mixture into a large crucible, and expoſing it in a furnace to a ſtrong heat. When this is red hot, throw in the reſt gradually; and, when the whole is red hot, pour it out on a moiſtened ſtone or marble, and put it into an earthen or clean iron pot, with ten pints of water; heat it over the fire till the ſalts be entirely melted; let it then ſtand to cool, and filter it through paper in a pewter cullender. When it is filtered, put the fluid again into the pot, and evaporate the ſalt to dryneſs, which will then be as white as ſnow; the nitre having expelled all the phlogiſtic matter that remained in the pearl-aſhes after their former calcination.

As to the ſand, it is to be ſifted and waſhed till ſuch time as the water come off very clear; and when it is well dried again, they mix it with the ſalt, paſſing the mixture through another ſieve. This done, they lay them in the annealing furnace for about two hours; in which time the matter becomes very light and white: in this ſtate they are called *frit* or *fritta*, and are to be laid up in a dry clean place, to give them time to incorporate: they lie here for at leaſt a year.

When they would employ this frit, they lay it for ſome hours in the furnace, adding to ſome, the fragments or ſhards of old and ill-made glaſſes; taking care firſt to calcine the ſhards by heating them red hot in the furnace, and then caſting them into cold water. To the mixture muſt likewiſe be added manganeſe, to promote the fuſion and purification.

The beſt compoſition for looking-glaſs plates conſiſts of 60 pounds of white ſand cleanſed, 25 pounds of purified pearl-aſhes, 15 pounds of ſaltpetre, and 7 pounds of borax. If a yellow tinge ſhould affect the glaſs, a ſmall proportion of magneſia, mixed with an equal quantity of arſenic, ſhould be added. An ounce of the magneſia may be firſt tried: and, if this proves inſufficient, the quantity ſhould be increaſed.

A cheaper compoſition for looking-glaſs plate conſiſts of 60 pounds of the white ſand, 20 pounds of pearl-aſhes, 10 pounds of common ſalt, 7 pounds of nitre, 2 pounds of arſenic, and 1 pound of borax. The matter of which the glaſſes are made at the famous manufacture of St. Gobin in France is a compoſition of ſolder and of a very white ſand, which are carefully cleaned of all heterogeneous bodies; afterwards waſhed for ſeveral times, and dried ſo as to be pulverized in a mill, conſiſting of many peſtles, which are moved by horſes. When this is done, the ſand is ſifted through ſilk ſieves and dried. The matter thus far prepared is equally fit for plate-glaſs, to be formed either for blowing or by caſting. The largeſt glaſſes at St. Gobin are run; the middle ſized and ſmall ones are blown.

2. *Blowing the plates.* The workhouſes, furnaces, &c. uſed in the making of this kind of plate-glaſs, are the ſame, except that they are ſmaller, and that the carquaiſſes are diſpoſed in a large covered gallery over againſt the furnace, as thoſe in the following article, to which the reader is referred.

After the materials are vitrified by the heat of the fire, and the glaſs is ſufficiently refined, the workman dips in his blowing-iron, ſix feet long, and two inches in diameter, ſharpened at the end which is put in the mouth, and widened at the

other, that the matter may adhere to it. By this means he takes up a ſmall ball of matter, which ſticks to the end of the tube, by conſtantly turning it. He then blows into the tube, that the air may ſwell the annexed ball; and carrying it over a bucket of water, which is placed on a ſupport at the height of about four feet, he ſprinkles the end of the tube to which the matter adheres with water, ſtill turning it, that by this cooling the matter may coaleſce with the tube, and be fit for ſuſtaining a greater weight. He dips the tube again into the ſame pot, and proceeds as before; and dipping it in the pot a third time, he takes it out loaded with matter, in the ſhape of a pear, about ten inches in diameter, and a foot long, and cools it at the bucket; at the ſame time blowing into the tube, and with the aſſiſtance of a labourer, giving it a balancing motion, he cauſes the matter to lengthen; which, by repeating this operation ſeveral times, aſſumes the form of a cylinder, terminating like a ball at the bottom, and in a point at the top. The aſſiſtant is then placed on a ſtool three feet and a half high; and on this ſtool there are two upright pieces of timber, with a croſs beam of the ſame, for ſupporting the glaſs and tube, which are kept in an oblique poſition by the aſſiſtant, that the maſter workman may with a puncheon ſet in a wooden handle, and with a mallet make a hole in the maſs: this hole is drilled at the centre of the ball that terminates the cylinder, and is about an inch in diameter. When the glaſs is pierced, the defects of it are perceived; if it is tolerably perfect, the workman lays the tube horizontally on a little iron treſſel, placed on the ſupport of the aperture of the furnace. Having expoſed it to the heat for about half a quarter of an hour, he takes it away, and with a pair of long and broad ſhears, extremely ſharp at the end, widens the glaſs, by inſinuating the ſhears into the hole made with the puncheon, whilſt the aſſiſtant, mounted on the ſtool, turns it round, till at laſt the opening is ſo large as to make a perfect cylinder at bottom. When this is done, the workman lays his glaſs upon the treſſels at the mouth of the furnace to heat it: he then gives it to his aſſiſtant on the ſtool, and with large ſhears cuts the maſs of matter up to half its height. There is at the mouth of the furnace an iron tool called *pontil*, which is now heating, that it may unite and coaleſce with the glaſs juſt cut, and perform the office which the tube did before it was ſeparated from the glaſs. This pontil is a piece of iron ſix feet long, and in the form of a cane or tube, having at the end of it a ſmall iron-bar, a foot long, laid equally upon the long one, and making with it a T. This little bar is full of the matter of the glaſs, about four inches thick. This red-hot pontil is preſented to the diameter of the glaſs, which coaleſces immediately with the matter round the pontil, ſo as to ſupport the glaſs for the following operation. When this is done, they ſeparate the tube from the glaſs, by ſtriking a few blows with a chiſſel upon the end of the tube which has been cooled; ſo that the glaſs breaks directly, and makes this ſeparation, the tube being diſcharged of the glaſs now adhering to the pontil. They next preſent to the furnace the pontil of the glaſs, laying it on the treſſel to heat, and redden the end of that glaſs, that the workman may open it with his ſhears, as he has already opened one end of it, to complete the cylinder; the aſſiſtant holding it on his ſtool as before. For the laſt time, they put the pontil on the treſſel, that the glaſs may become red-hot, and the workman cuts it quite open with his ſhears, right over-againſt the forementioned cut; this he does as before, taking care that both cuts are in the ſame line. In the mean time, the man who looks after the carquaiſſes comes to receive the glaſs upon an iron-ſhovel, two feet and a half long without the handle, and two feet wide, with a ſmall border of an inch and a half to the right and left, and towards the handle of the ſhovel. Upon this the glaſs is laid, flattening it a little with a ſmall ſtick a foot and a half long, ſo that the cut of the glaſs is turned upwards. They ſeparate the glaſs from the pontil, by ſtriking a few gentle blows between the two with a chiſſel. The glaſs is then removed to the mouth of the hot carquaiſſe, where it becomes red-hot gradually; the workman, with an iron tool ſix feet long, and widened at the end in form of a club at cards four inches long, and two inches wide on each ſide, very flat, and not half an inch thick, gradually lifts up the cut part of the glaſs to unfold it out of its form of a flattened cylinder, and render it ſmooth, by turning it down upon the hearth of the carquaiſſe. The tool already deſcribed, being inſinuated within the cylinder, performs this operation by being puſhed hard againſt all the parts of the glaſs. When the glaſs is thus made quite ſmooth, it is puſhed to the bottom of the carquaiſſe or annealing furnace with a ſmall iron raker, and ranged there with a little iron hook. When the carquaiſſe is full, it is ſtopped and cemented as in the caſe of run glaſſes, and the plates remain there for a fortnight to be annealed; after which time they are taken out to be poliſhed. A workman can make but one glaſs in an hour, and he works and reſts for ſix hours alternately.

Such was the method formerly made uſe of for blowing plate-glaſs, looking-glaſſes, &c.; but the workmen, by this method, could never exceed 50 inches in length, and a proportional breadth, becauſe what were larger were always found to warp, which prevented them from reflecting the objects regularly, and wanted ſubſtance to bear the neceſſary grinding. Theſe imperfections were remedied by the following invention of the Sieur Abraham Thevart, in France, about the year 1688.

3. *Caſting or running of Large Mirror*-GLASS *Plates*. The furnace is of a very large dimenſion (ſee pl. 44.), environed with ſeveral ovens or annealing furnaces called *carquaiſſes*, beſides others for making of frit and calcining old pieces of glaſs. This furnace, before it is fit to run glaſs, coſts 3500l. It ſeldom laſts above three years, and even in that time it muſt be refitted every ſix months. It takes ſix months to rebuild it, and three months to refit it. The melting pots are as big as large hogſheads and contain about 2000lb. weight of metal. If one of them burſts in the furnace, the loſs of the matter and time amounts to 250l. The materials in theſe pots are the ſame as deſcribed before. When the furnace is red-hot, theſe materials are put in at three different times, becauſe that helps the fuſion; and in 24 hours they are vitrified, refined, ſettled, and fit for caſting. A is the bocca, or mouth of the furnace; B is the ciſtern that conveys the liquid glaſs it receives out of the melting-pots in the furnace to the caſting table. Theſe ciſterns are filled in the furnace, and remain therein ſix hours after they are filled; and then are hooked out by the means of a large iron chain guided by a pulley, placed upon a carriage with four wheels marked C, by two men. This carriage has no middle piece; ſo that, when it has brought the ciſtern to the caſting-table D, they ſlip off the bottom of the ciſtern, and out ruſhes a torrent of flaming matter upon the table: this matter is confined to certain dimenſions by the iron rulers EE, which are moveable, retain the fluid matter, and determine the width of the glaſs; while a man, with the roller F reſting on the edge of the iron rulers, reduces it as it cools to an equal thickneſs, which is done in the ſpace of a minute. This table is ſupported on a wooden frame, with truſſles for the convenience of moving to the annealing furnace; into which, ſtrewed with ſand, the new plate is ſhoved, and there will harden in about ten days. What is moſt ſurpriſing throughout the whole of this operation is the quickneſs and addreſs wherewith ſuch maſſy ciſterns, filled with a flaming matter, are taken out of the furnace, conveyed to the table, and poured therein, the glaſs ſpread, &c. The whole is

inconceivable to ſuch as have not been eye-witneſſes of that ſurpriſing manufacture.

As faſt as the ciſterns are emptied, they carry them back to the furnace and take freſh ones, which they empty as before. This they continue to do ſo long as there are any full ciſterns; laying as many plates in each carquaiſſe as it will hold, and ſtopping them up with doors of baked earth, and every chink with cement, as ſoon as they are full, to let them anneal and cool again, which requires about 14 days. The firſt running being diſpatched, they prepare another, by filling the ciſterns anew from the matter in the pots; and after the ſecond, a third; and even a fourth time, till the melting-pots are quite empty.

The ciſterns at each running ſhould remain at leaſt ſix hours in the furnace to whiten; and when the firſt annealing furnace is full, the caſting table is to be carried to another. It need not here be obſerved, that the carquaiſſes, or annealing furnaces, muſt firſt have been heated to the degree proper for them. It may be obſerved, that the oven-full, or the quantity of matter commonly prepared, ſupplies the running of 18 glaſſes, which is performed in 18 hours, being an hour for each glaſs. The workmen work ſix hours, and are then relieved by others. When the pots are emptied, they take them out, as well as the ciſterns, to ſcrape off what glaſs remains, which otherwiſe would grow green by continuance of fire, and ſpoil the glaſſes. They are not filled again in leſs than 36 hours, ſo that they put the matter into the furnace, and begin to run it every 54 hours.

The manner of heating the large furnaces is very ſingular: the two tiſors, or perſons employed for that purpoſe, in their ſhirts, run ſwiftly round the furnace without making the leaſt ſtop: as they run along, they take two billets, or pieces of wood which are cut for the purpoſe; theſe they throw into the firſt tiſart; and, continuing their courſe, do the ſame for the ſecond. This they hold without interruption for ſix hours ſucceſſively, after which they are relieved by others, &c. It is ſurpriſing that two ſuch ſmall pieces of wood, and which are conſumed in an inſtant, ſhould keep the furnace to the proper degree of heat; which is ſuch, that a large bar of iron, laid at one of the mouths of the furnace, becomes red-hot in leſs than half a minute. The glaſs, when taken out of the melting-furnace, needs nothing farther but to be ground, poliſhed, and foliated.

4. *Grinding and Poliſhing of Plate* GLASS. Glaſs is made tranſparent by fire; but it receives its luſtre by the ſkill and labour of the grinder and poliſher, the former of whom takes it rough out of the hands of the maker. In order to grind plate-glaſs, they lay it horizontally upon a flat ſtone table made of a very fine-grained free-ſtone; and, for its greater ſecurity, they plaſter it down with lime or ſtucco; for otherwiſe the force of the workmen, or the motion of the wheel with which they grind it, would move it about. This ſtone table is ſupported by a ſtrong frame A (plate 44.), made of wood, with a ledge quite round its edges, riſing about two inches higher than the glaſs. Upon this glaſs to be ground is laid another rough glaſs not above half ſo big, and ſo looſe as to ſlide upon it; but cemented to a wooden plank, to guard it from the injury it muſt otherwiſe receive from the ſcraping of the wheel to which this plank is faſtened, and from the weights laid upon it to promote the grinding or triture of the glaſſes. The whole is covered with a wheel B, made of hard light wood, about ſix inches in diameter, by pulling of which backwards and forwards alternately, and ſometimes turning it round, the workmen, who always ſtand oppoſite to each other, produce a conſtant attrition between the two glaſſes, and bring them to what degree of ſmoothneſs they pleaſe, by firſt pouring in water and coarſe ſand; after that, a finer ſort of ſand, as the work advances, till at laſt they muſt pour in the powder of ſmalt. As the upper or incumbent glaſs poliſhes and grows ſmoother, it muſt be taken away, and another from time to time put in its place. This engine is called a *mill* by the artiſts, and is uſed only for the largeſt-ſized glaſſes; for, in the grinding of the leſſer glaſſes, they are content to work without a wheel, and to have only four wooden handles faſtened to the four corners of the ſtone which loads the upper plank, by which they work it about.

When the grinder, who finds it very difficult to bring the glaſs to an exact plainneſs, has done his part, it is turned over to the poliſher; who, with the fine powder of tripoli ſtone or emery, brings it to a perfect evenneſs and luſtre. The inſtrument made uſe of in this branch is a board, *c c*, furniſhed with a felt and a ſmall roller, which the workman moves by means of a double handle at both ends. The artiſt, in working this roller, is aſſiſted with a wooden hoop or ſpring, *b*, to the end of which it is fixed; for the ſpring, by conſtantly bringing the roller back to the ſame points, facilitates the action of the workman's arm.

Mr. Burrows invented a curious machine for grinding and poliſhing glaſs, a figure of which we have given in plate 57. Vol. II. The following deſcription is given by the inventor:

A, The ſhaft of the cog-wheel is 9 inches long, and $\frac{3}{4}$ in. diameter; the under ſide turns on a ſteel pivot, and its upper end is an iron gudgeon. B, An horizontal cog-wheel, 1 foot in diameter, with 168 teeth. This wheel gives motion to the ſmall horizontal wheel E, and the vertical wheel V. C, An horizontal collar beam faſtened to the perpendicular ſhaft. This machine is worked by a horſe faſtened to the horizontal collar beam, whoſe radius is $5\frac{1}{2}$ inches. D, Two collar ſtaves mortiſed into the collar beam. E, An horizontal ſpur wheel $1\frac{3}{4}$ in. diameter, with 32 teeth. F, An iron crank, whoſe radius is half an inch; the upper end of this crank is the ſpindle of the ſmall cog-wheel E: its extreme length is $5\frac{7}{8}$ in. thickneſs $\frac{1}{8}$ and $\frac{1}{16}$th of an inch: this crank gives a progreſſive and regreſſive motion to the iron rod K, which traverſes through a jaw in the head of the pillar L. G, A braſs curved arm, 2 in. and $\frac{8}{12}$ths long, with a hole for a centre-pin at its inner end, and a cock on its upper ſurface through which the directing rod K traverſes; and by the oblique motion of the crank T, the point of the curved arm G ſtrikes promiſcuouſly againſt the teeth of the ſtar wheel H, by which means an irregular motion is given to the box N. H, A braſs wheel $1\frac{5}{12}$ in. diameter, with 11 long teeth: this wheel is faſtened to an iron centre-pin, fixed in the middle of the wherrier-box N. The upper part of the centre-pin projects above the ſurface of the wheel, and paſſes looſely through a hole in the directing-rod K, for which purpoſe the rod is made flat at that part where the pin paſſes through. I, A jaw, or notch, in the pillar, to ſuſtain and guide the directing-rod. K, The directing rod, $8\frac{1}{2}$ in. long and $\frac{8}{12}$ths of an inch thick. At the inner end of this rod there is a hole to receive the crank F, and, four inches diſtant from it, there is another hole to receive the ſpindle of the wheel H. L, A braſs pillar whoſe extreme length is three inches and $\frac{3}{8}$ths; thickneſs, $\frac{5}{8}$ths of an inch at its baſe. M, A plate of glaſs properly fitted on its bed to be ground. N, A braſs wherrier-box, $3\frac{1}{2}$ in. long and 3 in. broad: on the apex of its upper ſurface is fixed an iron centre-pin, which paſſes through the ſtar-wheel H, and the middle of the directing-rod K. O, A block of wood, on which the glaſs is truly and properly laid to be ground. P, A ſand-box or bed, $4\frac{1}{2}$ in. by $4\frac{3}{4}$ths and $\frac{1}{2}$ an inch deep. Q, A pedeſtal of wood, whoſe baſe is 3 in. diameter; the height 2 inches. R, R, R, R, Four braſs pillars, each of whoſe extreme length is $8\frac{3}{8}$ in. and their diameter at the baſe $\frac{11}{12}$ths of an inch. Theſe pillars ſuſtain the croſs braces U, U. S, A flat piece of braſs, $8\frac{1}{2}$ in. long, $\frac{5}{8}$ in. broad, and $\frac{1}{4}$ in. thick, which ſupports the vertical wheel V, with its axis or crank. T, A braſs pillar $4\frac{3}{8}$ in. long, and $\frac{5}{8}$ in. in diameter at its baſe. On this pillar is fixed a convex

bed W, with a cap properly prepared either for grinding or polishing concave and convex glasses. U, U, Two cross braces; one of them 2 ft. long, the other 1 foot $3\frac{1}{2}$ in. long, $\frac{5}{8}$ in. broad, $\frac{2}{12}$ in. thick; the spindle of the main shaft A turns in the centre of this brace, and its four arms are fastened to the pillars R, R, R, R. V, A vertical spur-wheel, $3\frac{5}{8}$ in. diameter, with 52 teeth. The axis of this wheel is a compounded crank, which actuates 12 polishing rods. W, A convex rod $1\frac{1}{4}$in. diameter, covered with a concave or spherical cap. On the top of the cap is fixed an iron centre-pin, which passes through the iron-rod Y. X, A crank, whose radius is $\frac{1}{4}$in. This crank gives motion to 12 rods, polishers, &c. as before mentioned. The crank turns in one of the pillars R, the other in a flat piece of brass S, fastened to the floor and to one of the arms of the cross brace U. Y, An iron-rod $7\frac{1}{2}$ in. long and $\frac{2}{12}$ in. thick, with a hole in the middle of it to receive the iron pin in the spherical cap W; one end of this rod connects with the crank which gives motion to the spherical cap; the other end passes through a jaw or notch in a brass pillar (not in this view) in the same manner as the rod I in the pillar R. Z, Z, Two iron-rods, each $4\frac{1}{4}$ in. long, $\frac{2}{12}$ in. thick; the four ends of these rods are fastened to the polishers with screws and nuts; and their other ends to the crank X, whose reciprocal motion works 12 rods, and polishers, more or less according to the size of the glass-plate. *Note*, Two only of these rods are seen in the plate. *a*, *a*, *a*, *a*, Four brass pillars, each of whose extreme length is $4\frac{3}{4}$ in. and $\frac{5}{12}$ in. diameter at the base. These pillars support the bed or table C on which the glass is placed. *b*, *b*, The notched side of the bed $\frac{3}{4}$ in. broad and $\frac{1}{24}$ in. thick. There are 12 notches cut down parallel to each other in the sides of the bed for the direction of the rods Z, Z, &c.—*c*, the bed in which the glass is laid to be polished, its dimensions are $5\frac{1}{8}$ in. long, 4 broad, and $\frac{1}{2}$ in. thick. *d*, *d*, The polishers, clothed and fastened with screws to the crank rod. *e*, A plate of glass.

Colouring of Glass. That the colours given to glass may have their full beauty, it must be observed, that every pot when new and first used leaves a foulness in the glass from its own earthy parts; so that a coloured glass made in a new pot can never be bright or perfectly fine. For this reason the larger of these, when new, may be glazed with white glass; but the second time of using the pots lose this foulness. The glazing may be done by reducing the glass to powder, and moistening the inside of the pot with water; while it is yet moist, put in some of the powdered glass, and shake it about, till the whole inner surface of the pot be covered by as much as will adhere to it, in consequence of the moisture. Throw out the redundant part of the powdered glass; and the pot being dry, set it in a furnace sufficiently hot to vitrify the glass adhering to it, and let it continue there some time; after which, care must be taken to let it cool gradually. Those pots which have served for one colour must not be used for another; for the remainder of the old matter will spoil the colour of the new. The colours must be very carefully calcined to a proper degree; for if they are calcined either too much or too little, they never do well: the proper proportion as to quantity must also be carefully regarded, and the furnaces must be fed with dry hard wood. All these processes succeed much the better if the colour be used dividedly, that is, a part of it in the frit, and the rest in the melted metal.

A hard glass proper for receiving colours may be prepared by pulverizing 12 pounds of the best sand, cleansed by washing in a glass or flint mortar, and mixing seven pounds of pearl-ashes, or any fixed alkaline salt, purified with nitre, one pound of saltpetre, and half a pound of borax, and pounding them together. A glass less hard may be prepared of twelve pounds of white sand cleansed, seven pounds of pearl-ashes purified with salt-petre, one pound of nitre, half a pound of borax, and four ounces of arsenic, prepared as before.

Amethyst colour. See *Purple colour* below, and also the article Amethyst.

Balas colour. Put into a pot crystal frit, thrice washed in water; tinge this with manganese, prepared into a clear purple; to this add *alumen cativum*, sifted fine in small quantities, and at several times: this will make the glass grow yellowish, and a little reddish, but not blackish, and always dissipates the manganese. The last time you add manganese, give no more of the *alumen cativum*, unless the colour be too full. Thus will the glass be exactly of the colour of the balas-ruby. See *Ruby*-Glass.

The common black colour. The glass makers take old broken glass of different colours, grind it to powder, and add to it, by different parcels, a sufficient quantity of a mixture of two parts zaffer and one part manganese: when well purified, they work it into vessels, &c. Glass beads are coloured with manganese only.

Black velvet colour. To give this deep and fine colour to glass, take of crystalline and pulverine frit, of each 20 pounds; of calx of lead and tin four pounds; set all together in a pot in the furnace well heated; when the glass is formed and pure, take steel well calcined and powdered, scales of iron that fly off from the smith's anvil, of each an equal quantity; powder and mix them well; then put six ounces of this powder to the above described metal while in fusion; mix the whole perfectly well, and let them all boil strongly together; then let it stand in fusion 12 hours to purify, and after this work it. It will be a most elegant velvet black. There is another way of doing this which always produces a very fair black. It is this: Take a hundred weight of rochetta frit, add to this two pounds of tartar and six pounds of manganese, both in fine powder; mix them well, and put them to the metal while in fusion, at different times, in several parcels; let it stand in fusion after this for four days, and then work it. A glass perfectly black may also be formed of ten pounds of either of the compositions for hard glass above described, one ounce of zaffer, six drams of manganese, and an equal quantity of iron strongly calcined.

Blue colour. A full blue may be made by adding six drams of zaffer and two drams of manganese to ten pounds of either of the compositions for hard glass described above. For a very cool or pure blue glass, half an ounce of calcined copper may be used instead of the manganese, and the proportion of zaffer diminished by one half. Glass resembling sapphire may be made with ten pounds of either of the compositions for hard glass, three drams and one scruple of zaffer, and one dram of the *calx cassii*, or precipitation of gold by tin; or instead of this latter ingredient two drams and two scruples of manganese. Or a sapphire-coloured glass may be made by mixing with any quantity of the hard glass one eighth of its weight of smalt.

Venetian brown, with gold spangles, commonly called the *philosopher's stone*, may be prepared in the following manner: take of the second composition for hard glass above described, and of the composition for paste, of each five pounds, and of highly calcined iron an ounce; mix them well, and fuse them till the iron be perfectly vitrified, and has tinged the glass of a deep transparent yellow brown colour. Powder this glass, and add to it two pounds of powdered glass of antimony; grind them together, and thus mix them well. Take part of this mixture, and rub into it 80 or 100 leaves of the counterfeit leaf gold called *Dutch gold*; and when the parts of the gold seem sufficiently divided, mix the powder containing it with the other part of the glass. Fuse the whole with a moderate heat till the powder run into a vitreous mass, fit to be wrought into any of the figures or vessels into which it is usually formed;

but avoid a perfect liquefaction, because that in a short time destroys the equal diffusion of the spangles, and vitrifies, at least in part, the matter of which they are composed; converting the whole into a kind of transparent olive-coloured glass. This kind of glass is used for a great variety of toys and ornaments with us, who at present procure it from the Venetians.

Chalcedony. A mixture of several ingredients with the common matter of glass will make it represent the semi opake gems, the jaspers, agates, chalcedonies, &c. The way of making these seems to be the same with the method of making marbled paper, by several colours dissolved in several liquors, which are such as will not readily mix with one another when put into water, before they are cast upon the paper which is to be coloured. There are several ways of making these variously-coloured glasses, but the best is the following:

Dissolve four ounces of fine leaf silver in a glass vessel in strong aquafortis; stop up the vessel, and set it aside. In another vessel dissolve five ounces of quick-silver in a pound of aquafortis, and set this aside. In another glass vessel, dissolve in a pound of aquafortis three ounces of fine silver, first calcined in this manner: amalgamate the silver with mercury, mix the amalgam with twice its weight of common salt well purified, put the mixture in an open fire in a crucible, that the mercury may fly off, and the silver be left in form of powder. Mix this powder with an equal quantity of common salt well purified, and calcine this for six hours in a strong fire; when cold, wash off the salt by repeated boilings in common water, and then put the silver into the aquafortis; set this solution also aside. In another vessel, dissolve in a pound of aquafortis three ounces of sal-ammoniac; pour off the solution, and dissolve in it a quarter of an ounce of gold; set this also aside. In another vessel, dissolve three ounces of sal-ammoniac in a pound of aquafortis; then put into the solution cinnabar, crocus martis, ultramarine, and ferretto of Spain, of each half an ounce; set this also aside. In another vessel, dissolve in a pound of aquafortis three ounces of sal-ammoniac; then put into it crocus martis made with vinegar, calcined tin, zaffer, and cinnabar, of each half an ounce; let each of these be powdered very fine, and put gently into the aquafortis; set this also aside. In another vessel, dissolve three ounces of sal-ammoniac in a pound of aquafortis, and add to it brass calcined with brimstone, brass thrice calcined, manganese, and scales of iron which fall from the smith's anvil, of each half an ounce; let each be well powdered, and put gently into the vessel; then set this also aside. In another vessel, dissolve two ounces of sal-ammoniac in a pound of aquafortis, and put to it verdigrease an ounce, red lead, crude antimony, and the caput mortuum of vitriol, of each half an ounce; put these well powdered leisurely into the vessel, and set this also aside. In another vessel, dissolve two ounces of sal-ammoniac in a pound of aquafortis, and add orpiment, white arsenic, painters' lake, of each half an ounce. Keep the above nine vessels in a moderate heat for 15 days, shaking them well at times. After this pour all their contents from these vessels into one large vessel well luted at its bottom; let this stand six days, shaking it at times; and then set in a very gentle heat, and evaporate all the liquor, and there will remain a power of a purplish green.

When this is to be wrought, put into a pot very clear metal, made of broken crystalline and white glass that has been used; for with the virgin frit, or such as has never been wrought, the chalcedony can never be made, as the colours do not stick to it, but are consumed by the frit. To every pot of 20 pounds of this metal put two or three ounces of this powder at three several times; incorporate the powder well with the glass, and let it remain an hour between each time of putting in the powders. After all are in, let it stand 24 hours; then let the glass be well mixed, and take an assay of it, which will be found of a yellowish blue; return this many times into the furnace; when it begins to grow cold, it will show many waves of different colours very beautifully. Then take tartar, eight ounces; soot of the chimney, two ounces; crocus martis made with brimstone, half an ounce; let these be well powdered and mixed, and put them by degrees into the glass at six times, waiting a little while between each putting in. When the whole is put in, let the glass boil and settle for 24 hours; then make a little glass body of it; which put in the furnace many times, and see if the glass be enough, and whether it have on the outside veins of blue, green, red, yellow, and other colours, and have, beside these veins, waves like those of the chalcedonies, jaspers, and oriental agates, and if the body kept within looks as red as fire.

When it is found to answer thus, it is perfect, and may be worked into toys and vessels, which will always be beautifully variegated: these must be well annealed, which adds much to the beauty of their veins. Masses of this may be polished at the lapidary's wheel as natural stones, and appear very beautiful. If in the working the matter grow transparent, the work must be stopped, and more tartar, soot, and crocus martis must be put to it, which will give it again the necessary body and opacity, without which it does not show the colours well.

Chrysolite colour may be made of ten pounds of either of the compositions for hard glass described above, and six drams of calcined iron.

Red cornelian colour may be formed by adding one pound of glass of antimony, two ounces of the calcined vitriol called *scarlet ochre*, and one dram of manganese or magnesia, to two pounds of either of the compositions for hard glass. The glass of antimony and magnesia are first fused with the other glass, and then powdered and ground with the scarlet ochre: the whole mixture is afterwards fused with a gentle heat till all the ingredients are incorporated. A glass resembling the white cornelian may be made of two pounds of either of the compositions for hard glass, and two drams of yellow ochre well washed, and one ounce of calcined bones: grind them together, and fuse them with a gentle heat.

Emerald colour. See *Green* below.

Garnet colour. To give this colour to glass, the workmen take the following method: They take equal quantities of crystal and rochetta frit, and to every hundred weight of this mixture they add a pound of manganese and an ounce of prepared zaffer: these are to be powdered separately, then mixed and added by degrees to the frit while in the furnace. Great care is to be taken to mix the manganese and zaffer very perfectly; and, when the matter has stood 24 hours infusion, it may be worked. Glass of this kind may be made by adding one pound of glass of antimony, one dram of manganese, and the same quantity of the precipitate of gold by tin, to two pounds of either of the compositions for hard glass; or the precipitate of gold may be omitted, if the quantities of the glass of antimony and manganese be doubled.

Gold colour. This colour may be produced by taking ten pounds of either of the compositions for hard glass, omitting the saltpetre, and for every pound adding an ounce of calcined borax; or, if this quantity does not render the glass sufficiently fusible, two ounces; ten ounces of red tartar of the deepest colour, two ounces of magnesia, and two drams of charcoal of sallow, or any other soft kind. Precipitates of silver baked on glass will stain it yellow, and likewise give a yellow colour on being mixed and melted with 40 or 50 times their weight of vitreous compositions: the precipitate from aquafortis by fixed alkali seems to answer best. Yellow glasses may also be obtained with certain preparations of iron, particularly with Prussian blue. But Dr. Lewis observes that the colour does not con-

ſtantly ſucceed, nor approach to the high colour of gold, with ſilver or with iron. The neareſt imitations of gold which he has been able to produce have been effected with antimony and lead. Equal parts of the glaſs of antimony, of flint calcined and powdered, and of minium, formed a glaſs of a high yellow; and with two parts of glaſs of antimony, two of minium, and three of powdered flint, the colour approached ſtill more to that of gold. The laſt compoſition exhibited a multitude of ſmall ſparkles interſperſed throughout its whole ſubſtance, which gave it a beautiful appearance in the maſs, but were really imperfections owing to air-bubbles.

Neri directs, for a gold yellow colour, one part of red tartar and the ſame of mangancſe, to be mixed with a hundred parts of frit. But Kunckel obſerves that theſe proportions are faulty; that one part, or one and a quarter, of manganeſe is ſufficient for a hundred of frit; but that ſix parts of tartar are hardly enough, unleſs the tartar is of a dark red colour, almoſt blackiſh; and that he found it expedient to add to the tartar about a fourth of its weight of powdered charcoal. He adds that the glaſs ſwells up very much in melting, and that it muſt be left unſtirred, and worked as it ſtands in fuſion. Mr. Samuel More, in repeating and varying this proceſs in order to render the colour more perfect, found that the manganeſe is entirely uneſſential to the gold colour, and that the tartar is no otherwiſe of uſe than in virtue of the coaly matter to which it is in part reduced by the fire, the phlogiſton or inflammable part of the coal appearing in ſeveral experiments to be the direct tingeing ſubſtance. Mr. Pott alſo obſerves that common coals give a yellow colour to glaſs; that different coaly matters differ in their tingeing power; that caput mortuum of ſoot and lampblack anſwer better than common charcoal; and that the ſparkling coal, which remains in the retort after the rectification of the thick empyreumatic animal oils, is one of the moſt active of theſe preparations. This preparation, he ſays, powdered, and then burnt again a little in a cloſe veſſel, is excellent for tingeing glaſs, and gives yellow, brown, reddiſh, or blackiſh colours, according to its quantity; but the frit muſt not be very hard of fuſion, for in this caſe the ſtrong fire will deſtroy the colouring ſubſtance before the glaſs melts: and he has found the following compoſitions to be nearly the beſt, viz. ſand, two parts, alkali, three parts; or ſand, two, alkali, three, calcined borax, one; or ſand, two, alkali, two, calcined borax, one: and though ſaltpetre is hardly uſed at all, or very ſparingly, for yellow glaſſes, as it too much volatilizes the colouring ſubſtance, yet here for the moſt part a certain proportion of it, eaſily determined by trial, is very neceſſary; for without it the concentrated colouring matter is apt to make the glaſs too dark, and even of an opake pitchy blackneſs. It does not certainly appear that there is any material diverſity in the effects of different coals, the difference being probably owing to the different quantities of the inflammable matter which they contain; ſo that a little more ſhall be required of one kind than of another for producing the ſame degree of colour in the glaſs. Nor does the ſoftneſs or fuſibility of the frit appear to be in any reſpect neceſſary.

Gold-coloured ſpangles may be diffuſed through the ſubſtance of glaſs, by mixing the yellow talcs with powdered glaſs, and bringing the mixture into fuſion.

Green. This colour may be imparted to glaſs by adding three ounces of copper, precipitated from aquafortis, and two drams of precipitated iron, to nine pounds of either of the compoſitions for hard glaſs. The fineſt method of giving this beautiful colour to glaſs is this: Take five pounds of cryſtalline metal that has been paſſed ſeveral times through water, and the ſame quantity of the common white metal of polverine, 4 pounds of common polverine frit, and three pounds of red-lead; mix the red-lead well with the frit, and then put all into a pot in a furnace. In a few hours the whole maſs will be well purified: then caſt the whole into water, and ſeparate and take out the lead; then return the metal into the pot, and let it ſtand a day longer in fuſion; then put in the powder of the reſiduum of the vitriol of copper, and a very little crocus martis: there will be produced a moſt lively and elegant green, ſcarce inferior to that of the oriental emerald. There are many ways of giving a green to glaſs, but all are greatly inferior to this. To make a *ſea-green*, the fineſt cryſtalline glaſs only muſt be uſed, and no manganeſe muſt be added at firſt to the metal. The cryſtal frit muſt be melted thus alone; and the ſalt, which ſwims like oil on its top, muſt be taken off with an iron ladle very carefully. Then to a pot of twenty pounds of this metal add ſix ounces of calcined braſs, and a fourth part of the quantity of powdered zaffer: this powder muſt be well mixed, and put into the glaſs at three times; it will make the metal ſwell at firſt, and all muſt be thoroughly mixed in the pot. After it has ſtood in fuſion three hours, take out a little for a proof: if it be too pale, add more of the powder. Twenty-four hours after mixing the powder, the whole will be ready to work, but muſt be well ſtirred together from the bottom, leſt the colour ſhould be deepeſt there, and the metal at the top leſs coloured, or even quite colourleſs. Some uſe for this purpoſe half cryſtal frit and half rochetta frit; but the colour is much the fineſt when all cryſtal frit is uſed.

Lapis lazuli colour. See *Lapis* LAZULI.

Opal colour. See OPAL.

Purple of a deep and bright colour may be produced by adding to ten pounds of either of the compoſitions for hard glaſs above deſcribed, ſix drams of zaffer and one dram of gold precipitated by tin; or to the ſame quantity of either compoſition, one ounce of manganeſe and half an ounce of zaffer. The colour of amethyſt may be imitated in this way.

Red. A blood-red glaſs may be made in the following manner: Put ſix pounds of glaſs of lead and ten pounds of common glaſs into a pot glazed with white glaſs. When the whole is boiled and refined, add, by ſmall quantities and at ſmall diſtances of time, copper calcined to a redneſs as much as on repeated proofs is found ſufficient: then add tartar in powder by ſmall quantities at a time, till the glaſs is become as red as blood, and continue adding one or other of the ingredients till the colour is quite perfect.

Ruby. The way to give the true fine red of the ruby, with a fair tranſparence, to glaſs, is as follows: Calcine in earthen veſſels gold diſſolved in aqua-regia; the menſtruum being evaporated by diſtillation, more aqua-regia added, and the abſtraction repeated five or ſix times till it becomes a red powder. This operation will require many days in a hot furnace. When the powder is of a proper colour, take it out; and, when it is to be uſed, melt the fineſt cryſtal glaſs, and purify it by often caſting it into water; and then add, by ſmall quantities, enough of this red powder to give it the true colour of a ruby, with an elegant and perfect tranſparence.

The proceſs of tingeing glaſs and enamels by preparations of gold was firſt attempted about the beginning of the laſt century. Libavius, in one of his tracts intitled *Alchymia*, printed in 1606, conjectures that the colour of the ruby proceeds from gold, and that gold diſſolved and brought to redneſs might be made to communicate a like colour to factitious gems and glaſs. On this principle Neri, in his Art of Glaſs, dated in 1611, gives the proceſs above recited. Glauber in 1648 publiſhed a method of producing a red colour by gold, in a matter which is of the vitreous kind, though not perfect glaſs. For this purpoſe he ground powdered flint or ſand with four times its weight of fixed alkaline ſalt: this mixture melts in a moderately ſtrong fire, and when cold looks like glaſs, but, expoſed to the air, runs into a liquid ſtate. On adding this liquor

to a solution of gold in aqua-regia, the gold and flint precipitate together in form of a yellow powder, which by calcination becomes purple. By mixing this powder with three or four times its weight of the alkaline solution of flint, drying the mixture and melting it in a strong fire for an hour, a mass is obtained of a transparent ruby colour, and of a vitreous appearance; which nevertheless is soluble in water, or by the moisture of the air, on account of the redundance of the salt. The honourable Mr. Boyle, in a work published in 1680, mentions an experiment in which a like colour was introduced into glass without fusion; for, having kept a mixture of gold and mercury in digestion for some months, the fire was at last immoderately increased, so that the glass burst with a violent explosion; and the lower part of the glass was found tinged throughout of a transparent red colour, hardly to be equalled by that of the ruby.

About the same time, Cassius is said to have discovered the precipitation of gold by tin, and that glass might be tinged of a ruby colour by melting it with this precipitate; though he does not appear, says Dr. Lewis, from his treatise *De Auro*, to have been the discoverer of either. He describes the preparation of the precipitate and its use, but gives no account of the manner of employing it, only that he says one dram of gold duly prepared will tinge ten pounds of glass.

This process was soon after brought to perfection by Kunckel, who says that one part of the precipitate is sufficient to give a ruby colour to 1280 parts of glass, and a sensible redness to upwards of 1900 parts, but that the success is by no means constant. Kunckel also mentions a purple-gold powder, resembling that of Neri; which he obtained by evaporating solution of gold to dryness; abstracting from it fresh aqua-regia three or four times, till the matter appears like oil; then precipitating with strong alkaline ley, and washing the precipitate with water. By dissolving this powder in spirit of salt and precipitating again, it becomes, he says, extremely fair; and in this state he directs it to be mixed with a due proportion of Venice glass.

Orschal, in a treatise intitled *Sol sine Veste*, gives the following process for producing a very fine ruby. He directs the purple precipitate made by tin to be ground with six times its quantity of Venice glass into a very fine powder, and this compound to be very carefully mingled with the frit or vitreous composition to be tinged. His frit consists of equal parts of borax, nitre, and fixed alkaline salt, and four times as much calcined flint as of each of the salts; but he gives no directions as to the proportion of the gold precipitate or mode of fusion. Hellot describes a preparation, which, mixed with Venice glass, was found to give a beautiful purple enamel. This preparation consists of equal parts of solution of gold and of solution of zinc in aqua-regia mixed together, with the addition of a volatile salt prepared from sal-ammoniac by quick-lime, in sufficient quantity to precipitate the two metals. The precipitate is then gradually heated till it acquires a violet colour. However, though a purple or red colour approaching to that of ruby may, by the methods above recited, be baked on glass or enamels, and introduced into the mass by fusion, the way of equally diffusing such a colour through a quantity of fluid glass is still, says Dr. Lewis, a secret. The following process for making the ruby glass was communicated to Dr. Lewis by an artist, who ascribed it to Kunckel. The gold is directed to be dissolved in a mixture of one part of spirit of salt and three of aquafortis, and the tin in a mixture of one part of the former of these acids with two of the latter. The solution of gold being properly diluted with water, the solution of tin is added, and the mixture left to stand till the purple matter has settled to the bottom. The colourless liquor is then poured off, and the purple sediment, while moist and not very thick, is thoroughly mixed with powdered flint or sand. This mixture is well ground with powdered nitre, tartar, borax, and arsenic, and the compound melted with a suitable fire. The proportions of the ingredients are 2560 parts of sand, 384 of nitre, 240 of tartar, 240 of borax, 28 of arsenic, 5 of tin, and 5 of gold.

Topaz colour. Glass resembling this stone may be made by pulverizing ten pounds of either of the compositions for hard glass with an equal quantity of the gold-coloured glass, and fusing them together.

White opake and *semitransparent* glass may be made of ten pounds of either of the compositions for hard glass and one pound of well-calcined horn, ivory, or bone; or an opake whiteness may be given to glass by adding one pound of very white arsenic to ten pounds of flint glass. Let them be well powdered and mixed by grinding them together, and then fused with a moderate heat till they are thoroughly incorporated. A glass of this kind is made in large quantities at a manufactory near London, and used not only for different kinds of vessels, but as a white ground for enamel in dial-plates and snuff-boxes, which do not require finishing with much fire, because it becomes very white and fusible with a moderate heat.

Yellow. See *Gold colour* above.

Painting in GLASS. The ancient manner of painting in glass was very simple: it consisted in the mere arrangement of pieces of glass of different colours in some sort of symmetry, and constituted what is now called *Mosaic work.* See MOSAIC. In process of time they came to attempt more regular designs, and also to represent figures heightened with all their shades: yet they proceeded no farther than the contours of the figures in black with water-colours, and hatching the draperies after the same manner on glasses of the colour of the object they designed to paint. For the carnation they used glass of a bright red colour; and upon this they drew the principal lineaments of the face, &c. with black. At length, the taste for this sort of painting improving considerably, and the art being found applicable to the adorning of churches, palaces, &c. they found out means of incorporating the colours in the glass itself, by heating them in the fire to a proper degree, having first laid on the colours. A French painter at Marseilles is said to have given the first notion of this improvement, upon going to Rome under the pontificate of Julius II.; but Albert Durer and Lucas of Leyden were the first that carried it to any height.

This art, however, has frequently met with much interruption, and sometimes been almost totally lost; of which Mr. Walpole gives the following account in his Anecdotes of Painting in England. "The first interruption given to it was by the reformation, which banished the art out of churches; yet it was in some measure kept up in the escutcheons of the nobility and gentry in the windows of their seats. Towards the end of queen Elizabeth's reign, indeed, it was omitted even there; yet the practice did not entirely cease. The chapel of our Lady at Warwick was ornamented anew by Robert Dudley earl of Leicester and his countess, and the cipher of the glass-painter's name yet remains, with the date 1574; and in some of the chapels at Oxford the art again appears, dating itself in 1622, by the hand of no contemptible master.

"I could supply even this gap of 48 years by many dates on Flemish glass: but nobody ever supposed that the secret was lost so early as the reign of James I.; and that it has not perished since will be evident from the following series, reaching to the present hour.

"The portraits in the windows of the library at All Souls, Oxford. In the chapel at Queen's College there are twelve windows, dated 1518. P. C. a cipher on the painted glass in the chapel at Warwick, 1574. The windows at Wadham-college: the drawing pretty good, and the colours fine, by Bernard Van Linge, 1622. In the chapel at Lincoln's Inn, a window, with the name Bernard, 1623. This was probably the

preceding Van Linge. In the church of St. Leonard, Shoreditch, two windows by Baptista Sutton, 1634. The windows in the chapel at University-college, Hen. Giles *pinxit* 1687. At Christ-church, Isaac Oliver, aged 84, 1700. Window in Merton-chapel, William Price, 1700. Windows at Queen's New-college, and Maudlin, by William Price, the son, now living, whose colours are fine, whose drawing is good, and whose taste in ornaments and Mosaic is far superior to any of his predecessors; is equal to the antique, to the good Italian masters, and only surpassed by his own singular modesty.

"It may not be unwelcome to the curious reader to see some anecdotes of the revival of taste for painted glass in England. Price, as we have said, was the only painter in that style for many years in England. Afterwards one Rowell, a plumber at Reading, did some things, particularly for the late Henry earl of Pembroke; but Rowell's colours soon vanished. At last he found out a very durable and beautiful red; but he died in a year or two, and the secret with him. A man at Birmingham began the same art in 1756 or 1757, and fitted up a window for Lord Lyttelton in the church of Hagley, but soon broke. A little after him, one Peckitt at York began the same business, and has made good proficiency. A few lovers of that art collected some dispersed panes from ancient buildings, particularly the late Lord Cobham, who erected a Gothic temple at Stowe, and filled it with arms of the old nobility, &c. About the year 1753 one Asciotti, an Italian, who had married a Flemish woman, brought a parcel of painted glass from Flanders, and sold it for a few guineas to the honourable Mr. Bateman of Old Windsor. Upon that I sent Asciotti again to Flanders, who brought me 450 pieces, for which, including the expence of his journey, I paid him 36 guineas. His wife made more journeys for the same purpose; and sold her cargoes to one Palmer, a glazier in St. Martin's-lane, who immediately raised the price to one, two, or five guineas for a single piece, and fitted up entire windows with them, and with mosaics of plain glass of different colours. In 1761 Paterson, an auctioneer at Essex-house in the Strand, exhibited the two first auctions of painted glass, imported in like manner from Flanders. All this manufacture consisted in rounds of scripture-stories, stained in black and yellow, or in small figures of black and white; birds and flowers in colours, and Flemish coats of arms."

The colours used in painting or *staining of glass* are very different from those used in painting either in water or oil colours. For black, take scales of iron, one ounce; scales of copper, one ounce; jet, half an ounce: reduce them to powder, and mix them. For blue, take powder of blue, one pound; nitre, half a pound; mix them and grind them well together. For carnation, take red chalk, eight ounces; iron scales, and litharge of silver, of each two ounces; gum arabic, half an ounce; dissolve in water, grind all together for half an hour as stiff as you can; then put it in a glass and stir it well, and let it stand to settle fourteen days. For green, take red lead, one pound; scales of copper, one pound; and flint, five pounds: divide them into three parts, and add to them as much nitre; put them into a crucible, and melt them with a strong fire; and when it is cold powder it, and grind it on a porphyry. For gold colour, take silver, an ounce; antimony, half an ounce: melt them in a crucible; then pound the mass to powder, and grind it on a copper plate; add to it yellow ochre, or brick-dust calcined again, fifteen ounces, and grind them well together with water. For purple, take minium, one pound; brown stone, one pound; white flint, five pounds: divide them into three parts, and add to them as much nitre as one of the parts; calcine, melt, and grind it as you did the green. For red, take jet, four ounces; litharge of silver, two ounces; red chalk, one ounce; powder them fine, and mix them. For white, take jet, two parts; white flint, ground on a glass very fine, one part; mix them. For yellow, take Spanish brown, ten parts; leaf-silver, one part; antimony, half a part; put all into a crucible, and calcine them well.

In the windows of ancient churches, &c. there are to be seen the most beautiful and vivid colours imaginable, which far exceed any of those used by the moderns, not so much because the secret of making those colours is entirely lost, as that the moderns will not go to the charge of them, nor be at the necessary pains, by reason that this sort of painting is not now so much in esteem as formerly. Those beautiful works, which were made in the glass-houses, were of two kinds.

In some, the colour was diffused through the whole substance of the glass. In others, which were far the most common, the colour was only on one side, scarce penetrating within the substance above one-third of a line; though this was more or less according to the nature of the colour, the yellow being always found to enter the deepest. These last, though not so strong and beautiful as the former, were of more advantage to the workmen, by reason that on the same glass, though already coloured, they could show other kinds of colours where there was occasion to embroider draperies, enrich them with foliages, or represent other ornaments of gold, silver, &c.

In order to this, they made use of emery, grinding or wearing down the surface of the glass till such time as they were got through the colour to the clear glass. This done, they applied the proper colours on the other side of the glass. By these means, the new colours were hindered from running and mixing with the former, when they exposed the glasses to the fire, as will appear hereafter. When indeed the ornaments were to appear white, the glass was only bared of its colour with emery, without tingeing the place with any colour at all; and this was the manner by which they wrought their lights and heightenings on all kinds of colour.

The first thing to be done, in order to paint or stain glass in the modern way, is to design, and even colour the whole subject on paper. Then they choose such pieces of glass as are clear, even, and smooth, and proper to receive the several parts; and proceed to distribute the design itself, or the paper it is drawn on, into pieces suitable to those of the glass, always taking care that the glasses may join in the contours of the figures and the folds of the draperies; that the carnations and other finer parts may not be impaired by the lead with which the pieces are to be joined together. The distribution being made, they mark all the glasses as well as papers, that they may be known again: which done, applying every part of the design upon the glass intended for it, they copy or transfer the design upon this glass with the black colour diluted in gum-water, by tracing and following all the lines and strokes as they appear through the glass with the point of a pencil.

When these strokes are well dried, which will happen in about two days, the work being only in black and white, they give it a slight wash over with urine, gum arabic, and a little black; and repeat it several times, according as the shades are desired to be heightened; with this precaution, never to apply a new wash till the former is sufficiently dried. This done, the lights and risings are given by rubbing off the colour in the respective places with a wooden point, or the handle of the pencil.

As to the other colours above mentioned, they are used with gum-water, much as in painting in miniature; taking care to apply them lightly, for fear of effacing the outlines of the design; or even, for the greater security, to apply them on the other side; especially yellow, which is very pernicious to the other colours, by blending therewith. And here too, as in pieces of black and white, particular regard must always be had not to lay colour on colour, or put on a new lay, till such time as the former is well dried.

It may be added, that the yellow is the only colour that penetrates through the glaſs, and incorporates therewith by the fire; the reſt, and particularly the blue, which is very difficult to uſe, remaining on the ſurface, or at leaſt entering very little. When the painting of all the pieces is finiſhed, they are carried to the furnace or oven to anneal or bake the colours.

The furnace here uſed is ſmall, built of brick from 18 to 30 inches ſquare. At ſix inches from the bottom is an aperture to put in the fuel and maintain the fire. Over this aperture is a grate made of three ſquare bars of iron, which traverſe the furnace, and divide it into two parts. Two inches above this partition is another little aperture, through which they take out pieces to examine how the baking goes forward. On the grate is placed a ſquare earthen pan, ſix or ſeven inches deep, and five or ſix inches leſs every way than the perimeter of the furnace. On the one ſide hereof is a little aperture through which to make trials, placed directly oppoſite to that of the furnaces deſtined for the ſame end. In this pan are the pieces of glaſs to be placed in the following manner: Firſt, the bottom of the pan is covered with three ſtrata or layers of quicklime pulverized; thoſe ſtrata being ſeparated by two others of old broken glaſs, the deſign whereof is to ſecure the painted glaſs from the too intenſe heat of the fire. This done, the glaſſes are laid horizontally on the laſt or uppermoſt layer of lime.

The firſt row of glaſs they cover over with a layer of the ſame powder an inch deep; and over this they lay another range of glaſſes, and thus alternately till the pan is quite full; taking care that the whole heap always end with a layer of the lime-powder.

The pan being thus prepared, they cover up the furnace with tiles, on a ſquare table of earthen ware, cloſely luted all round; only leaving five little apertures, one at each corner and another in the middle, to ſerve as chimneys. Things thus diſpoſed, there remains nothing but to apply fire to the work. The fire for the firſt two hours muſt be very moderate, and muſt be increaſed in proportion as the coction advances, for the ſpace of ten or twelve hours; in which time it is uſually completed. At laſt the fire, which at firſt was charcoal, is to be of dry wood, ſo that the flame covers the whole pan, and even iſſues out at the chimneys. During the laſt hours, they make eſſays, from time to time, by taking out pieces laid for the purpoſe through the little aperture of the furnace and pan, to ſee whether the yellow be perfect, and the other colours in good order. When the annealing is thought ſufficient, they proceed with great haſte to extinguiſh the fire, which otherwiſe would ſoon burn the colours and break the glaſſes.

Glass-*Balls*, which are globular or otherwiſe ſhaped hollow veſſels of glaſs, may be coloured within, ſo as to imitate the ſemipellucid gems. The method of doing it is this: Make a ſtrong ſolution of ichthyocolla, or iſinglaſs, in common water, by heat; pour a quantity of this while warm into the hollow of a white glaſs veſſel; ſhake it thoroughly about, that all the ſides may be wetted, and then pour off the reſt of the moiſture. Immediately after this, throw in red lead, ſhake it and turn it about, throw it into many places with a tube, and the moiſture will make it ſtick and run in waves and pretty figures. Then throw in ſome of the painter's blue ſmalt, and make it run in waves in the ball as the red-lead; then do the ſame with verdegris, next with orpiment, then with red lake, all well ground; always caſting in the colours in different places, and turning the glaſs, that the moiſture within may run them into the waves. Then take fine plaſter of Paris, and put a quantity of it into the ball; ſhake it alſo nimbly about; this will every where ſtick firmly to the glaſs, and give it a ſtrong inner coat, keeping all the colours on very fairly and ſtrongly. Theſe are ſet on frames of carved wood, and much eſteemed as ornaments in many places.

Glass-*Drops*. See Rupert's *drops*.

Engraving on Glass. See Chemistry, page 425.

Foliating of Glass. See Foliating *and* Looking-*glaſs*.

Gilding of Glass. See Gilding.

Impreſſions of antique Gems taken in Glass. See Gems.

Glass *of Lead*, a glaſs made with the addition of a large quantity of lead, of great uſe in the art of making counterfeit gems. The method of making it is this: Put a large quantity of lead into a potter's kiln, and keep it in a ſtate of fuſion with a moderate fire till it is calcined to a grey looſe powder; then ſpread it in the kiln, and give it a greater heat, continually ſtirring it to keep it from running into lumps; continue this ſeveral hours, till the powder become of a fair yellow; then take it out, and ſift it fine: this is called *calcined-lead*. Take of this calcined lead 15 pounds, and cryſtalline or other frit 12 pounds; mix theſe as well as poſſible together; put them into a pot, and ſet them in the furnace for ten hours; then caſt the whole, which will be now perfectly melted, into water; ſeparate the looſe lead from it, and return the metal into the pot; and, after ſtanding in fuſion 12 hours more, it will be fit to work. It is very tender and brittle, and muſt be worked with great care, taking it ſlowly out of the pot, and continually wetting the marble it is wrought upon.

It is well known that ceruſs or white lead, minium, litharge, and all the other preparations and calces of lead, are eaſily fuſed by a moderate fire, and formed into a tranſparent glaſs of a deep yellow colour. But this glaſs is ſo penetrating and powerful a flux, that it is neceſſary to give it a greater conſiſtence, in order to render it fit for uſe. With this view, two parts of calx of lead, e. g. minium, and one part of ſand or powdered flints, may be put into a crucible of refractory clay, and baked into a compact body. Let this crucible, well cloſed with a luted lid, be placed in a melting furnace, and gradually heated for an hour or an hour and a half; and afterwards let the heat be increaſed ſo as to obtain a complete fuſion, and continued in that ſtate for the ſame time: let the crucible remain to cool in the furnace: and when it is broken, a very tranſparent yellow-coloured glaſs will be found in it. Some add nitre and common ſalt to the above mixture, becauſe the ſalts promote the fuſion and the more equal diſtribution of the ſand. This glaſs of lead has a conſiderable ſpecific gravity, and its loweſt part is always the heavieſt. It is an important flux in the aſſaying of ores to facilitate their ſcorifications.

Glaſs of lead is capable of all the colours of the gems in very great perfection. The methods of giving them are theſe: for green, take polverine frit 20 pounds, lead calcined 16 pounds; ſift both the powders very fine; then melt them into a glaſs, ſeparating the unmixed lead, by plunging the maſs in water; after this return it into the pot, and add braſs thrice calcined ſix ounces, and one penny-weight of crocus martis made with vinegar; put this in at ſix different times, always carefully mixing it together; let it finally ſettle an hour, then mix it together, and take a proof of it; when the colour is right, let it ſtand eight hours, and then work it. If inſtead of the calcined braſs the ſame quantity of the caput mortuum of the vitriolum veneris be uſed, the green is yet much finer.

For topaz-colour, take cryſtal frit 15 pounds, calcined lead 12 pounds; mix them well together, by ſifting the powders through a fine ſieve; then ſet them in a furnace not too hot, and ſeparate the ſuperfluous unmixed lead, by caſting the whole into water; repeat this twice: then add half gold-yellow glaſs, and let them incorporate and purify, and they will be of the true and exact colour of the oriental topaz.

For ſea-green, take cryſtal frit 16 pounds, calcined lead 10 pounds; mix and ſift them together, and ſet them in a pot in a furnace; in 12 hours the whole will be melted; then caſt it into water, and ſeparate it from the looſe lead; put them

into the furnace again for eight hours; then separate the loose lead by washing a second time, and return it to the pot for eight hours more.

Muscovy Glass. See Mica.

Painting on Glass by means of Prints. See Back-*painting*.

Glass-*Porcelain*, the name given by many to a modern method of imitating the china-ware with glass. The method given by Mr. Reaumur, who was the first that carried the attempt to any degree of perfection, is shortly this: The glass-vessels to be converted into porcelain are to be put into a large earthen vessel, such as the common fine earthen dishes are baked in, or into sufficiently large crucibles; the vessels are to be filled with a mixture of fine white sand, and of fine gypsum or plaster-stone burnt into what is called plaster of Paris, and all the interstices are to be filled up with the same powder, so that the glass vessels may no where touch either one another, or the sides of the vessel they are baked in. The vessel is to be then covered down and luted, and the fire does the rest of the work; for this is only to be put into a common potter's furnace; and when it has stood there the usual time of baking the other vessels, it is to be taken out, and the whole contents will be found no longer glass, but converted into a white opake substance, which is a very elegant porcelain, and has almost all the properties of that of China.

The powder which has served once will do again as well as fresh, and that for a great many times: nay, it seems, ever so often. The cause of this transformation, says Macquer, is probably that the vitriolic acid of the gypsum quits its basis of calcareous earth, and unites with the alkaline salt and saline earth of the glass, with which it forms a kind of salt or selenites, different from the calcareous selenites, by the interposition of which matter the glass acquires the qualities of porcelain.

Glass-*Pots*, the vessels in the glass-houses used for melting the glass. Those for the white glass works are made of a tobacco-pipe clay, brought from the Isle of Wight, which is first well washed, then calcined, and afterwards ground to a fine powder in a mill. This being mixed with water, is then trod with the bare feet till it is of a proper consistence to mould with the hands into the proper shape of the vessels. When these are thus made, they are afterwards annealed over the furnace. Those for the green glass work are made of the nonsuch, and another sort of clay from Staffordshire; they make these so large as to hold three or four hundred weight of metal. And, besides these, they have a small sort called piling-pots, which they set upon the larger, and which contain a finer and more nice metal fit for the nicest works.

The clay that is used for this purpose should be of the purest and most refractory kind, and well cleansed from all sandy, ferruginous, and pyritous matters; and to this it will be proper to add ground crucibles, white sand, calcined flints well levigated, or a certain proportion of the same clay baked, and pounded not very finely. The quantity of baked clay that ought to be mixed with the crude clay, to prevent the pots from cracking when dried, or exposed to a great heat, is not absolutely determined, but depends on the quality of the crude clay, which is more or less fat. M. D'Antic, in a memoir on this subject, proposes the following method of ascertaining it: the burnt and crude clay, being mixed in different proportions, should be formed into cakes, one inch thick, and four inches long and wide. Let these cakes be slowly dried, and exposed to a violent heat, till they become as hard and as much contracted as possible, and in that state be examined; and the cake, he says, which has suffered a diminution of its bulk equal only to an eighteenth part, is made of the best proportions. He observes, in general, that most clays require that the proportion of the burnt should be to the fresh as four to five.

Salt of Glass, a substance apparently analogous to what is called *Sandiver* or *Glass-gall*. M. Fongeroux, in the Memoirs of the Academy of Sciences at Paris, asserts that an explosion as loud as a cannon is produced whenever this substance in a heated state is brought into contact with water.

"The following circumstance (says he) is what occasions the explosion I have mentioned. When the ashes of sea-wrack (which contain a great quantity of sea-salt, and which are used in certain glass-houses as a flux,) are mixed with sand, this mixture is exposed to the heat of the furnace, where it is changed into glass; after the fusion is completed, the *salt of glass* separates from the vitrified substance, and rises to the top of the metal, upon the surface of which it swims. Formerly it was the custom to leave this salt exposed to the heat of the furnace a sufficient time for it to be sublimed; and under the salt was found glass free from specks, and in a proper state to be worked, either flat or in cylinders, &c. But since the last forty or fifty years, or thereabouts, it has been found that leaving the salt to evaporate causes an unnecessary waste of fuel, and that it is even advantageous to take it away as soon as it separates itself from the glass, and swims on the top of it. The taking this *salt of glass* from the metal is a very hazardous operation in glass-houses, or other inclosed places, when, in executing it, proper precautions, such as we are now going to describe, are not taken. In all great glass-houses there are ladles of iron, the handles of which are about six feet long; the workmen make use of these to lade out the *salt of glass* in a liquid state, which they carry away, and pour into a hole or pit prepared for that purpose near the great furnace, that it may be sufficiently dry and warm.

"That the ladles may be cooled more quickly, it is usual to throw them into a large trough full of water; but great care must be taken that no *salt of glass* remains in them; should any be left in them when they are thrown into the water, an explosion similar to that of a cannon would take place. The same thing would happen if the ladle, when put again into the pot, contained any water, or even if it were wet; indeed the explosion in the latter case would be so violent, that the ladle would probably be driven through the inclosure of the furnace, in such a manner as to expose the surrounding workmen to very great risk. This misfortune is not without example in great glass-houses. The degree of danger attending the explosion is, as must be obvious, in proportion to the closeness of the place in which it happens; it is not equally dangerous in the open air.

"It must be remembered that this explosion only takes place when the *salt of glass* is produced from soda made of sea-wrack; that which arises from Alicant soda, or from potash, occasions no explosion. I have observed that this latter kind of *salt of glass* contains only vitriolated tartar and magnesia; whereas the former gives sea-salt with an alkaline basis, sea-salt with an earthy basis, and glauber's salt.

"Any one who is present at the burning of the sea-wracks which are used for making of soda may easily convince himself that those species of fucus contain a great quantity of volatile alkali. May it not be supposed that, during the combustion of these plants, which contain a substance analogous to the corneous matter of animals, there takes place a decomposition of the sea-salt, by means of the volatile alkali, from which an explosion may be produced? If the explosion does not proceed from the expansion of the air contained in the water, it must be the effect of some gas peculiar to sea-salt, and arising, as I have just mentioned, from its decomposition by volatile alkali."

Tin-Glass, the same with bismuth. See Chemistry, page 433.

Vessels of Glass *used in Chemical Experiments.* See Chemistry, page 478.

Drinking-Glasses, are simple vessels of common glass or crystal, usually made in form of an inverted cone. Each glass

confifts of three parts, viz. the calyx or bowl, the bottom, and the foot; which are all wrought or blown feparately. Nothing can be more dexterous and expeditious than the manner wherein thefe parts are all blown, two of them opened, and all three joined together. An idea is only to be formed of the procefs by feeing the men actually at work. The glaffes chiefly ufed in England are made of the afhes of fern; cryftal glaffes being lefs frequently ufed. The exceeding brittlenefs of this commodity, notwithftanding the eafy price of each glafs, renders the confumption thereof very confiderable. For the method of gilding the edges of drinking-glaffes, fee GILDING *on Enamel and Glafs*.

Optical GLASSES. See OPTICS. The improvements hitherto made in telefcopes by means of combining lenfes made of different kinds of glafs, though very great, are yet by no means adequate to the expectations that might reafonably be formed if opticians could fall on any method of obtaining pieces of glafs fufficiently large for purfuing the advantages of Mr. Dollond's difcovery. Unfortunately, however, though the Board of Longitude have offered a confiderable reward for bringing this art to the requifite perfection, no attempt of any confequence has hitherto been made. Mr. Keir is of opinion, that the accomplifhment of this is by no means an eafy tafk, as it requires not only a competent knowledge of the properties of glafs fitteft for the purpofe (the faults not being evident to common infpection), but a confiderable degree of chemical knowledge is alfo neceffary in order to invent a compofition by which thefe faults may be avoided; and laftly, a kind of dexterity in the execution of the work which can only be acquired by practice. Our author, however, thinks that if the fubject were more generally underftood, and the difficulties more fully pointed out, for which purpofe he makes the following remarks, the end might be more eafily accomplifhed.

1. The rays of light paffing through a glafs lens or prifm, or through any other medium of unequal thicknefs, are refracted: but not in an equal manner, the blue, violet, &c. being more refracted than the red.

2. Hence it happens, that the rays of light, when refracted by a common lens, do not all unite in one focus, but in reality form as many different foci as there are colours; and hence arife the prifmatic colours, or irifes, which appear towards the borders of the image formed by the common convex lenfes, and which render vifion extremely indiftinct.

3. The indiftinctnefs of vifion produced by this caufe, which is fenfible in telefcopes of a fmall aperture, increafes in fo great a proportion, viz. as the cubes of the diameters, that it feemed impoffible to increafe the power of dioptric telefcopes greatly, without extending them to a very inconvenient length, unlefs this confufion of colours could be corrected.

4. It was known that different tranfparent bodies poffeffed different degrees of refractive power; and, until Mr. Dollond difcovered the contrary, it was fuppofed, that the refractions of the coloured rays were always in a determinate ratio to one another. On this fuppofition it feemed impoffible to correct the faults of refracting telefcopes: for it was fuppofed, that if the difperfion of light produced by a convex lens were counteracted by another lens or medium of a concave form, the refraction would be totally deftroyed; and this indeed would be the cafe, if the two mediums were made of the fame matter; and, from fome experiments made by Sir Ifaac Newton, this was fuppofed to be actually the cafe in all fubftances whatever.

5. From confidering that the eyes of animals are formed of mediums of different colours, it occurred firft to Mr. David Gregory, the celebrated profeffor of aftronomy at Oxford, and then to Mr. Euler, that, by a combination of mediums which had different refractive powers, it might be poffible to remedy the imperfections of dioptric telefcopes. It does not, however, appear, that either of thefe gentlemen underftood the true principle on which thefe phenomena depend. Mr. Euler executed his idea by forming a compound object lens from two glafs lenfes with water interpofed; but his attempt was not attended with fuccefs. Mr. Dollond, however, was led, by fome arguments adduced by Mr. Klingefternia, to repeat one of Sir Ifaac Newton's experiments, and which had induced even that great philofopher himfelf to fuppofe that the improvement afterwards executed by Mr. Dollond was impoffible. This experiment was made by Sir Ifaac Newton, by placing a glafs prifm within a prifmatic veffel filled with water, in fuch a manner that the rays of light which were refracted by the glafs prifm fhould pafs through and be refracted in a contrary direction by the water prifm. In this manner the refraction of the light was entirely deftroyed. But when Mr. Dollond repeated the experiment, he found, that, contrary to his own expectations, when the angles of the two prifms were fo proportioned that they counteracted each other's mean refraction, then colours appeared; and, on the other hand, when they were fo proportioned that the difperfion of the coloured rays was counteracted, the mean refraction ftill fubfifted; which evidently proved, that the mean refractive and difperfive powers of glafs and water were not proportional to one another.

6. To apply this to the propofed improvement, Mr. Dollond examined feveral kinds of glafs. Crown-glafs was found to poffefs the fmalleft difperfive power in proportion to its refraction; while flint-glafs poffeffed the greateft difperfive power in proportion to its refraction, which was alfo very great. On comparing thefe two exactly together, he found, that a wedge of white flint glafs whofe angle was about 25 degrees, and another of crown-glafs whofe angle was 29 degrees, refracted very nearly alike. He found alfo that, when the wedges were ground to fuch angles, the refraction produced by the flint-glafs was to that produced by the crown-glafs nearly as two to three; the refracted light was then free from colour. On meafuring the general refracting powers of thefe two glaffes, he found that in flint-glafs the fine of incidence of the rays was to the fine of mean refraction as 1 to 1.583; and that in crown-glafs the fine of incidence was to the fine of mean refraction as 1 to 1.53.

The methods of determining the different refractive powers of glafs are given under the article OPTICS. Here we fhall only obferve, that two kinds of glafs are neceffary for the conftruction of acromatic telefcopes; one of which fhall poffefs as fmall, and the other as great, difperfive powers, relative to their mean refracting powers, as can be procured. The difference of glaffes in this refpect depends on the quality of the ingredients employed in their compofition. Crown-glafs, which is compofed of fand melted by means of the afhes of fea-weeds, barilla, or kelp, both which fluxes are known to confift of vegetable earth, alkali, and neutral falt, is found to give the fmalleft difperfive power. Plate-glafs, which confifts of fand melted by means of fixed vegetable alkali, with little or no vegetable earth, gives a greater difperfive power; but both thefe give much lefs than flint-glafs, which confifts of fand melted by means of minium and fixed alkali. It appears, therefore, that the difperfion of the rays is greateft when minium, or probably other metallic calces, are made ufe of; and that alkalis give a greater power of difperfion than vegetable or other earths. Mr. Zieher of Peterfburgh, however, informs us, that he has made a kind of glafs much fuperior in this refpect to flint-glafs; but it does not as yet appear whether it be more fit for optical purpofes than that commonly made ufe of. There feems no difficulty in augmenting the difperfive power, as that is found to depend on the quantity of minium or other flux: but thus we unfortunately increafe alfo the capital fault to which flint glafs and all compofitions of that kind are fubject; namely, the being fubject to

veins or ſmall threads running through it. By theſe, even when ſo ſmall as to be imperceptible to the naked eye, the rays which fall on them are diverted from their proper direction, and thereby render the images confuſed. This is owing to the greater denſity of the veins, as appears by their image being received on white paper, when the glaſs is held between the paper and the ſun or a candle at a proper diſtance. The rays of light being then made to converge by the ſuperior denſity of the veins, their images will appear as bright lines bordered with obſcure edges on the paper. Flint-glaſs is ſo much ſubject to this kind of imperfection, that it is with difficulty the opticians can pick out pieces of the ſize commonly uſed from a large quantity of the glaſs. It is farther to be regretted, that the minium which produces the greateſt diſperſive power is likewiſe the very ſubſtance which renders flint-glaſs much more ſubject to theſe imperfections than any other. The reaſon is, that the ſand and earthy matters mix uniformly in fuſion; and having not only a conſiderable degree of affinity towards each other, but alſo being not much different from each other, they are not apt to ſeparate. On the other hand, when ſuch an heavy ſubſtance as minium is added to theſe earthy ſubſtances, though it has a pretty ſtrong tendency to unite with the earthy ſubſtances, it has none with the fixed alkali, which is another ingredient in this glaſs. Hence ſome parts of the glaſs will contain more metallic matter than the reſt; particularly that near the bottom of the pot, which is ſo full of large veins as to be applied only to the making of wares of little value. The veins in this caſe are formed by the deſcent of the minium to the bottom, which in its paſſage forms threads or veins by dragging other parts of the glaſs along with them.

The correction of this fault appears therefore to be very difficult. M. Macquer informs us, that he had in vain tried to remove it by very long fuſion and a fierce fire; which indeed others have found by experience not to correct but to augment the evil. Mr. Keir is of opinion that ſome new compoſition muſt be ſought for, which, along with a ſufficient refractive power, ſhould poſſeſs a greater uniformity of texture; but he is likewiſe of opinion, that ſcarce any alteration in this reſpect could be made without injuring the colour of the glaſs. For optical purpoſes, however, our author does not think that an alteration in the colour of the ingredients would be very detrimental. "I am convinced (ſays he) that glaſſes ſenſibly tinged with colour might tranſmit as much or more light than the beſt flint-glaſs. For the colourleſs appearance of flint-glaſs is an optical deception. The minium gives it a pretty conſiderable tinge of yellow, and the alkali inclines it to a blueiſh caſt, beſides the colour ariſing from a greater or leſs impurity of the materials; ſo that the glaſs would actually be very ſenſibly coloured, unleſs by the addition of manganeſe, which is known to give a purpliſh red. Thus the other tinges are counteracted, but not effaced or deſtroyed, as has been frequently imagined. By the mixture of the three principal colours, red, yellow, and blue, more or leſs exactly counterpoiſed, a certain dark ſhade is introduced, in which, as not any one of the colours predominates, no coloured tinge appears, but the effect is merely a diminution of the tranſparency of the glaſs, which, however, is too ſmall for ordinary objection." Mr. Keir is even of opinion, that a certain tinge of yellow would in many caſes be of ſervice, becauſe it would exclude ſome of the blue rays, which being moſt refrangible are moſt injurious to the diſtinctneſs of viſion.

Very conſiderable difficulties, however, muſt ariſe in attempting improvements of this kind, as the experiments muſt all be tried on a very large ſcale. This is not only attended with a very heavy expence in itſelf on account of the quantity of materials employed, but from the heavy duty of exciſe which is rigorouſly exacted whether the glaſs be manufactured into ſaleable articles or not. It is obſerved in the manufacture of every kind of glaſs, that the glaſs in the middle of the area or tranſverſe ſection of a pot is much purer and freer from veins and other imperfections than the part which is near the ſides, and that the glaſs at the bottom is the worſt of all. Conſequently it is chiefly in large pots, ſuch as are uſed in manufactures, that there is a probability of ſucceſs. Very fine and beautiful glaſſes, called *paſte* and *artificial gems*, may be made in ſmaller pots or crucibles; but this glaſs is ſuffered to cool and ſubſide in the veſſel, by which means the contiguous parts are more uniform in their texture than can be expected in a piece of glaſs taken out of the pot while hot in the common way, by making it adhere and twiſt round an iron rod or pipe. But although the method of allowing the glaſs to cool in the pots is very advantageous for the purpoſes of the jeweller, it is by no means applicable to thoſe of the optician. Glaſs cooled in that gradual manner ſuffers ſome degree of cryſtallization or peculiar arrangement of its parts; the conſequence of which is, that the rays of light undergo certain refractions, not dependent on the form of the glaſs, which greatly affect the diſtinctneſs of viſion in teleſcopes.

Looking GLASS, a kind of MIRROR made by coating with quickſilver the back of a fine plate of poliſhed glaſs. See FOLIATING. The general name of *Mirror* is given to any poliſhed body, whoſe uſe is to form the images of diſtant objects, by reflection of the rays of light. See REFLECTION. Mirrors are either plain, convex, or concave. The firſt reflect the rays of light in a direction exactly ſimilar to that in which they fall upon them, and therefore repreſent bodies of their natural magnitude. The convex ones make the rays diverge much more than before reflection, and therefore greatly diminiſh the images of thoſe objects which they ſhow: while the concave ones, by collecting the rays into a focus, not only magnify the objects they ſhow, but will burn very fiercely when expoſed to the rays of the ſun; and hence they are commonly known by the name of *burning mirrors*. See BURNING-*Mirrors*.

In ancient times the mirrors were made of ſome kind of metal; and from a paſſage in the Moſaic writings, we learn that the mirrors uſed by the Jewiſh women were made of braſs. The Jews certainly had been taught to uſe that kind of mirrors by the Egyptians; from whence it is probable that brazen mirrors were the firſt kind uſed in the world. Any kind of metal, indeed, when well poliſhed, will reflect very powerfully; but of all others ſilver reflects the moſt, though it has been in all countries too expenſive a material for common uſe. Gold alſo is very powerful; and metals, or even wood, gilded and poliſhed, will act very powerfully as reflecting mirrors. Poliſhed ivory, or ſtraw nicely plaited together, it is ſaid, will form mirrors capable of burning, if on a very large ſcale.

Since the invention of glaſs, and the application of quickſilver to it became generally known, it hath been univerſally employed for thoſe plain mirrors uſed as ornaments to houſes; but in making reflecting teleſcopes, theſe have been found much inferior to metallic ones. It does not appear that the ſame ſuperiority belongs to the metalline burning mirrors, conſidered merely as burning glaſſes; ſince the mirror with which Mr. Macquer melted platina, though only 22 inches diameter, and which was made of quickſilvered glaſs, produced much greater effect than M. Villette's metalline ſpeculum, which conſiderably exceeded it in ſize. It is very probable, however, that this mirror of M. Villette's was by no means ſo well poliſhed as it ought to have been; as the art of preparing the metal for taking the fineſt poliſh has not long been diſcovered and publiſhed in the Philoſophical Tranſactions by Mr. Mudge. See GLASS-*Grinding*, and the *Mechanical Part* of OPTICS.

Muſical GLASSES. See HARMONICA.

Burning GLASS. See BURNING *Glaſs*.

Weather GLASS. See BAROMETER.

Cupping Glass. See Surgery.
Hour Glass. See Hour *Glaſs*.
Watch Glass. See Watch.

Glass-wort, *Salſola*, a genus of the digynia order, belonging to the pentandria claſs of plants, and in the natural method ranking under the 12th order, *Holoraceæ*. The calyx is pentaphyllous; there is no corolla; the capſule is monoſpermous, with a ſcrewed ſeed. The *ſpecies* are, 1. The *kali*, which grows naturally in the ſalt marſhes in many parts of England. It is an annual plant, which riſes about five or ſix inches high, ſending out many ſide branches, which ſpread on every ſide, garniſhed with ſhort awl-ſhaped leaves, which are fleſhy, and terminate in acute ſpines. The flowers are produced from the ſide of the branches, to which they ſit cloſe, and are encompaſſed by ſhort prickly leaves; they are ſmall, and of an herbaceous colour. The ſeeds are wrapped up in the empalement of the flower, and ripen in autumn, ſoon after which the plant decays. 2. The *tragus* grows naturally on the ſandy ſhores of the ſouth of France, Spain, and Italy. This is alſo an annual plant, which ſends out many diffuſed ſtalks, garniſhed with linear leaves an inch long, ending with ſharp ſpines. The flowers come out from the ſide of the ſtalks in the ſame manner as thoſe of the former; their empalements are blunt, and not ſo cloſely encompaſſed with leaves as thoſe of the other. 3. The *ſoda* riſes with herbaceous ſtalks near three feet high, ſpreading wide. The leaves on the principal ſtalk, and thoſe on the lower part of the branches, are long, ſlender, and have no ſpines; thoſe on the upper part of the ſtalk and branches are ſlender, ſhort, and crooked. At the baſe of the leaves are produced the flowers, which are ſmall and hardly perceptible; the empalement of the flower afterwards encompaſſes the capſule, which contains one cochleated ſeed. 4. The *vermiculata* grows naturally in Spain. This hath ſhrubby perennial ſtalks, which riſe three or four feet high, ſending out many ſide-branches, garniſhed with fleſhy, oval, acute-pointed leaves, coming out in cluſters from the ſide of the branches; they are hoary, and have ſtiff prickles. The flowers are produced from between the leaves toward the ends of the branches; they are ſo ſmall as ſcarce to be diſcerned, unleſs they are cloſely viewed. The ſeeds are like thoſe of the other kinds. 5. The *roſacea* grows naturally in Tartary. This is an annual plant, whoſe ſtalks are herbaceous, and ſeldom riſe more than five or ſix inches high. The leaves are awl-ſhaped, ending in acute points; the empalements of the flowers ſpread open: the flowers are ſmall, and of a roſe-colour, but ſoon fade: the ſeeds are like thoſe of the other ſorts.

All the ſorts of glaſs-wort are ſometimes promiſcuouſly uſed for making the ſal kali, but it is the third ſort which is eſteemed beſt for this purpoſe. The manner of making it is as follows: Having dug a trench near the ſea, they place laths acroſs it, on which they lay the plant in heaps, and, having made a fire below, the liquor which runs out of the heap drops to the bottom, and at length thickening becomes ſal kali, which is partly of a black, and partly of an aſh-colour, very ſharp and corroſive, and of a ſaltiſh taſte. This, when thoroughly hardened, becomes like a ſtone; and in that ſtate is exported to different countries for the purpoſe of making glaſs.

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